E-type pronouns: congressmen, sheep and paychecks

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First draft / still work in progress. Comments welcome.

1   E-type pronouns

Pronouns can be *co-referential*. This means that they can refer to an entity that is the referent of some nearby referring expression. The simplest case of this is where a pronoun refers to the referent of a recently used proper name, as in (1). If we think that Sue refers to s, then (1) is true if and only if s saw a man s once dated.

 (1) Sue saw a man she once dated.

Pronouns form a seemingly different kind of anaphoric relation with quantificational DPs like *every girl*. In (2), for instance, the pronoun *she* does not (co)refer to the referent of *every girl*. This is for the simple reason that *every girl* does not refer to a type e entity. Quantificational DPs are interpreted not as objects of type e, but rather as an object of the quantificational type $\langle\langle e, t\rangle, t\rangle$.

 (2) Every girl saw a boy she once dated.

The pronoun in (2) is not coreferential but *bound*. The essential difference between the occurrence of *she* in (1) and its occurrence in (2) is that while it

makes sense to ask what *she* refers to in the former, it seems to make much less sense for the latter case. The pronoun in (2) does not (co-)refer, rather it *co-varies* with its antecedent.

This chapter is about pronouns that have a linguistic antecedent, but that are neither co-referential nor bound in an obvious way. Evans (1977) and Evans (1980) called such pronouns *e-type pronouns* and the relevant anaphoric relation *e-type anaphora.*[1] Consider (3) as an example.

(3) Each of my students failed the test. They will do a resit next week.

The pronoun *they* in the second sentence of (3) can be argued to be an e-type pronoun. In other words, one can argue, as Evans indeed did, that this pronoun is neither co-referential nor bound. It should be obvious why one would exclude the option that *they* co-refers with *each of my students*, since we claimed above that such quantifiers do not refer themselves.

It is a bit harder (but instructive) to spell out the reason for dismissing the idea that *they* in (3) is a bound pronoun. That is, we should dismiss an analysis of (3) as (4), where the second sentence has been moved within the scope of the quantifier and the pronoun is bound by it.[2]

(4) Each of my students is such that she failed the test and she will do a resit next week.

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[1] It is important to note that the focus of this chapter is restricted to referential phenomena involving linguistic antecedents. Pronouns that refer to salient, but non-mentioned, individuals, are also not co-referential and not bound. They are not, however, e-type. An example is the deictic use of a pronoun, as in *It's him*, where the speaker points out the culprit of a crime in a line-up.

[2] A bound analysis of *they* in (3) 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.

Intuitively, (3) is indeed equivalent to (4). However, the equivalence between (3) and (4) is a logical coincidence. For different quantifiers such an equivalence cannot be found. Take (5) and (6).

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

(6) Exactly two of my students are such that they failed the test and they 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 (6) is true, but (5) is false. This is because (5) entails that exactly two of the student failed the test, while (6) does not entail that.

By this reasoning, the pronoun *they* in (5) cannot be a *bound* pronoun, for if it were, then we would expect (5) to have a reading which is synonymous to that of (6). Indeed, Evans' own example, (7), also purposefully involved a non-universal quantifier, so as to allow this reasoning.

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

If the pronoun were bound, (7) 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 (3), it is natural to assume that the observations regarding (5) and (7) point out a general constraint on the scope of quantifiers (cf. footnote 2).

If the plural pronouns in (3), (5) and (7) are neither bound nor co-referential, 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 (3) and (5) refer to *the students who failed the test*. The pronoun in (7) 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 or co-referential. It is just that our traditional understanding of binding and co-reference 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. I believe it will be instructive to depart from the e-type literature by distinguishing two types of e-type phenomena. Both classes involve pronouns that are neither co-referential nor bound in the traditional sense. They have distinguishing features, though: one involves *maximal reference*, while the other involves *co-variation* despite not being bound in the classical sense. I will simply call them e1- vesus e2 type anaphora. These classes are, as far as I am aware, not explicitly acknowledged in the literature, but I believe they will make the discussion easier. One reason for this is that 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. Connected to this is the fact that there lacks a uniform terminology for describing the phenomena. Throughout the chapter I will be using the term *e-type pronoun* for all pronouns that are neither bound nor co-referential. Most other terms used in this realm, such as (among many others) *donkey pronoun*, *paycheck pronoun*, and *pronoun of laziness* are simply special cases of e-type pronouns. (We will encounter them along the way.)[3] Still, using the term e-type in this way is slightly dubious since that terminology 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

