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Homogeneity in donkey anaphora*

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Abstract Donkey sentences have existential and universal readings, but they are not often perceived as ambiguous. We extend the pragmatic theory of homogeneity in plural definites by Križ (2016) to explain how context disambiguates donkey sentences. We propose that the denotations of such sentences produce truth value gaps — in certain scenarios the sentences are neither true nor false — and demonstrate that Križ's pragmatic theory fills these gaps to generate the standard judgments of the literature. Building on Muskens's (1996) Compositional Discourse Representation Theory, the semantic analysis defines a general schema for quantification that delivers the required truth value gaps. Given the independently motivated pragmatic account of homogeneity inferences, we argue that donkey ambiguities do not require plural information states, contra Brasoveanu 2008, 2010, or error states and supervaluationist determiners, contra Champollion 2016. Moreover we point out several empirical issues with the trivalent dynamic fragment in Champollion 2016, all of which are avoided by not relying on plural information states. Yet, as in Champollion 2016, the parallel between donkey pronouns and definite plurals is still located in the pragmatics rather than in the semantics, which sidesteps problems known to arise for some previous accounts according to which donkey pronouns and definite plurals both have plural referents (Krifka 1996, Yoon 1996).

Keywords: donkey sentences, trivalence, weak/strong (existential/universal) ambiguity, extension gaps, pragmatics

1 Introduction

It is an old observation that some donkey pronouns seem to be understood as having existential force and others as having universal force. The following pair is adapted from Yoon 1996:

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(1) Usually, if a man has a garage with a window, ...

a. he keeps it open while he is away.
b. he keeps it closed while he is away.

On the most plausible reading of (1a), the donkey pronoun *it* could be paraphrased as *one of the windows in his garage* (except that there is no implication that the garage actually has more than one window). This is sometimes referred to as a weak or existential interpretation; following Chierchia (1992, 1995), we will call it the ∃-reading. As for (1b), on its most plausible reading, the meaning of the pronoun is paraphrasable as *all of the windows in his garage*. This is the strong or universal interpretation, and we will refer to it as the ∀-reading.[1]

Yoon (1994, 1996) and Krifka (1996) link this behavior of donkey pronouns to maximal and nonmaximal interpretations of plural definites. Imagine the following sentences, adapted from Krifka 1996, uttered among bank robbers in a situation where the local bank has a safe that is accessible through any one of three doors.

(2) (I wasn't/was able to reach the safe because ...)

a. The doors are closed.
b. The doors are open.

As Krifka observes, in the situation just described, sentence (2a) expresses the fact that all of the doors are closed (a *maximal* interpretation), while sentence (2b) expresses the fact that at least some of the doors are open (a *nonmaximal* interpretation). These two readings naturally correspond to the ∀-reading and to the ∃-reading of donkey pronouns. On the basis of this kind of similarity, Yoon and Krifka develop a sum-based analysis of donkey sentences, in which the pronoun *it* in (1) is analyzed as referring to the mereological sum of all the windows in the garage in question. It is interpreted as number-neutral, that is, it does not presuppose that there is more than one window or door. Apart from this, it is essentially synonymous with the definite plural *the doors* in (2).

However, Kanazawa (2001) convincingly shows that singular donkey pronouns, unlike definite plurals, cannot refer to sums. For example, singular donkey pronouns are incompatible with collective predication, while definite plurals are compatible:

(3) a. Every donkey-owner gathers his donkeys at night.
b. *Every farmer who owns a donkey gathers it at night.

1 As Kanazawa (1994) notes, the weak/strong terminology is misleading, because when the embedding quantifier is downward entailing in its nuclear scope, as in the case of *no*, the weak reading is the logically stronger of the two.

This poses a challenge for analyses of the ∃/∀ ambiguity that try to reduce the behavior of donkey pronouns to that of plural definite descriptions. The goal of this paper is to develop a theory that meets this challenge but succeeds at predicting how context disambiguates donkey sentences. To do so, we build on a pragmatic account of how context disambiguates plural definites. We adopt the specific implementation in Križ 2016; for a similar and more elaborate account, see Malamud 2012. To avoid the problems that arise from interpreting pronouns as referring to sums, we locate the parallel between donkey pronouns and definite plurals in the pragmatics rather than in the semantics. Our core strategy, following a suggestion by Kanazawa (1994), is to combine a trivalent semantics that produces truth-value gaps in certain cases with a pragmatics that fills these gaps with truth or falsity. This corresponds to what Malamud (2012), Križ (2016), and others assume for plural definites. We assume that these truth-value gaps are filled at the sentence level, not at the level of plural definites or donkey pronouns. Donkey pronouns are not similar to plural definites; it is donkey sentences as a whole that are similar to sentences with plural definites.

The paper is structured as follows. Section 2 highlights the pragmatic nature of the ∃/∀ ambiguity by focusing on the role of context in disambiguating it. Section 3 is a brief summary of the theory developed by Križ (2016) for plural definites. Section 4 applies this theory to donkey sentences. Section 5 presents a fragment that delivers truth-value gaps as needed by building on standard compositional approaches to dynamic semantics (in particular, Muskens 1995, 1996). Section 6 compares the present account with previous work. Section 7 concludes.

2 The ∃/∀ ambiguity and the role of context

It is easy to judge the truth of the donkey sentence in (4) if no man treats any two donkeys differently. In such scenarios, if every man beats every donkey he owns, it is clearly true; if instead some man beats none of the donkeys he owns, it is clearly false.

(4) Every man who owns a donkey beats it.

Truth conditions become more difficult to ascertain in scenarios we will call *mixed*, namely those where every man owns and beats one donkey, and at least some men own additional donkeys that they do not beat (e.g. Heim 1982, Rooth 1987).

We will say that a donkey sentence has a *heterogeneous* interpretation if it is readily judged true in relevant mixed scenarios; otherwise, we will speak of *homogeneous* interpretations. An example whose most salient interpretation is homogeneous is (5a), adapted from Rooth 1987. It is homogeneous because it is judged false as soon as some father lets any of his 10-year-old sons drive the car, even if he has other 10-year-old sons that he forbids from driving it. Two heterogeneous examples are (5b), adapted from Schubert & Pelletier 1989, and (5c), from Chierchia 1995.

(5) a. No man who has a 10-year-old son lets him drive the car.
b. Usually, if a man has a quarter in his pocket, he will put it in the meter.
c. No man who has an umbrella leaves it home on a day like this.

As for (4) itself, Chierchia (1995) reports that although it is most readily interpreted in terms of a (homogeneous) ∀-reading, it turns out to allow quite clearly for (heterogeneous) ∃-readings in suitable contexts. Chierchia gives this context as a tongue-in-cheek example and attributes it to Paolo Casalegno (see also Almotahari 2011 for a different context manipulation):

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

The distinction between homogeneous and heterogeneous readings cuts across the one between ∃-readings, such as (5a) and (5b), and ∀-readings, such as (5c). It also cuts across the distinction between determiner-based donkey sentences, such as (5a) and (5c), and adverbial ones, such as (5b), and across the one between downward-entailing embedding quantifiers, as in (5a) and (5c), and upward-entailing ones, as in (5b). Hence it is not possible to reduce one of these distinctions to another.

