Scalar Implicatures
and the Grammar of Plurality and Disjunction

by

Natalia Ivlieva

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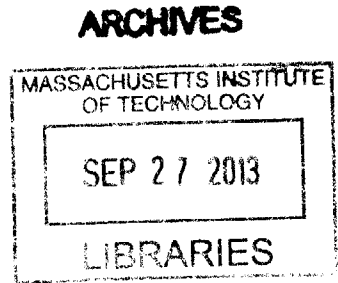
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Abstract

This dissertation explores the role of scalar implicatures in the grammar of plurality and disjunction. I argue that scalar implicatures are relevant not only for the *meaning* of plurals and disjunctions, but also for their distribution in language. For example, the computation of scalar implicatures will be shown to be the decisive factor regulating the patterns of (un)grammaticality of plural agreement with disjunctive noun phrases (Chapter 3). But before getting to conclusions like that, I will spend some time on the semantics of bare plurals (Chapter 2), developing a version of the grammatical view of scalar implicatures along the way (some necessary background on scalar implicatures will be built in Chapter 1).

The claim that scalar implicatures are calculated in the grammar is very far from uncontroversial. But if they really are, then many of the facts that I discuss could be predicted, more or less straightforwardly. If one treats scalar implicature calculation as a purely pragmatic process, these facts are arguably harder to make sense of.

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Kai was the last to join my committee and now I regret very much that I didn't use

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To the memory of my father

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Chapter 1 Introduction: Theories of Scalar Implicatures

In this dissertation, we are going to look at two seemingly disparate phenomena: the comings and goings of the multiplicity component in the meaning of bare plurals, and number agreement with disjunctions. We will argue that both of these phenomena can be given an account in terms of the theory of scalar implicatures, by making reference to obligatory implicatures.

In this chapter, I introduce some basic background on scalar implicatures, briefly review the classical (pragmatic) and grammatical approaches to the phenomenon, focusing on some arguments for the latter, and discuss some relevant concepts which we will be making use of in our account of bare plurals and plural disjunctions.

1.1   Background on Scalar Implicatures

Consider a sentence in (1):

(1)   Some of John's friends arrived.

It is usually assumed that a sentence like (1) leads to an inference in (2):

(2)   It is not the case that all of John's friends arrived.

Inferences like the one in (2) are not a logical entailment, because if it were, the sequence in (3) would be considered contradictory, similar to what we see in (4):

(3)   Some of John's friends arrived. In fact, all of them did.

(4)   #Some of John's friends arrived. In fact, none of them did.

Such inferences are called implicatures. Below, we will review several approaches to how

these inferences have been analyzed, starting from the classical *pragmatic approach* (Grice 1975).

1.2 Pragmatic approaches

According to the classic pragmatic approach of Grice 1975, implicatures are inferences that follow from the assumption that speakers behave rationally and cooperatively. Grice offers a set of maxims that a cooperative and rational speaker obeys. Some of those maxims are given below:

(5)   *Gricean Maxims*

    Quantity

    a. Make your contribution to the conversation as informative as is required.

    b. Do not make your contribution more informative than required.

    Quality

    c. Do not say what you believe to be false.

    d. Do not say what you don't have adequate evidence for.

    Relation

    e. Be relevant.

    Manner

    f. Avoid obscurity and ambiguity.

    g. Be brief and orderly.

If the hearer hears (1), he starts reasoning about why the speaker chose this particular sentence. Let's see how the reasoning about (1) could go. The speaker asserted (1), therefore, by the Maxim of Quality (5), the speaker believes (1). At the same time, the speaker didn't assert (6):

(6)   All of John's friends arrived.

Therefore, by the Maxim of Quantity (5) the speaker does not have the information that (6) is true, which leads to the inference in (7):

(7)   The speaker does not believe that all of John's friends arrived.

Under an additional assumption that the speaker is *opinionated* about how many of John's friends arrived, (7) can be strengthened to (8) (Sauerland's (2004) epistemic step):

(8)   The speaker believes that it's not the case that all of John's friends arrived.

Note that when we went through the reasoning process, we assumed that the speaker compares (1) to the sentence in (6). The question that needs to be addressed at this point is what are the alternative utterances that the hearer compares the sentence to? The first requirement is that stronger sentences should be considered, as according to the Maxim of Quantity the speaker is required to be as informative as possible, and hence, if he didn't utter any stronger sentence, it means that he is not a position to utter it. The sentence with *all* is stronger than the sentence with *some*, so it counts as a possible candidate for comparison.