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[3]It has to be said, though, that *pronoun of laziness* is a confusing expression that *is* sometimes meant to describe pronouns that go proxy for their antecedent and sometimes for pronouns that go proxy for some definite description (in the way the term d-type pronoun is used). See section XXX for discussion.

conception that Evans had in mind: a pronoun that is not bound and is not coreferential. With the term e-type pronoun I thus hope to describe a class of pronouns that falls outside our classical understanding of coreference and binding, without giving any hint at what an alternative characterisation of such a pronoun may be.

2   E1-type anaphora

Before I can introduce the concept of e1-type anaphora, I need to say a bit more about coreference. Above, I stated that binding can only take place within a sentence. Coreference, however, can be intersentential. The relation between *John* and *he* in (8) is a simple illustration of this.

(8) John entered the room. He sighed.

Coreference, and intersentential coreference in particular, is not limited to anaphoric relations involving proper names. In order for coreference to obtain, the antecedent merely needs to be referential in nature. At this point, it is useful to say a few things about quantificational versus referential aspects of DPs. As I discussed above, it is intuitively clear that universal quantifiers like *every girl* or *no girl* do not refer in the sense that they lack a type *e* referent. Things are different for indefinites, which have both quantifying and referring characteristics. Take (9).

(9) A beautiful young man came in.

The meaning of (9) could either be described in terms of a quantificational statement: $\exists x[young(x) \wedge beautiful(x) \wedge man(x) \wedge came-in(x)]$. Or, alternatively, it could be described in terms of a referential act: the speaker is using the indefinite to refer to m, who is a beautiful man, and she is asserting $came-in(m)$. (In parallel, if the man in question is called *Martin* exactly the same meaning could be assigned to *Martin came in.*) Quite a few theories hold that there is no semantic difference between the quantificational and the referential understanding of indefinites: the latter is truth-conditionally indistinguishable from a wide scope reading. (For the origins of this debate see among many others Fodor and Sag (1982), Heim (1982), Abush (1994), Reinhart (1997) and Kratzer (1997)). Leaving theory aside for a moment, since indefinites can be referential DPs, they can be involved in coreference,

including intersentential coreference. That is, we can continue (9) by saying *He sighed*, where *he* refers to whatever beautiful young man the speaker was referring to in (9).

Let us now turn to what I will call e1-type anaphora, which as we will see in some sense resembles intersentential coreference, yet differs in one crucial respect. This key property of e1-type anaphora is that it involves *maximal* or *exhaustive reference.*[4] I can illustrate that by Evans' congressmen example, repeated here.

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

On the assumption that *few congressmen* is quantificational and cannot refer and given that binding cannot take place across a clausal border, the plural pronoun in (10) is neither coreferential nor bound. 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 (11) corresponds to *all the students that passed* no matter what the antecedent quantifier is.

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

E1-type pronouns are plural, since the exhaustive reference they involve concerns an (at least potentially) plural set of entities. 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 (13).

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

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

The clearest way to illustrate e1-type anaphora is to contrast it with intersentential coreference. So, we will need to compare (11) and (12) to similar examples with potentially referential DPs. Take (14).

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[4]I will use both *maximal* and *exhaustive.* They are intended to be interchangeable.

(14) *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.

The plural pronoun in (14) need 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. As a consequence, one
could create examples that contrast with (12) in that singular pronouns are
felicitous. For instance, even though the first sentence of (15) is compatible
with the speaker having many pens, the singular pronoun is felicitous.[5]

(15) *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.

E1-type anaphora involve quantificational antecedents. Bear in mind, though,
that indefinites *can* be quantificational and, thus, we *will* find e1-type

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[5]Following Kamp (1981), Kadmon (1987) and Kamp and Reyle (1993), there is a
considerable body of work that tries to make sense of the relation between referential
aspects of generalised quantifiers and this type of anaphora. In one part of this literature,
the notion of a witness set has become crucial (see Beghelli, Ben-Shalom, and Szabolcsi
(1997);Szabolcsi (1997);Winter (1998);Ebert and Endriss (2004)). A witness set is defined
as follows Barwise and Cooper (1981):

(16) A set W is a *witness set* to an $\langle\langle e,t\rangle,t\rangle$ quantifier $Q(A)$ if and only if (i) $Q(A)(W)$
holds, (ii) $W \subseteq A$.