The influence of context on donkey sentences has been noticed before:

(7) Anyone who catches a Medfly should bring it to me.

Gawron, Nerbonne & Peters (1991) observe that the interpretation of (7) is different depending on whether the speaker is a biologist looking for samples on a field trip, in which case the ∃-reading emerges, or a health department official engaged in eradicating the Medfly, in which case the ∀-reading surfaces.

3 Križ (2016) on plural definites

Sentences with definite plurals exhibit a related phenomenon also called homogeneity, whose presence likewise depends on the context (e.g. Löbner 2000, Križ 2016). As mentioned before, if one can reach a safe by going through any one of three doors arranged in parallel, and if two of these doors are open, the sentence *The doors are open* is readily judged true. However, if the doors are arranged in a sequence and one needs to pass through all of them, the sentence is only judged true if all the doors are open. If some but not all of them are open, it is judged false or neither true nor false.

To explain how these different interpretations arise, Križ (2016) assumes a salient current issue I, a partition of the set of worlds which gives rise to an equivalence relation $\approx_I$. Intuitively, $w \approx_I w'$ means that the current issue is resolved in the same way in w and w', and any differences between these two worlds are irrelevant for current purposes. A sentence S is judged true just in case it is *true enough at w with respect to I*, where being "true enough" means being true either at w itself or at some $w' \approx_I w$ (see Lewis 1979, Lasersohn 1999, Malamud 2012).[2]

Križ assumes that sentences can have extension gaps (van Fraassen 1969, Schwarzschild 1993). In a scenario when some but not all doors are open, *The doors are open* is literally (at the semantic level) neither true nor false. These literal truth values are not intended to directly reflect native speakers' intuitions. They are merely an intermediate step on the way towards computing pragmatic truth values.

Križ proposes to relax the Gricean Maxim of Quality in the following way. A sentence S may be used at w to address an issue I even if it lacks a truth value at w, as long as it is true enough at w and not false at any $w' \approx_I w$. That is, speakers may utter a sentence even if they do not believe it to be true, as long as they do not believe it to be false at any world that is equivalent to the actual world.[3] Sentences that are true enough are judged true. In the absence of a clearly identifiable current issue, sentences that are neither true nor false at the semantic level cannot be assigned a pragmatic truth value. Speakers who are presented with such sentences and scenarios can try to guess what the current issue might be; when no issue can be easily guessed, speakers may become confused and give guarded judgments.

Suppose that the current issue is whether there is a way to the safe. That is, suppose that $w' \approx_I w$ just in case the safe is reachable either in both w and w' or in neither w nor w'. Say the doors are arranged in parallel. Consider two worlds w_{all}, where all the doors are open, and w_{some}, where two of three doors are open (a mixed scenario). These worlds are equivalent for current purposes, and *The doors are open* counts as true enough at both of them. Accordingly, it will be interpreted non-maximally (and hence, heterogeneously) as the proposition $\{w_{all}, w_{some}\}$. Now consider a context where the doors are arranged in sequence: w_{all} and w_{some} are no longer equivalent. Instead, w_{some} is equivalent to a world w_{none} where no door is

2 Current issues are similar to questions under discussion (Roberts 2012) and to the way questions are modeled in Groenendijk & Stokhof 1984. Nevertheless, Križ (2016: Section 4.5) resists identifying current issues with questions under discussion because it is not possible to directly manipulate the current issue by asking it as a question. We will remain neutral on how these two concepts are related.

3 More generally, Križ stipulates that S may not be used to address an issue I if there are w_1 and w_2 such that $w_1 \approx_I w_2$ and S is true at w_1 but false at w_2, whether the actual world is among them or not.

open. Since w_{all} is the only world at which *The doors are open* is true enough, it is interpreted maximally (and hence homogeneously) as $\{w_{all}\}$.

4 Applying Križ 2016 to donkey sentences

Let us assume that donkey sentences have extension gaps at worlds that correspond to mixed scenarios. Then we can apply this theory straightforwardly. Suppose the semantics assigns sentence (4), repeated here, the truth and falsity conditions below:

(8) Every man who owns a donkey beats it. = (4)

a. **true** iff every donkey-owner beats every donkey he owns;
b. **false** iff at least one donkey-owner does not beat any donkey he owns;
c. **neither** in all other cases, in particular, if every donkey-owner beats exactly one donkey and one of them owns a donkey he does not beat.

For the purpose of exposition, pretend that there are only three possible worlds. Let w_{true} be a world where (8a) holds, w_{false} one where (8b) holds, and w_{mixed} one where (8c) holds. Assume that the current issue in scenario (6) is whether every farmer follows the recommendation to beat at least one donkey. Then $w_{true} \approx_I w_{mixed}$. Hence (4) is interpreted as $\{w_{true}, w_{mixed}\}$; this is a heterogeneous ∃-reading. If we change the scenario so that the recommentation is to beat all one's donkeys, w_{mixed} and w_{false} are now equivalent to each other, but not to w_{true}. This time, (4) is not true enough at w_{mixed}. It is pragmatically interpreted as $\{w_{true}\}$. Since this proposition does not contain w_{mixed}, sentence (4) receives a homogeneous reading; and since at w_{true}, every donkey-owner beats all of his donkeys, this is a ∀-reading.

Turning to sentences headed by *no*, we have seen that sentence (5c) has an ∀-reading. Assume that it has the following truth and falsity conditions:

(9) No man who has an umbrella leaves it home on a day like this. = (5c)

a. **true** iff no umbrella-owner leaves any of his umbrellas home;
b. **false** iff at least one umbrella-owner leaves all his umbrellas home;
c. **neither** in all other cases, in particular, if every umbrella-owner takes exactly one umbrella along, and someone also leaves one home.

As before, let w_{true}, w_{false} and w_{mixed} be worlds in which (9a), (9b), and (9c) are the case respectively. Suppose that the current issue is whether any man with an umbrella is getting wet. A man gets wet if he fails to take any umbrella along. This is the case at w_{false}. It is neither the case at w_{true} nor at w_{mixed}, so these two worlds are equivalent. Given this issue, (5c) is therefore true enough at both w_{true} and w_{mixed}. Since w_{true} is not equivalent to w_{false}, (5c) can be used to address the current issue at both w_{true} and w_{mixed}. This means (5c) will be pragmatically interpreted as $\{w_{true}, w_{mixed}\}$. Since this proposition contains w_{mixed}, this is a heterogeneous reading. Since the strongest thing we can say about both w_{true} and w_{mixed} is that no umbrella-owner left all of his umbrellas home, this is a $\forall$-reading.

Now let us consider a donkey sentence headed by *no* that has a homogeneous reading. Assume that sentence (5a) has the following truth and falsity conditions:

(10) No man who has a 10-year-old son lets him drive the car. = (5a)

a. **true** iff no man lets any son of his drive his car;
b. **false** iff at least one man has a son and lets all his sons drive his car;
c. **neither** in all other cases, for example, if every father allows one son to drive the car, and some of them have additional sons that they don't.