However, note that by the same logic we could have compared the sentence in (1) to a sentence in (9):

(9)   Some but not all of John's friends arrived.

The reasoning could go as follows: The speaker asserted (1), therefore, the speaker believes (1). The speaker didn't assert (9). Therefore, the speaker does not have the information that (9) is true, which leads to (10):

(10)   The speaker does not believe that some but not all of John's friends arrived.

Assuming that the speaker is opinionated leads to the strengthening of (10) shown in (11):

(11)   The speaker believes that it's not the case that some but not all of John's friends arrived.

But in fact what we get in (11) contradicts the actual implicature. So there should be way to rule out (9) as an alternative utterance.

In order to solve this problem (known as the symmetry problem), Horn (1972) proposed that certain lexical items are associated with lexical scales, which specify which elements count as alternatives, for example *some* is a member of the scale {*some, all*}, *or* is a member of a scale {*or, and*}. The Maxim of Quantity (5) can now be modified to state that hearers do not compare the utterance to all the relevant and more informative alternatives, but rather they only compare it to alternatives from a formally defined set.

(12)   The Neo-Gricean Maxim of Quantity

If S_1 and S_2 are both relevant to the topic of conversation, S_1 is more informative than S_2, and $S_1 \in$ ALT(S_2), then, if the speaker believes that both are true, the speaker should prefer S_1 to S_2 (Fox 2007: 76),

where ALT(S_2) is the set of alternatives to S_2, defined as follows:

(13)   ALT(S) = {S': S' is derivable from S by successive replacement of scalar items with members of their Horn-Set}[1]

Thus the fact that *all* is a scale-mate of *some* allows us to go through the reasoning we showed above, whereas we cannot do the same for *some but not all*.

According to the pragmatic approach, there are certain characteristics that implicatures have. First of all, implicatures are optional/cancellable. An implicature arises as a result of certain assumptions regarding the speaker: namely, that he is opinionated and that the alternatives are contextually relevant. Those assumptions clearly do not always hold. In situations when they do not hold, implicatures are not expected to arise. Second, the pragmatic reasoning is obligatorily global – it can only apply to the level of whole sentences.

1.3   Grammatical approaches

In recent years the Neo-Gricean approach has been challenged based on a number of reasons. Among the considerations which are problematic for the Neo-Gricean view we can mention the following: existence of embedded implicatures, existence of obligatory implicatures, interaction of implicatures with polarity items, modularity of the implicature calculation process. To solve those problems, new theories of implicatures were proposed which treat scalar implicatures[2] as calculated within the grammar (Chierchia 2004, Chierchia, Fox and Spector 2012, Fox 2007, Magri 2009).

Chierchia 2004 offered that scalar implicatures (SI) are derived through a purely grammatical mechanism, they are computed compositionally and recursively along with

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[1] In Katzir 2007 and Fox and Katzir 2011 it was proposed that the set of alternatives is constructed in the grammar, without reliance on lexical scales. For our purposes in this dissertation, however, we will appeal to Horn-sets rather than grammatically defined alternatives.

[2] Note that in this dissertation we use the term "scalar implicature" extensionally to refer to those types of inferences that under the Gricean perspective arise as a result of reasoning about the speaker's beliefs based on the Maxim of Quantity, Horn Alternatives, and the assumption of an opinionated speaker.

the ordinary truth-conditional meaning. We will discuss this theory and its shortcomings in relation to how it accounts for the multiplicity implicature associated with plurals in Chapter 2.

In this section, we will present another version of such a theory, explicitly laid out in Fox 2007. After presenting it, we will discuss three arguments in favor of the grammatical view, more specifically, we will survey the argument from embedded implicatures, the existence of obligatory implicatures and the encapsulation of the implicature calculation, as each of these will be relevant for the analysis of the facts we will discuss in Chapter 2 and 3. We will put a particular emphasis on the question of obligatory implicatures.

Following proposals by Groenendijk and Stokhof (1984), Krifka (1995), Landman (1998), van Rooy (2002), Fox argues that implicatures are brought about by a covert operator $\mathcal{E}xh$ akin to *only*, which has a semantics shown below:

(14) $[\![\; \mathcal{E}xh \;]\!] \; (A_{<st,t>})(p_{<s,t>})(w) \Leftrightarrow p(w) \wedge \forall q \in \mathrm{Excl}(p,A)[\; \neg q(w)]$

This operator takes a proposition, called *prejacent*, and a set of alternatives and asserts the prejacent and negates all the excludable alternatives. Let's for the time being assume that the set of excludable alternatives consists of alternatives that are stronger than the prejacent. Thus, if we have a sentence (15) with a scalar item *some* and assume that the set of formal alternatives to *some* contains *all*, the result of applying $\mathcal{E}xh$ to (15) will be as shown in (16):

(15)   John ate some of the cookies.