The idea is that some quantifiers allow for anaphoric relations involving a witness set.
For instance, a witness to *more than three students* is any set consisting of more than three
students (and nothing else). One such witness is *what the speaker has in mind* when she
uses that quantifier in a sentence like *more than three students passed*, and subsequently it
is this witness which is available for pronominal reference. The notion of witness falls short
for other kinds of quantifiers. For instance, any set consisting of at least two students and
no non-students is a witness of *two students*. But discourse anaphora to *two students* will
always be about *two* rather than more than two students. Szabolcsi suggests to use the
notion of *minimal witness set* for these quantifiers:

(17) A set W is a *minimal witness set* to $Q(A)$ if W is a witness set to $Q(A)$ and there
is no subset of W that is also a witness set.

Notice that witness sets are the non-maximal alternative to the notion of reference set
that I introduce below.

anaphora with indefinites. In fact, Evans gave the famous example of e1-type anaphora in (18), using the indefinite *some sheep.*

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

On its most salient reading, them in (18) is an e1-type pronoun and (18) 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.[6] Once more, this does not exclude the possibility that Harry fails to vaccinate other sheep owned by John.

The key property of e1-type anaphora is that it involves *maximal reference.* But maximal reference to what? There is an intuitive way of making sense of this as follows. If we view determiners as relations between two sets (Barwise and Cooper 1981), then e1-type pronouns refer to what has been called the reference set of the quantificational relation (see e.g. Nouwen (2003a)):

(19) Let Q(A)(B) be a quantificational statement, the *reference set* is A∩B.

Take the congressmen sentence as an example. *Few congressmen admire Kennedy* gets the interpretation 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 e1-type anaphora.

This is merely a descriptive analysis of the examples above, but an illuminating one. It captures the intuition that the pronoun refers to the totality of individuals that instantiate the relation between the quantifier's restrictor (i.e. set A) and scope (B in 19). Having said that, (19) only captures part of the data involving e1-type anaphora. Consider a variation on Evans' sheep example, (20).

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[6]To be clear, such a referential reading is probably available as well for (18), parallel to (14).

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

The indefinite in (21) 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. Assuming narrow scope for the indefinite we then come to expect type e1 anaphora. Indeed, *them* appears to refer exhaustively to the set of all sheep owned by Harry's neighbours. However, it is not immediately clear either 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 (21) is: 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.

Examples like (20) raise interesting questions regarding the status of indefinites like *a sheep*. We saw in (15) that singular indefinites do not license e1-type anaphora, but rather only co-reference. This suggests such singular indefinites lack quantificational readings. In the first sentence of (20), however, there exists a narrow scope reading, which is not referential either. I will return to this issue below. I should make absolutely clear, though, that the problem I sketched for (20) was completely independent of the fact that the embedded DP was an indefinite. I could make exactly the same point using strictly quantificational DPs. For instance, (21) contains an embedded quantifier *most*. The plural pronoun refers to *the toys that were given away by **some** or other boy.*

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

It is remarkably difficult to give an descriptive model for e1-type anaphora that is fully predictive of which are the potential anaphoric relations following a quantificational statement. For instance, we want a model that predicts that (22) has the potential to resolve subsequent e1-type pronouns in the three ways in (23). (The sets in (23) are based on a specific understanding of (22), namely one in which *a flower* has narrowest scope and *every boy* has widest scope.)

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

(23)   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

Here is a stab at a descriptive algorithm to retrieve these sets. It basically transforms a sentence into a definite description with a relative clause based on the sentence. 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 (23) for (22).

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

step 1	a flower
step 2	that all the boys 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 (22 c) matters are a bit more complicated. The algorithm will yield *the set of all his sisters that some boy gave a flower to*. Obviously, we want to be able to resolve the pronoun in the relative clause *the set of all girls that one of their brothers gave a flower to*. Needless to say, such cases complicate the algorithm hopelessly. The theoretical goal, then, is to find a more natural mechanism that can be shown to be responsible for the

particular sets involved in e1-type anaphoric reference. Before I turn to such a theory, I will need to introduce the second kind of descriptive pronouns, which I call e2-type.