Let w_{true}, w_{false} and w_{mixed} match these propositions as before. Suppose that the current issue is whether there are reckless fathers. A father who allows just one of his sons to drive the car is just as reckless as one who gives permission to all of his sons. Reckless fathers are absent from w_{true} but present at both w_{false} and w_{mixed}, so $w_{false} \approx_I w_{mixed}$. Hence (5a) is true enough only at w_{true}. Since $w_{true} \not\approx_I w_{false}$, (5a) can be used to address the current issue. This means (5a) will be pragmatically interpreted as $\{w_{true}\}$. Therefore, (5a) receives a homogeneous reading. Since at w_{true}, no father lets any of his sons drive the car, this is an $\exists$-reading.[4]

An interesting prediction arises from the idea that some contexts might provide fine-grained current issues in which every world represents an equivalence class of its own (up to some remote distinctions that are not at stake). We might paraphrase this as "What is the actual world like?" (see van Rooij 2003, Malamud 2012). Given such a context, our theory will map to *false* every world for which the semantics returns either *false* or *neither*. Given a trivalent proposition p, let a fact-finding context be any issue I such that for all w and w', if $p(w) = true$ and $p(w') = neither$ then $w \not\approx_I w'$. A donkey sentence that is interpreted in a fact-finding context will always be interpreted as having a homogeneous reading. For donkey sentences headed by *every*, this is the $\forall$-reading; for sentences headed by *no*, this is the $\exists$-reading. Here is a sentence that evokes a fact-finding context, from Kanazawa 1994:

(11) Every girl in this neighborhood who has a younger brother is taller than him.

4 Some donkey sentences are formulated in such a way as to make mixed scenarios logically or practically impossible, such as *Most farmers who own exactly one donkey beat it* or *Most men who have a Social Security number know it by heart* (see Kanazawa 1994: p. 113). For the latter sentence, the "mixed" scenarios would involve people who have more than one Social Security number (something impossible in the US American context).

As Kanazawa notes, this sentence is judged false when one girl in the neighborhood has a younger brother taller than her, even if she is taller than her other younger brothers. This is the ∀-reading. If we replace *every* in (11) by *no* and interpret the sentence again in a fact-finding context, the ∃-reading emerges, as expected.

To sum up, we have a simple pragmatic theory that expects the semantic component to pass it a trivalent proposition and a current issue (an equivalence relation over possible worlds). The theory maps the trivalent proposition to an ordinary bivalent proposition that is true in mixed scenarios whenever the current issue lumps those scenarios together with worlds at which the proposition is true.

5 A trivalent dynamic compositional semantics

With a pragmatic theory in place that combines trivalent meanings with current issues to deliver disambiguated readings, the next step consists in delivering these trivalent meanings compositionally. As mentioned earlier, many early theories assumed that donkey pronouns can pick up both atoms and sums as discourse referents, so that the donkey pronoun in (4) could be paraphrased as *the donkey or donkeys he owns* (Lappin & Francez 1994, Yoon 1994, 1996, Krifka 1996). But as we have seen, Kanazawa 2001 argues convincingly that singular donkey pronouns can only have atomic discourse referents.

Several frameworks have been proposed that do not interpret singular donkey pronouns as sum individuals, in particular, dynamic systems such in the tradition of Groenendijk & Stokhof 1991. An earlier version of this work, which we discuss in Section 6.5, relied on Brasoveanu's (2008) plural compositional discourse representation theory (plural CDRT or PCDRT) to generate and manage discourse referents (Champollion 2016). In this paper, we eschew the evaluation pluralities in favor of the simpler CDRT variant described in Muskens 1995. In Section 6, we argue that donkey ambiguities do not require the full power of PCDRT.

At the core of dynamic systems is the notion of assignment. Assignments keep track of anaphora by relating discourse referents d, e, f etc. to entities x, y, z etc. Muskens's (1995) Logic of Change situates dynamic semantics in a version of Ty2 (Gallin 1975) that includes a third basic type, s, in addition to the usual e, the type of entities, and t, the type of truth values. There are two common strategies for conceptualizing the way that s-type objects track anaphora (Janssen 1983, Muskens 1991). Either s is taken to be the type of discourse referents, in which case assignments are modeled as functions from discourse referents to their values, or s is taken to be the type of assignments, in which case discourse referents are modeled as functions from assignments to values. As long as these values all have the same type, such as individuals, the choice between these two options does not matter. Since we are only interested in anaphora to individuals, we use the primitive type s

for discourse referents (of which we assume that there are infinitely many) and we represent assignments as functions of type $\langle s, e \rangle$. The converse choice would also be possible and is in fact adopted in Muskens (1991, 1995, 1996) and in Brasoveanu (2007, 2008). Since those works treat assignments as primitive, they provide sets of axioms to ensure that these *assignment objects* behave in the way *assignment functions* do. Such axioms are unnecessary here.

Suppose i and j are assignments and d is a discourse referent. We want $i[d]j$ to mean that i and j agree on all things except possibly on the value they assign to d. This is guaranteed by the following definition:

(12) $\quad i[d]j \equiv \forall d'_s \,.\, d' \neq d \rightarrow i(d') = j(d')$

Sentences denote relations over assignments. By convention, we will use i, i', etc. as variables over the first component of a main clause relation, and o, o', etc. as variables over the second. When intermediate assignments are needed, we write j, j', etc. for them. We let d, e, f and primed versions thereof range over discourse referents. Finally, $\mathbf{t}$ abbreviates the type $\langle se, \langle se, t \rangle \rangle$.

Like many other dynamic theories, CDRT assumes that anaphoric links are encoded in LFs through coindexation. Determiners are superscripted with the discourse referents they introduce, and anaphoric elements such as pronouns are subscripted with the discourse referents they pick up. For example, here is sentence (4) with the relevant annotations:

(13) $\quad$ every farmer who owns a^{d} donkey beats it$_{d}$

Phrase	*Type*	*Translation*
farmer	$\langle e, \mathbf{t} \rangle$	$\lambda xio \,.\, i = o \wedge \mathsf{farmer}(x)$
donkey	$\langle e, \mathbf{t} \rangle$	$\lambda xio \,.\, i = o \wedge \mathsf{donkey}(x)$
who	$\langle e\mathbf{t}, \langle e\mathbf{t}, e\mathbf{t} \rangle \rangle$	$\lambda PQxio \,.\, \exists j \,.\, Q x i j \wedge P x j o$
owns	$\langle \langle e\mathbf{t}, \mathbf{t} \rangle, e\mathbf{t} \rangle$	$\lambda Gx \,.\, G(\lambda yio \,.\, i = o \wedge \mathsf{own}(x,y))$
beats	$\langle \langle e\mathbf{t}, \mathbf{t} \rangle, e\mathbf{t} \rangle$	$\lambda Gx \,.\, G(\lambda yio \,.\, i = o \wedge \mathsf{beat}(x,y))$
a^{d}	$\langle e\mathbf{t}, \langle e\mathbf{t}, \mathbf{t} \rangle \rangle$	$\lambda PQio \,.\, \exists j \exists k \,.\, i[d]j \wedge P(j(d))jk \wedge Q(j(d))ko$
it$_{d}$	$\langle e\mathbf{t}, \mathbf{t} \rangle$	$\lambda Pio \,.\, i = o \wedge P(i(d))io$