3   E2-type anaphora

Donkey pronouns (Geach (1962), cf. Smith (T.V.)) are e-type. *It* in (24) is not bound by its antecedent *a donkey*, nor is it coreferential. In fact, on the salient reading of (24) where different farmers own different donkeys, *a donkey* does not refer to a single donkey, just as was the case with *a sheep* in (20).

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

As in (20) in the previous section, the antecedent here is an indefinite. But unlike e1-type anaphora, there is an important difference: the pronoun in (24) does not refer exhaustively. If (24) were a case of e1-type anaphora, the pronoun *it* would refer to *the set of all farmer-owned donkeys*. This is incompatible with the singular *it*.

E1-type anaphora is unavailable in a configuration like (24). To be more precise: e1-type anaphora is unavailable in the scope of the quantifier that scopes over the antecedent. For instance, there is no interpretation of (25) that says that each collector who brought a rare stamp was familiar with most of the totality of stamps that some or other collector brought in.

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

In some other sense, though, there could be said to be exhaustive reference in (24). In its most salient reading, (24) 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 (26), due to Robin Cooper. (See Smith (T.V.) for discussion.)

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

The upshot is that at least some cases of e2-type anaphora do not involve exhaustive reference. Instead, e2-type anaphora always involves 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 covariation without binding?

Donkey anaphora is not the only kind of e2-type anaphora. Here are two further cases that have played key roles in the literature, where once more the key observation has been that the pronoun is not coreferential, nor exhaustive, nor bound, but nevertheless covarying:

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

(28) Each degree candidate walked to the stage. He took his diploma from the dean and returned to his seat.

The second sentence in (27), based on an example from Krifka (1996), contains two pronouns. On the most salient reading, the plural pronoun is to be interpreted as an e1-type pronoun referring to all the students that wrote an article. The singular pronoun *it* is type e2. It obviously does not refer exhaustively to the articles written by some or other student. (That would require a plural pronoun.) Instead it covaries over articles in such a way that this second sentence may be paraphrased by a donkey sentence: *Every student who did write an article sent it to L&P*.

The example in (28) is often referred to using the term *telescoping*, after Roberts (1987), who attributed (28) 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 degree candidate* has scope over both sentences in (28). 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 e1-type referent *the set of degree candidates that walked to the stage*, yielding: *Each of the degree candidates that walked to the stage is such that he took his diploma from the dean and returned to his seat.*

So, whereas (27) may descriptively be analysed as donkey anaphora involving quantification over an e1-type pronoun, (28) can be seen as straightforward binding on the basis of quantification over an e1-type referent. As we will see, this will indeed be the intuition behind the theoretical proposals 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).[7] Put crudely, the idea is that a successful account of pronominal reference is to equate 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 quantifiers in first order predicate logic, $\forall x[girl(x) \rightarrow \exists y[boy(y) \wedge dated(x,y) \wedge saw(x,y)]]$. 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:

(29) $\forall x\varphi$ 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 $g(x) = d$.

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 thus have a very natural likeness to bound variables. The question now is what to do with co-referential pronouns. Here, too, however there is a natural choice. 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. In the case of a co-referential pronoun, 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

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[7]It should be noted that Quine himself at the same time also entertained the idea that some class of 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.

that unbound pronouns need. To illustrate, a sentence like *he won* receives a uniform interpretation, independent of whether the pronoun is bound or co-referential.

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

(31) $won(x)$ 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.[8] 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 (32), where $\uparrow$ indicates undefinedness. (See Geurts (1997) for an advanced, and moreover dynamic, presuppositional semantics for proper names.)

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

In summary, the pronouns as variables view offers a unified account of coreference and covariation 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 E1-type and 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 that quantifiers do not just interpret their scope with respect

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[8]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.

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 e1-type anaphora involves exhaustive (potentially) plural reference.

In this subsection, I will follow the spirit of a number of similar proposals, most notably, Berg (1994), Berg (1996), Elworthy (1995), Nouwen (2003a), Nouwen (2007) and Brasoveanu (2008). Having said that, what I will present is in many ways be 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 as simple as possible exposition of such a system, but the reader should bear in mind that a full semantics will be quite a bit more involved.[9]

One of the complexities 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 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. Rather than to evaluate 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.[10] I will call these sets *assignment states*. They are sets of functions from V to D_e.

The idea is now that propositions express functions that take an assignment state as input and produce an output assigmnent state.[11] I will write $F[p]$

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[9]To give one example, Nouwen (2003b) and Nouwen (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 Eijck (2001).

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

[11]This is different from much of the literature. In dynamic predicate logic (DPL, Groenendijk and Stokhof (1991)) propositions express relations between states. This relational nature is due to the fact that the dynamic effect of a referential indefinite is thought to be non-deterministic. That is, using a DP like *a man$_x$* referentially results in changing the assignment to x in the state in such a way that x now corresponds to some man. There are many such states and thus the dynamic logic interprets propositions as relating a single input state to potentially many different output states. Most dynamic

to represent the output of interpreting p with respect to input state F. Take now a sentence like (33), where I have indicated the associated variable names by subscripts. This sentence will express a function that given some input state produces an output state G that has the properties in (34)-(37).

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

(34) $G(x)$ is the set of boys who gave a flower to most of his sisters.
(35) $G(y)$ is the set of girls who got a flower from their brother (i.e. one of the boys).
(36) $G(z)$ is the set of flowers that were given by one of the boys to one of their sisters
(37) 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: $G(x) = \{g(x)|g \in G\}$.[12] The advantage of the lift from assignment functions to assignment states becomes apparent in (37). 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 e2-type anaphora.

Before I delve into the details of how a dynamic interpretation of (33) yields the result in (34)-(37) in a systematic way, it is instructive to zoom out a little bit. I should stress that the account of e1-type anaphora discussed here is basically treating such anaphoric relations as a kind of coreference, 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

accounts of non-referential quantification follow this relational setup, even though the exhaustive reference of e1-type anaphora is deterministic in nature. That is, since e1-type anaphora is exhaustive, the referent is unique.

   This chapter will sketch a fully deterministic (and thus functional) approach to dynamics by assuming that referential indefinites do have a deterministic referent, namely *the intended referent of the speaker*. (See below, cf. Rooij (2001)). This choice will hopefully simplify the exposition a little, but bear in mind that this choice is essentially independent of the analysis of e-type anaphora.

   [12]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).

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 e1-type pronouns have *exhaustive* reference; (ii) why the dependent reference of the e2 variety follow 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.)
- 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 variables, then $Qv(p)(q)$ is a proposition
- Nothing else is a proposition

To give an example, (33) looks like (38) in this language:

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

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

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

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 returns 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 it scope with respect to parts of the input state.

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

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:

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

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

This 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 referential nature of e1-type

anaphora. Second, the way this maximal set is built up is distributively. That is, the set of boys is collected by considering atomic individuals at a time. This will explain why in the scope of a quantifier, the value of x does not refer exhaustively, but rather via covariation. 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. Before we can use Σ to do this, 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.*

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

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 $I(Q)$.

(42) $F[Qv(p)(q)] = \begin{cases} F[\Sigma v(p; q)] & \text{if } I(Q)(F[\Sigma v(p)](v))(F[\Sigma v(p; q)](v)) \\ \emptyset & \text{otherwise} \end{cases}$

To illustrate how this definition works, let us compare (43) with (44). The former is the interpretation of the original congress 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.*

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

The final occurrence of x in (43) 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 (44), 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 Σx(congressmen(x);admire-Kennedy(x);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 accounts for e-type anaphora only. It fails to provide referents for pronouns that corefer with referentially used indefinite quantifiers. One could now assume that indefinites are lexically ambiguous between referential and quantificational uses.[13] On the latter, they are interpreted as dynamic generalised quantificational statements as in (42). A referentially used indefinite, on the other hand, is interpreted differently, namely as a quantifier introducing some non-maximal referent.

With such a move, the dynamic interpretation will have to be non-deterministic. This is because the interpretation for a referentially used indefinite will have to output multiple states G for a single input F: each of these G's will contain a potential non-maximal referent for the indefinite. This is why non-maximal pronouns are sometimes referred to as pronouns that go proxy for *indefinite descriptions*. Take for instance once again (45):

(45) I have a pen. It's in my bag

Say that the speaker has in fact three pens: one in his bag, one at home and one in his desk. On a dynamic non-maximal approach to referential indefinites, the first sentence in (45) would create three potential output states G, one for each of the pens the speaker could be referring to.