Table 1 Basic translations

The lexical entries in Table 1 are based on Muskens (1995: section 5) with slight modifications.[5] Determiners are not included in the table, with the exception of

5 We use the following notational conventions. Dots separate binding operators — including λ, $\exists$, and $\forall$ — from the formulas that they quantify over. The scope of an operator extends as far to the right as

the indefinite *a*. In line with common practice in dynamic frameworks, we treat indefinites separately from other determiners. The restrictor and nuclear scope of sentence (4) reduce to the following by a series of lambda conversions and equivalent simplifications:

(14) a. $\lambda xio.\,\mathsf{farmer}(x) \wedge i[d]o \wedge \mathsf{donkey}(o(d)) \wedge \mathsf{owns}(x, o(d))$
b. $\lambda xio.\,\mathsf{beats}(x, i(d)) \wedge i = o$

In the restrictor, (14a), the indefinite *a donkey* introduces the discourse referent d and makes sure it picks out a donkey. The variable x ranges over individuals; its value must be a farmer who owns the donkey in question. It is the job of the embedding quantifier to pass on the assignments obtained in this way to the nuclear scope, (14b), which examines each assignment as to whether the farmer beats the donkey picked out by d.

This sketch leaves open what happens if a farmer owns more than one donkey. Imagine a model in which Stevenson is a farmer, and Modestine and Maxwelton are the donkeys he owns. The question arises whether the nuclear scope of *every* should process only one of these assignments picked at random or all of them. Generalized quantifiers can be lifted into the dynamic setting in two ways, each corresponding to one of these options (Chierchia 1995).

We propose that both options are operative in the semantics of donkey sentences. An embedding quantifier like *every* or *no* checks whether they both lead to the same outcome. If they do, the sentence as a whole is assigned that outcome as a classical truth value; otherwise, it receives the truth value **neither**.

To implement this formally, we first define the two type shifters $\mathfrak{E}$ and $\mathfrak{A}$, which lift a static determiner D of type $\langle et, \langle et, t\rangle\rangle$ into its internally dynamic counterparts. These type shifters correspond to the schemata $\mathscr{Q}_w$ and $\mathscr{Q}_s$ in Kanazawa 1994: 138, where they are attributed to Chierchia. Here we write R and N for the restrictor and nuclear scope of these dynamic determiners; these variables are both of type $\langle e, \mathbf{t}\rangle$ because they each take an individual and return a dynamic proposition.

(15) a. $\mathfrak{E} \stackrel{\text{def}}{=} \lambda DRNi.\,D(\lambda x.\,\exists j.\,Rxij)(\lambda x.\,\exists j.\,Rxij \wedge \exists o.\,Nxjo)$
b. $\mathfrak{A} \stackrel{\text{def}}{=} \lambda DRNi.\,D(\lambda x.\,\exists j.\,Rxij)(\lambda x.\,\forall j.\,Rxij \to \exists o.\,Nxjo)$

On the basis of these type shifters, we define a new type shifter that takes a static determiner D and returns an internally dynamic determiner that behaves as desired:

possible (until the edge of the nesting group), so for instance, $(\exists x.\,Px \wedge Qx) \wedge Rx$ is equivalent to $(\exists x.\,(Px \wedge Qx) \wedge Rx)$. Prefixal lambdas are collapsed: $\lambda fx.\,fx$ abbreviates $\lambda f.\,\lambda x.\,fx$. Finally, functions are passed into arguments without the aid of parentheses (which are used only for grouping), so that fx represents f applied to x.

(16) $$\mathfrak{D} \overset{\text{def}}{=} \lambda DRNio.\begin{cases}\textbf{true} & \text{if } i=o \wedge \mathfrak{E}DRNi \wedge \mathfrak{A}DRNi\\ \textbf{false} & \text{if } i=o \wedge \neg\mathfrak{E}DRNi \wedge \neg\mathfrak{A}DRNi\\ \textbf{neither} & \text{otherwise}\end{cases}$$

In particular, this determiner returns **true** when $\mathfrak{E}$ and $\mathfrak{A}$ are both true; it returns **false** when they are both false; and it returns **neither** when they disagree. In order to maintain compatibility with the rest of the grammar, we also equip the lifted determiner with two lambda slots for input and output assignments. To keep things simple, and because this paper does not deal with discourses, we require these assignments to be identical, making the lifted determiner externally static. For the same reason, we omit the treatment of discourse referents introduced by embedding quantifiers.

In many cases, the truth conditions that result from the $\mathfrak{D}$ type shifter can be presented in a simplified way. For example, in the case of *every*, the $\mathfrak{A}$ proposition asymmetrically entails the $\mathfrak{E}$ proposition; for *no*, it is the other way around. Taking this into account, the output of $\mathfrak{D}$ for these two determiners can be represented as follows:

(17) $$\mathfrak{D}_{every} \overset{\text{def}}{=} \mathfrak{D}\left(\llbracket\text{every}\rrbracket\right) = \\ \lambda RNio.\begin{cases}\textbf{true} & \text{if } i=o \wedge \\ & \quad \forall x.\,(\exists j.\,Rxij) \to (\forall j.\,Rxij \to \exists o'.\,Nxjo')\\ \textbf{false} & \text{if } i=o \wedge \\ & \quad \exists x.\,(\exists j.\,Rxij) \wedge (\neg\exists j.\,Rxij \wedge \exists o'.\,Nxjo')\\ \textbf{neither} & \text{otherwise}\end{cases}$$

(18) $$\mathfrak{D}_{no} \overset{\text{def}}{=} \mathfrak{D}\left(\llbracket\text{no}\rrbracket\right) = \\ \lambda RNio.\begin{cases}\textbf{true} & \text{if } i=o \wedge \\ & \quad \forall x.\,(\exists j.\,Rxij) \to (\forall j.\,Rxij \to \neg\exists o'.\,Nxjo')\\ \textbf{false} & \text{if } i=o \wedge \\ & \quad \exists x.\,(\exists j.\,Rxij) \wedge (\forall j.\,Rxij \to \exists o'.\,Nxjo')\\ \textbf{neither} & \text{otherwise}\end{cases}$$

In the case of nonmonotonic determiners like *exactly one* or *an odd number of*, the $\mathfrak{A}$ and $\mathfrak{E}$ propositions do not stand in an entailment relation. As a result, these determiners look somewhat more complex when they have been lifted. For example, here is $\mathfrak{D}_{ex.one}$:

(19) $\mathfrak{D}_{ex.one} \overset{\text{def}}{=} \mathfrak{D}\,(\llbracket\text{exactly one}\rrbracket) =$

$$\lambda R N i o\,.\begin{cases}\textbf{true} & \text{if } i = o \wedge \\ & \left(\begin{array}{l}1 = \left|\left\{x \mid \exists j\,.\,R x i j \,\wedge\, \exists o'\,.\,N x j o'\right\}\right| \,\wedge \\ 1 = \left|\left\{x \mid (\exists j\,.\,R x i j) \,\wedge\, (\forall j\,.\,R x i j \rightarrow \exists o'\,.\,N x j o')\right\}\right|\end{array}\right) \\ \textbf{false} & \text{if } i = o \wedge \\ & \left(\begin{array}{l}1 > \left|\left\{x \mid \exists j\,.\,R x i j \,\wedge\, \exists o'\,.\,N x j o'\right\}\right| \,\vee \\ 1 < \left|\left\{x \mid (\exists j\,.\,R x i j) \,\wedge\, (\forall j\,.\,R x i j \rightarrow \exists o'\,.\,N x j o')\right\}\right|\end{array}\right) \\ \textbf{neither} & \text{otherwise}\end{cases}$$

To bridge the gap between semantics and pragmatics, we define truth and falsity relative to an assignment as follows:

(20) **Bridging principle 1**
Let i be an assignment and ϕ be a term of type **t**.

a. ϕ is true relative to i iff there is an assignment o such that $\phi\, i\, o$ is true.
b. ϕ is false relative to i iff it is not true relative to i and there is an o such that $\phi\, i\, o$ is false.
c. In all other cases, ϕ is neither true nor false relative to i.

For sentences and discourses without unresolved anaphoric dependencies, we define truth and falsity simpliciter by universally quantifying over input assignments:

(21) **Bridging principle 2**
Let ϕ be a term of type **t**.

a. ϕ is true iff it is true relative to every input assignment.
b. ϕ is false iff it is false relative to every input assignment.
c. In all other cases, ϕ is neither true nor false.

These entries and principles deliver the desired truth and falsity conditions for our examples. As we have seen, the restrictor phrase *farmer who owns a*^{d} *donkey* reduces to (14a), and the nuclear scope phrase *beats it*$_{d}$ reduces to (14b). After plugging these terms into the entry in (17) and appealing to the two bridging principles, we obtain the following truth and falsity conditions:

$$(22)\quad \begin{cases} \textbf{true} & \text{if } \forall i \forall x.\ (\exists j.\, \mathsf{frm}(x) \wedge i[d]j \wedge \mathsf{dnk}(j(d)) \wedge \mathsf{own}(x, j(d))) \\ & \qquad \rightarrow \begin{pmatrix} \forall j.\, (\mathsf{frm}(x) \wedge i[d]j \wedge \mathsf{dnk}(j(d)) \wedge \mathsf{own}(x, j(d))) \\ \quad \rightarrow \mathsf{beat}(x, j(d)) \end{pmatrix} \\ \textbf{false} & \text{if } \forall i \exists x.\ (\exists j.\, \mathsf{frm}(x) \wedge i[d]j \wedge \mathsf{dnk}(j(d)) \wedge \mathsf{own}(x, j(d))) \\ & \qquad \wedge \begin{pmatrix} \forall j.\, (\mathsf{frm}(x) \wedge i[d]j \wedge \mathsf{dnk}(j(d)) \wedge \mathsf{own}(x, j(d))) \\ \quad \rightarrow \neg\mathsf{beat}(x, j(d)) \end{pmatrix} \\ \textbf{neither} & \text{otherwise} \end{cases}$$

These are the desired truth and falsity conditions. That is, the sentence is true only if every donkey-owning farmer beats all of their donkeys, and false only if some donkey-owning farmer beats none of their donkeys. Analogously for sentence (5a), we obtain the following result from the entry in (18) and the bridging principles:

$$(23)\quad \begin{cases} \textbf{true} & \text{if } \forall i \forall x.\ (\exists j.\, \mathsf{man}(x) \wedge i[d]j \wedge \mathsf{son}(j(d), x)) \\ & \qquad \rightarrow \begin{pmatrix} \forall j.\, (\mathsf{man}(x) \wedge i[d]j \wedge \mathsf{son}(j(d), x)) \\ \quad \rightarrow \neg\mathsf{lets\text{-}drive}(x, j(d)) \end{pmatrix} \\ \textbf{false} & \text{if } \forall i \exists x.\ (\exists j.\, \mathsf{man}(x) \wedge i[d]j \wedge \mathsf{son}(j(d), x)) \\ & \qquad \wedge \begin{pmatrix} \forall j.\, (\mathsf{man}(x) \wedge i[d]j \wedge \mathsf{son}(j(d), x)) \\ \quad \rightarrow \mathsf{lets\text{-}drive}(x, j(d)) \end{pmatrix} \\ \textbf{neither} & \text{otherwise} \end{cases}$$

Once again, these are the desired conditions. The **true** case states, roughly, that there is no way of assigning a man to any son of his such that the man in question lends the son in question his car. The **false** case states that there is a man who has at least one son and who lends every one of his sons the car.

To wrap up this section, we note that the $\mathfrak{D}$ schema is not intended to apply to genuine indefinite determiners like *a* and bare numerals, even though the types are compatible. All dynamic frameworks are motivated at least in part by the differential behavior of indefinite determiners — which bind and scope out of islands — and quantificational operators — which do not. This fragment is no different. If *a* were shifted by $\mathfrak{D}$, it too would end up externally static, which would not only prevent cross-sentential anaphora, it would for the same reason also ruin all of the donkey-derivations we have seen so far, as none of the restrictor indefinites would succeed in binding any of the nuclear scope pronouns that characterize the phenomenon.

The absence of $\mathfrak{D}$-shifted indefinites immediately predicts the absence of truth value gaps for donkey configurations headed by indefinite determiners.

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

b. $\lambda io\,.\,\exists j\,.\,i[f]j \wedge \mathsf{farmer}(j(f)) \wedge$
$j[d]o \wedge \mathsf{donkey}(o(d)) \wedge \mathsf{own}(o(f), o(d)) \wedge \mathsf{beat}(o(f), o(d))$

For example, the only reading that the current fragment predicts for the sentence in (24a) is described by the formula in (24b). This corresponds to an obligatory ∃-reading of the sentence. It is true just in case some farmer owns and beats some donkey, and false otherwise. This prediction is consistent with the experimental results of Geurts 2002, where it was found that participants only accepted exactly these weak truth conditions for such sentences.

6 Comparison with previous work

The question of which factors affect the ∃/∀ ambiguity has been taken on by many authors (Heim 1990, Gawron, Nerbonne & Peters 1991, Chierchia 1992, 1995, Geurts 2002). We first focus on two proposals that are similar in spirit to ours in that they do not postulate a semantic ambiguity: Kanazawa 1994 and Barker 1996. The related question of how to formally represent the ambiguity has been addressed thoroughly as well (e.g. Groenendijk & Stokhof 1991, Dekker 1993). In this respect, our theory is similar to many accounts couched in ordinary dynamic predicate logic or compositional versions thereof, such as compositional DRT (Muskens 1995, 1996). We focus our comparison on more recent accounts that use Plural Compositional DRT to represent the ambiguity (Brasoveanu 2008, 2010, Champollion 2016).