A different take can be found in Rooij (2001), who argues that the referential nature of referentially used indefinites should be taken serious. Van Rooij's arguments find their origin amongst others in the work of Strawson (1952). This is Strawson's example:

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

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[13]See, for instance, Kamp and Reyle (1993). See also footnote XXX above for a particular strategy to identify the potential non-maximal referents.

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.

Following van Rooij, I will assume that indefinites are either used referentially or quantificationally. In both cases, they introduce 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 (42)).

4.4   E2-type and variables

The effect of the dynamic interpretation for quantifiers, (42), 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: $\Sigma v(p)$
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 no, 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 (47), interpreted like (48).

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

(48) $\text{EVERY}_x(\text{SOME}_y(\text{donkey}(y))(\text{own}(x,y);\text{farmer}(x)))(\text{beat}(x,y))$

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 states like that. The result is that the occurrence of y in the scope will covary (different donkeys for different farmers), even though it is not technically bound by the quantifier.

Other types of e2-type anaphora 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).

(49) 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 e1-type referent for x. The interpretation is in (50), where $\top$ is the trivially successful dynamic action, i.e. it expresses the identity function.

(50) $\text{MOST}_x(\text{student}(x))(\text{SOME}_y(\text{article}(y))(\text{wrote}(x,y)))$;
$\quad\ \text{EVERY}_x(\top)(\text{sent-to-L\&P}(x,y))$

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 moreover 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 subsection are the most likely place where this determinacy makes wrong predictions. The examples (47) and (49) 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 e2-type pronouns here, this means that we predict (47)-(49) 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. As far as I can see this prediction is an open empirical question, but it is not unlikely that this prediction is too strong. In that case, the present analysis would need to escape these predictions by making sure that the relevant readings emerge on a referential construal of indefinites. For this to work, *what the speaker has in mind* should be allowed to covary within the scope of the quantifier. Technically, I think there are options here - the choice function approach in Kratzer (1997) springs to mind, but it is going to be hard to reconcile this idea the conceptualisation of referential indefinites as involving *speaker reference.*

Abstracting away from the technicalities, the gist of the dynamic analysis of e2-type anaphora is that it involves quantificational subordination. That is, the e2-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 (49) this concerns the dependency between two variables created by an antecedent complex quantificational statement. For the case of telescoping in (51), there is no dependency involved, but rather straightforward quantification over the e1-type referent set up in the first sentence, as becomes clear in the analysis in (52)

(51) Each degree candidate walked to the stage. He took his diploma from the dean and returned to his seat.

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

In this section, I have given my take on the pronouns as variables view as can be found in Berg (1996), Nouwen (2003b) or Brasoveanu (2008), among quite a few others. These proposals give a uniform analysis of co-referential, co-variational, e1-type and e2-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 covariation 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.[14]

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 following the contrast between (53) and (54), from Heim (1982), who attributes the example to Barbara Partee.

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

(54) 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 (53) and (54) is to be expected. Contrast like (53)/(54), however, show that e-type anaphora is licensed only if there is a *formal link* (Kadmon 1987). The two sentence in (53) are felicitous since the pronoun *it* stands in a formal anaphoric relation with its antecedent *one. Formally* no such antecedent is available in (54)

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

and, so, even though we may infer from the first sentence of (54) that there is a missing marble, anaphoric reference to that marble is prohibited.[15]

Note that the pronouns as variables view has no issues with (53) and (54) 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 (55). (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.)

(55) 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 e1-type anaphora involves the reference set of a quantificational statement. As we stated there, a rule like (55) is too simplistic, since it will not be able to handle cases like (56), where the antecedent is in the scope of a quantifier itself.

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

The most recent approach in the pronouns as description line is that of Elbourne (2005), who takes pronouns to be definite description 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. However, just like in Neale's approach, Elbourne's theory lacks a component that explains why *them* in (56) when interpreted as *the sheep* refers to the sheep Harry's neighbours own.

Nevertheless, Elbourne's theory is undoubtedly the most powerful analysis on the market that takes this route. Elbourne assumes a framework that makes

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[15]It is likely, however, that some pronouns *are* best analysed in terms of a inferential process that determines the referent. For instance, (54) 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.