6.1 Kanazawa 1994

Kanazawa 1994 proposes a principled explanation why the ∃-reading and ∀-reading are natural interpretations of donkey sentences and what makes one or the other surface. He claims that all other things being equal, the availability of ∃-readings and ∀-readings of donkey sentences headed by a determiner is systematically related to the monotonicity properties of that determiner.

Kanazawa notes that the effect of the determiner *every*, at least relative to other determiners like *most*, *no*, and *at least two*, is to make the ∀-reading more readily available; in fact, his sense is that sentences with *every* have a default preference for the ∀-reading. At the same time, he acknowledges that there are clear examples of the ∃-reading with *every* as well.

We can account for Kanazawa's observation that *every* triggers ∀-readings by default by appealing to the notion of a fact-finding context described in Section 4. It is natural to assume that sentences presented in absence of any clues as to what the current issue might be are typically interpreted as if they had been uttered in a fact-finding context (for discussion see van Rooij 2003, Malamud 2012).

Kanazawa discusses a generalization to the effect that determiners that are downward-entailing on their nuclear scope (such as *no*, *few*, and *at most n*) only have the ∃-reading.[6] We have seen that (5c) is a counterexample to that generalization. Kanazawa also offers the sentences in (25) as potential counterexamples; to the extent that intuitions are clear about them, they too tend to favor the ∀-reading:

(25) a. No man who had a credit card failed to use it.
b. Not all students who borrowed a book from Peter returned it.

Again, we can make sense of the default tendency for downward-entailing determiners to generate ∃-reading-type interpretations by assuming that the default context is fact-finding. The sentences in (25) are exceptions to this tendency because they evoke current issues that are not fact-finding, such as: *Did every card-owner pay by card?* and *Did Peter get all of his books back?*

Kanazawa also discusses the role of context in selecting an interpretation of a given donkey sentence. He attributes this example to David Beaver (p.c.):

(26) A: John has a silver dollar. He didn't put it in the charity box.
B: No, everybody who had a coin put it in the box.

As he notes, the context created by A's utterance makes the ∀-reading of B's response the only sensible interpretation. This makes sense on the present account if we assume that A's utterance gives rise to the current issue *Did anybody keep any of their coins?* More generally, we can recast questions about the availability of various readings as questions about the availability of various current issues.

One benefit of the theory developed here is that it accounts for the observation that "people have firm intuitions about situations where farmers are consistent about their donkey-beating" while they give "varied and guarded judgments" in mixed scenarios (Rooth 1987). In consistent situations, the semantics delivers a classical truth value, so there is no need to consider what the current issue might be. This is in line with a speculation by Kanazawa (1994):

> [P]eople are capable of assessing the truth value of a donkey sentence without resolving the 'vagueness' of the meaning given by the grammar when there is no need to do so. For our purposes, it is enough to assume that underspecification causes no problem for people in assigning a truth value to a donkey sentence in situations

6 Kanazawa attributes this generalization to Rooth 1987 but notes that Rooth does not explicitly endorse it; nor does Kanazawa himself.

> where the uniqueness condition for the donkey pronoun is met. These are a special class of consistent donkey-beating situations, and the uniqueness condition can be checked just by looking at the extensions of the predicates in the N' of the sentence. (Kanazawa 1994: p. 152)

The present account extends this perspective to all consistent donkey-beating situations. Consider for example a situation where every man owns two donkeys and beats both of them. Even though the uniqueness condition for the donkey pronoun is not met, the present account still predicts that the donkey sentence (4) is true no matter what the current issue is.[7]

Finally, the present theory parts ways with Kanazawa's in its treatment of quantificational determiners such as *at least n* that are upward-entailing on both arguments. Donkey sentences with such determiners are generally claimed to only have the ∃-reading. The account here however predicts that their meaning will depend on the current issue. For example, given the issue *Did anyone get wet?*, the sentence *At least two men who had an umbrella left it at home today* ought to get an ∀-reading. We think this is correct; the sentence is interpreted as true if at least two men left all of their umbrellas at home, and false otherwise. The monotonicity principle in Kanazawa 1994 predicts that upward-entailing determiners prefer the ∃-reading, and an additional principle ensures that intersective determiners like *at least two* do not generate an ∀-reading. Not only is this empirically misguided, we think, but as Yoon (1996) notes, this latter principle is problematic in the case of *no*, which is intersective yet clearly receives an ∀-reading in sentence (5c).

6.2 Barker 1996

Barker 1996 shares many aspects and predictions of the present theory and has in part inspired it. However, it only briefly touches on donkey sentences headed by determiners. The main focus is on adverbial donkey sentences, such as these:

(27) a. Usually, if a woman owns a dog, she is happy.
b. Usually, if an artist lives in a town, it is pretty.
c. Usually, if a linguist hears of a good job, she applies for it.

7 On the present account, even some non-consistent situations are assigned a classical truth value by the semantics and are therefore not dependent on the current issue for their interpretation. Thus if every man owns two donkeys, John beats neither of his donkeys, and everyone else beats only one of his donkeys, the semantics predicts sentence (4) to be false no matter what the current issue is. This leads us to expect that speakers should not hesitate to judge such a sentence false. We believe that this is on the whole correct, but see Kanazawa 2001: Section 6.2 for a different perspective.

Following earlier work, Barker distinguishes between symmetric and asymmetric interpretations of donkey sentences. Sentence (27a) is naturally understood as making a claim about how many dog-owning women are happy. If a woman owns more than one dog, she is counted only once. Barker refers to this as a subject-asymmetric reading. Sentence (27b) is about the number of towns that have artists living in them (an object-asymmetric reading), and sentence (27c) is about linguist-job pairs (a symmetric reading). Barker's main claim is that asymmetrically interpreted adverbial donkey sentences come with a homogeneity presupposition:

(28) *The homogeneity hypothesis* (HH, Barker 1996):
The use of a proportional adverbial quantifier when construed under a particular proportional reading presupposes that members of the same quantificational case all agree on whether they satisfy the nuclear scope.

Barker defines quantificational cases as equivalence classes of variable assignments that agree on what they assign to those variables that are bound by the adverbial quantifier. In (27a), each woman corresponds to a quantificational case. According to HH, (27a) presupposes that any woman is happy either about all of her dogs, or about none of them. Likewise, (27b) presupposes that any town is pretty or not no matter which artists live in it. No asymmetric readings are available for (27c), because the homogeneity presuppositions of these readings fail. In effect, homogeneity presuppositions neutralize the difference between $\forall$-readings and $\exists$-readings by ruling out any scenarios in which this difference could be observed.

Although HH is formulated so as to apply only to adverbial quantifiers, Barker tentatively assumes that it governs nominal quantifiers as well. If so, the subject-asymmetric reading of example (29) presupposes that every man who owns several donkey beats all or none of them.

(29) Most men who own a donkey beat it.

HH differs from the present account in that it predicts a presupposition failure for all those cases in which we assume a donkey sentence that is not literally true can be "true enough". An obvious challenge for HH arises from heterogeneous readings. Take sentence (5b), repeated here:

(30) Usually, if a man has a quarter in his pocket, he will put it in the meter.

First, we predict that the sentence has these truth and falsity conditions:

(31) a. **true** iff most quarter-owning men put all their quarters into the meter
b. **false** iff most quarter-owning men put none of their quarters into the meter

c. **neither** in all other cases, for example, if every quarter-owning man puts exactly one quarter into the meter, and most of these men have additional quarters that they hold on to

Let w_{true}, w_{false}, and w_{mixed} be worlds described by (31a), (31b), and (31c) respectively. Suppose that the current issue is whether most men who have a quarter follow the law by putting at least one quarter into the meter. This is the case both at w_{true} and at w_{mixed}. Hence (30) is true enough at w_{mixed}, and the present account will correctly predict that (30) on its asymmetric reading is interpreted heterogeneously as $\{w_{true}, w_{mixed}\}$, an ∃-reading.

By contrast, HH as presented so far wrongly rules out the asymmetric ∃-reading due to presupposition failure at w_{mixed}. Barker is aware of this and assumes that contextual domain narrowing prevents this presupposition failure by removing those quarters from consideration that remain in a man's pocket at w_{mixed} after the parking laws have been satisfied. While Barker proposes no formal theory of domain narrowing, the general idea is that any entities that do not settle the current issue can be removed from the domain. In the restricted domain, the homogeneity presupposition is satisfied, and (30) is predicted true.

In the absence of an explicit theory of domain narrowing, it is difficult to find examples for which Barker 1996 and the present account differ clearly in their predictions. That said, our theory is not merely a formalization of HH because the two theories differ in how heterogeneity arises. In particular, Barker assumes that homogeneity is a presupposition and that domain narrowing is always available to step in and rescue sentences from presupposition failure, while the present account does not treat donkey sentences as presuppositional and need not appeal to domain narrowing. While we cannot directly compare our approach to HH without an explicit theory of domain narrowing, we do think there are reasons to prefer our account. In particular, HH is tailored to donkey sentences and does not seem to apply elsewhere, while the core ingredients of our account are independently motivated by analyses of plural definites (i.e., Križ 2016).

6.3 Brasoveanu 2008

Brasoveanu 2008 argues that an account of anaphora and quantification requires a richer notion of information state than that provided by ordinary dynamic semantics or compositional DRT. He introduces PCDRT, a system in which information states are sets of assignments rather than just assignments, and motivates it in part by donkey sentences with multiple instances of donkey anaphora such as the following:

(32) Everyone who buys a^d book online and has a^e credit card uses it$_e$ to pay for it$_d$.

(33) Every boy who bought a^d Christmas gift for a^e girl in his class asked her$_e$ deskmate to wrap it^d.

Brasoveanu proposes that indefinites are ambiguous between a maximal or "strong" and a nonmaximal or "weak" interpretation. Donkey pronouns whose antecedents are strong receive the ∀-reading, those whose antecedents are weak receive the ∃-reading. For example, in (32), the indefinite *a book* is easily understood as strong and the indefinite *a credit card* as weak; in (33), the indefinites *a Christmas gift* and *a girl* are both strong. Brasoveanu refers to the weak-strong contrast as a scalar implicature; however, in his system it is not modeled as a scalar implicature but as a lexical ambiguity. Maximal indefinites simultaneously introduce as many values as possible, while nonmaximal indefinites are free to assign a smaller set. For example, the assignments in any output state of a^d *donkey* map d to farmer-owned donkeys. If a^d is maximal, these assignments do this in such a way that no farmer-owned donkey is left out. If a^d is nonmaximal, among the output states of the indefinite there will be some whose assignments leave out some donkeys. Pronouns check that all assigments in their input state agree on the value of their discourse referent.

In Brasoveanu 2008, the main purpose of this ambiguity is to account for the ∃/∀ ambiguity. Brasoveanu (2008: 148) claims that the contrast between maximal and nonmaximal interpretations of indefinites surfaces only if two conditions are fulfilled: (i) there is anaphora to the indefinites and (ii) the indefinites and the anaphoric expressions are embedded in quantificational contexts. However, as Brasoveanu (2008: 164) points out, in his system condition (i) is sufficient for the contrast to emerge. For example, a discourse like A^d *man came in. He*$_d$ *sat down.* is predicted to be ambiguous between *There is a man who came in and who sat down* and *Exactly one man came in, and he sat down*. The uniqueness inference in the latter reading arises from the interaction of the maximal indefinite and the uniqueness condition of the pronoun.

While there are worries about overgeneration outside of donkey sentences in Brasoveanu 2008, we believe our analysis offers more fundamental improvements. In particular, we have shown that in the presence of a pragmatic theory such as the one we have proposed, one can analyze most if not all phenomena involving donkey anaphora with only ordinary CDRT, without having to resort to full PCDRT. Because we delegate the work of disambiguating between readings to the pragmatics, we no longer require the semantics to model the ambiguity at the level of the pronouns or the indefinites. This allows us to rely on simpler semantic theories such as Muskens (1995). There are certainly other arguments for PCDRT in Brasoveanu 2008, but our work shows that the variety of readings available for donkey anaphora does not necessitate a move to plural assignments.

6.4 Brasoveanu 2010

The main focus of Brasoveanu 2010 is on the truth-conditional and anaphoric components of quantificational and modal subordination, but the paper contains a discussion and an implementation of donkey anaphora. Brasoveanu (2010) treats indefinites as ambiguous, but takes a different route than Brasoveanu (2008) did. Indefinites can still introduce their own discourse referents; when they do, they are always interpreted nonmaximally, resulting in existential readings. To model universal readings, Brasoveanu now assumes that an indefinite can be translated identically to a singular anaphoric definite. In that case, instead of introducing a discourse referent the indefinite is anaphoric. To that purpose, embedding quantifiers are given the ability to introduce additional discourse referents, on which indefinites can be anaphoric. As Brasoveanu notes, this move is in the spirit of Dekker 1993; the necessary adjustments to the translations of embedding quantifiers make them multiply selective instead of singly selective. Simplifying somewhat, the LFs for the existential and universal reading of sentence (4) are assumed to be as follows:

(34) a. Every^{f} farmer who owns a^{d} donkey beats it$_{d}$. *existential reading*
b. Every^{f,d} farmer who owns a$_{d}$ donkey beats it$_{d}$. *universal reading*

The multiply selective quantifier *every*^{f,d} in (34b) quantifies in effect over farmer-donkey pairs; the indefinite *a*$_{d}$ *donkey* receives the interpretation of the anaphoric definite *the*$_{d}$ *donkey*.

A problem with this approach is that since indefinites and definites share a reading, their distribution must be stipulated and cannot be explained in semantic terms. Brasoveanu assumes that only embedding quantifiers can be antecedents of definite-like indefinites. A similar stipulation is required to rule out discourse-initial sentences like the following:

(35) Every^{f,d} farmer who owns the$_{d}$ donkey beats it$_{d}$.

If the definite was able to pick up the discourse referent d introduced by the embedding quantifier, the resulting reading would be indistinguishable from the universal reading of sentence (4).

Setting these points aside, a more general problem with approaches that locate the ambiguity in the indefinite arises from mixed existential-universal sentences in which the same indefinite antecedes two pronouns:

(36) Every man who has an umbrella takes it along on rainy days but leaves it home on sunny days.