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 covarying.

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.[16] In fact, 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.[17]

In summary, the pronouns as description view lacks an account of e1-type anaphora, and its account of e2-type anaphora, 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 all of e1-type and e2-type anaphora, we would end up with an approach whose core mechanism is but a notational variant 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 quite an unattractive theory. However, that depiction is fully dependent on the empirical focus one has. There are case of e-type anaphora that are neither type e1 nor type e2. I will discuss two of these and show that in

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[16]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 Grootte (2006) may come close.

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

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 lead 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 (57). Clearly *he* does not refer to this year's president. Also, there are no real signs of quantification, so this is unlikely to be a case of e2-type anaphora. 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.

(57) 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 (58) and (59). His observation was that while (58) claims that the current mayor of Boston switched political pursuasion, (59) can in addition be interpreted as claiming that Boston has had Democrat mayor in the past.

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

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

Certainly, Geach's observation concerning lazy pronouns, as in (57) is at odds with Evans's conclusion. Also, Neale (1990) has pointed out that if pronouns do go proxy for definite descriptions, then (59) is not the correct paraphrase for (58). Instead, the interesting clause to look at would be *the mayor Boston has used to be a democrat*, which behaves differently from (59).

It appears then that genuine pronouns of laziness exist and that they fall beyond the phenomena discussed above under the rubric of type e1 and

type e2 anaphora. As such, pronouns of laziness are outside the reach of the pronouns as variables approach as it was presented above. Clearly, the line of analysis that treats pronouns as descriptions has a natural account to offer for examples like (57). Such theories are also at an advantage when it concerns so-called paycheck pronouns (sometimes called *functional pronouns*). Consider (60).

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

The example in (60) is the original example by Karttunen (1969) of a *paycheck sentence.* As with donkey pronouns, the *it* in (60) covaries with the men. However, just like with (57) the problem for dynamic accounts is that the pronoun refers to an entity that has not been contextually introduced. Just like *he* in (57) refers to a different president from its antecedent, the paycheck *it* refers to is not the paycheck 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.* I will adopt this terminology in what follows.

One could take examples like (60) 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 (61), for instance. The question Q can of course be answered by naming a single person universially admired by Englishmen. However, the answer in A does something different. It yields a functional answer.

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

Accepting these data, one could think of paycheck pronouns as simple co-referential pronouns with a functional antecedent. This possibility is for instance worked out within Jacobson's variable free framework (Jacobson 1999; Jacobson 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.

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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 (62) is infelicitous, since it lacks a formally explicit antecedent.

(62) 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 (63), for instance.

(63) 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 (63) become felicitous. The examples in (64)-(65), both from

Nouwen (2003b), provide further examples of e-type anaphora that is only licensed in pragmatically ideal circumstances. That is, they contrast with the infelicitous cases in (66)-(67), respectively.

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

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

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

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

What goes wrong in (66)-(67) is that some minimal conditions that make inferential anaphora possible are missing. In (66), 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 (64) does guarantee there being a set of party-going MPs. In (67) the pronoun *he* has no way of identifying a unique part of the referent of four men introduced in the first sentence. In contrast, the couple next door in (65) can be assumed to be a man and a woman, and thus *he* and *she* in (65) uniquely identify one of the couple.

According to the general definition of e-type I gave throughout this chapter, the pronouns in (63), (64) and (65) are definitely that. I do believe however that these inferential cases of anaphora are fundamentally different from the cases I have discussed above (e1, e2 and neontological). This is because they are only available in certain ideal contextual circumstances, and they are infelicitous otherwise, as the contrast (64)-(65)/(66)-(67) makes clear. There is one case of e2-type anaphora, 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: (68) may be paraphrased as (69).

(68) Each degree candidate walked to the stage. He took his diploma from the dean and returned to his seat.

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

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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 (70) from Hornstein (1984) (cf. Poesio and Zucchi (1992)).

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

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

If (68) can be understood as (69), then why can't (70) be understood as (71)? 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, e1-type pronouns. In contrast to what we observed for (66), the reference set pronoun in (72) is felicitous even though the quantificational statement does not by itself guarantee that this set contains any individuals (as can be observed by 73).

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

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

I believe that here lies the real puzzle of e-type anaphora, that what 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 semantics of 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.

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