On the most natural reading of this sentence, what is required for its truth is for every umbrella-owner to take one umbrella along when it is raining, and to leave all of his umbrellas at home when the sun is shining. In other words, the first donkey pronoun is naturally interpreted existentially and the second one universally. No matter if the antecedent is interpreted strongly or weakly, one of the pronouns will be assigned the wrong meaning on both Brasoveanu (2008) and Brasoveanu (2010).

On the present account, the ambiguity is located in the pragmatics, and generating the plausible reading poses no particular problem. The semantics treats sentence (36) as true only if every umbrella-owner takes all his umbrellas with him when it is rainy (even though one would suffice to stay dry). While this is not the case in the situation of interest, a Current Issue such as *Did everyone stay dry when it rained and unburdened when it was sunny?* will lump this situation together with those where everyone took multiple umbrellas with them.

6.5 Champollion 2016

With essentially the same goals in mind as in the project here, Champollion (2016) sketched a dynamic fragment intended to generate effective truth-value gaps for donkey readings in mixed scenarios. But where the current approach fairly directly lifts Križ's (2016) semantic clauses into a simple compositional dynamic framework (Muskens 1995), Champollion leaned on the quite powerful plural dynamic semantics of Brasoveanu 2010 — augmented with designated "error" discourse referents and objects — combined with ideas from supervaluation theory. Not only is this unnecessary, as we hope to have shown with the fragment in Section 1, it leads to several empirical issues.

First, Champollion relies on the *strong* entry for indefinites proposed in Brasoveanu 2010. This corresponds to an update that introduces as many potential referents for its restrictor as possible, across the various output assignments of the sentence. But that kind of update overgenerates evaluation pluralities when not in the restrictor of a dynamic quantifier. For instance, given the maximality of *a*, the assignments coming out of sentence in (37b) will contain, between them, as many sandwiches as were eaten by girls. The subsequent pronoun ought then to be able to refer to this discourse plurality, as it can in (37a), but this is impossible.

(37) a. Every girl ate a^{d} sandwich. They$_{d}$ were tasty.
b. A girl ate a^{d} sandwich. #They$_{d}$ were tasty.

Brasoveanu (2010) can at least avoid this possibility by stipulating that indefinites outside the arguments of generalized quantifiers are necessarily interpreted *weakly*, but since Champollion is in part motivated by a desire to avoid semantic ambiguity in the elements that comprise donkey sentences, he is committed to a single maximal indefinite everywhere.

As a corollary of this, plural pronouns in the *scope* of generalized quantifiers also ought to have no trouble picking up the evaluation pluralities introduced by maximal indefinites. The example in (38a) shows that such evaluation pluralities can in general be interpreted collectively: it is true if the collection of backpacks brought by girls forms a pile out back. But as mentioned in Section 1, donkey pronouns cannot be interpreted collectively. Thus in (38b), *it* cannot refer collectively to the set of backpacks that the set of girls brought.

(38) a. Every girl brought a^d backpack. They_d are piled up out back.
b. *Every girl who brought a^d backpack piled it_d up out back.

Second, Champollion assigns to the singular donkey pronoun a meaning that tests the outputs of its local update for uniformity across a certain index. For instance, in the sentence *Every farmer who owns* a^d *donkey beats* it_d, the pronoun will be in charge of inspecting whether the discourse referent associated with the subject of the predicate *beats* — which will in each distributive cycle refer to some particular donkey-owning farmer — behaves uniformly with respect to the values stored in the discourse referent d — which will pick out all of the donkeys owned by whoever the particular farmer of the moment is. In other words, when considering Farmer John, it_d will test the incoming sets of assignments to see whether John either beats all/none of the donkeys injected by the maximal a^d.

To make this work, the pronoun must take scope over the predicate that it uses as the basis of its uniformity test. In the presence of scope islands, this leads to both under- and over-generation issues.[8] Consider the sentence in (39):

(39) Every girl who brought a^d backpack got in a fight with somebody who insulted it_d.

Its ∀-reading, for example, is true just in case every girl defended the honor of each of her backpacks. The property that it_d would need to test for uniformity in this case is the entire nuclear scope of the quantifier: the property of getting in a fight with somebody who insulted d. But since the pronoun is embedded in the relative clause island, it cannot scope high enough to see all of this information. This is the undergeneration worry. The overgeneration worry is that instead, the pronoun *can* scope just within the relative clause. But (39) has no reading which would correspond to the truth conditions obtained by throwing an error just in those cases where girls' behaviors are mixed with respect to whether they were insulted; all of

8 Thanks to Simon Charlow for pointing this out.

its readings ought to depend on whether girls are mixed with respect to whether they got in fights with their insulters.

Another consequence of treating the pronouns like dynamic tests is that they throw out all dynamic information in the constituents in their scope. This means that indefinites in the nuclear scopes of donkey sentences will be dynamically inert. So even if the pronoun *could* scope over the entire verb phrase of (39), it would prevent the indefinite from anteceding discourse anaphora. But the felicity of (40a) shows that this is a bad prediction. The discourse in (40b) makes the same point but is perhaps easier to process. The pronoun *it* needs to inspect each secret-keeper for homogeneity with respect to their various secrets; that is, did they sell all/none of them to reporters. But to do that, it needs to scope over the property denoted by VP, $\lambda d\,.\,\textit{sell d to a reporter}$, which will capture and eliminate the discourse referent introduced by *a reporter*. Yet anaphora to reporters is fine here. An even simpler case is given in (40c). If the pronoun in the second clause outscopes the indefinite, then cross-sentential anaphora to *a stool* should fail. But of course it doesn't.

(40) a. Every girl who brought a backpack got in a fight with somebody^{e} who insulted it. The fights were mostly quite intense, but still, none of them$_{e}$ regretted what they had said.

b. Everybody who had a secret sold it to a^{e} reporter. Most of them$_{e}$ were very grateful for the gossip.

c. John walked in. He sat on a^{e} stool. He said it$_{e}$ was comfy.

7 Conclusion

This work has shown that definite plurals and donkey anaphora can be given a uniform pragmatic treatment, as suggested by Yoon (1994, 1996) and Krifka (1996). By moving the explanatory burden to the pragmatics, we can avoid problems that arise by trying to make definite plurals and donkey anaphora semantically uniform. In particular, Yoon and Krifka relied on the problematic assumption that *it* and *the donkey(s) he owns* can be given a parallel analysis in terms of plural individuals. However, Kanazawa (2001) showed that plural individuals cannot be involved in the semantics of *it*. This paper avoids the need for plural individuals.

The pragmatic component of our account is broadly similar to Barker (1996) but does not rely on presuppositions or domain narrowing. Our semantic component also allows us to keep the semantics streamlined to a fragment of CDRT (Muskens 1995, 1996). We have shown that the $\exists/\forall$ ambiguity in donkey sentences does not require moving to systems that treat donkey anaphora in terms of evaluation-level pluralities and plural information states like those in Brasoveanu 2008, 2010. By not relying on plural information states, we were able to avoid a number of empirical issues we identified in Champollion 2016, a precursor of the present work.

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