(16) $[\![\; \mathcal{E}xh \; [\text{John ate some of the cookies} \;] \;]\!] = 1$ iff John ate some of the cookies and didn't ate all of the cookies.

As $\mathcal{E}xh$ is a grammatical operator, it might be plausible to assume that it can be inserted at any level of embedding – at the root level as well as at embedded levels of the appropriate type.

However, it is not the case that the application of the exhaustification operator $\mathcal{E}xh$ is completely free. For example, it is well-known that implicatures disappear in downward-entailing contexts. Thus, if we adopt an assumption that there is an exhaustification operator in the grammar that can be applied at any scope position, we should also somehow constrain its $\mathcal{E}xh$ application (to rule it out in DE contexts at least). One such attempt was made by Fox and Spector 2009. We will use the following simplified version of their constraint for our purposes:

(17) *Exh* is not allowed to weaken the overall meaning (a sentence with *Exh* cannot be entailed by a sentence without *Exh*).

1.4 Embedded implicatures

One argument in favor of the grammatical theory of implicatures comes from the existence of embedded implicatures. We will discuss an argument offered by Chierchia, Fox & Spector 2012, which is related to a felicity condition on the use of disjunction. Let's consider the following sentences:

(18) #John lives in Paris or France.

(19) #John saw a dog or an animal.

Hurford (1974) offered the following constraint to account for the ungrammaticality of (18)-(19): A disjunction *p or q* is unacceptable when one of the disjuncts entails the other one. Indeed, in both (18)-(19) one of the disjuncts entails the other, for example, *John lives in Paris* entails *John lives in France* and *John saw a dog* entails *John saw an animal*. Now, if we look at (20)- (21), we can notice that these are also cases where the second disjunct entails the first one (*both Mary and Sue* entails *Mary or Sue* and *all* entails *some*). Thus, (20)- (21) should violate the Hurford constraint and be ruled out. However, the prediction is not borne out. Chierchia, Fox and Spector (2012) argue that the sentences in (20)-(21) must receive the parse in (22)-(23), with the first disjunct being exhaustified. Such parses do not violate the Hurford constraint: when the first disjunct is exhaustified, it negates the second disjunct and hence the second disjunct does not entail the first one.

(20) John talked to Mary or Sue or both.

(21) John did some or all of the homework.

(22) *Exh* [John talked to Mary or Sue] or John talked to both Mary and Sue.

(23) *Exh* [John did some of the homework] or John did all of the homework.

If the analysis of the facts in (20)-(21) offered by Chierchia, Fox and Spector 2012 is correct, then it can be taken as an argument in favor of the existence of embedded implicatures.

1.5   Modularity hypothesis

Let us recall the way we defined the exhaustivity operator above:

(24) $[\![\, \mathcal{E}xh \,]\!] \, (A_{<st,t>})(p_{<s,t>})(w) \Leftrightarrow p(w) \wedge \forall q\colon q(w) \vDash p(w) \, [\neg q(w)]$

What the operator does is it takes the set of formally defined alternatives and negates those alternatives from the set which asymmetrically entail the prejacent. The question that arises at that point is what kind of entailment it is. Is it logical entailment or rather entailment given the contextual knowledge?

From the Gricean perspective it seems reasonable to assume that the notion of entailment relevant for the implicature calculation is contextual entailment. The Maxim of Quantity requires the speaker to be as informative as possible. Thus an implicature arises if the speaker used a less informative alternative with respect to other relevant alternatives. But if two alternatives convey the same amount of information given the context, it seems plausible that an implicature is not generated in this situation. However, if we believe that scalar implicatures are generated by the grammatical mechanism, it would not be surprising if the implicature calculation process was blind to the contextual information and took into account only logical information. Moreover, there were claims in the literature arguing that other grammatical modules are sensitive to logical rather than to contextual entailment (see Fox 2000, Fox and Hackl 2006, Magri 2009).

Chierchia, Fox and Spector (2012) present some evidence in favor of the fact that the notion of entailment relevant for the implicature calculation is logical entailment rather than contextual one. Let's briefly illustrate their argument. Consider the following sequence of sentences:

(25)   John has an even number of children. More specifically, he has 3 (children).

They claim that this sequence is contradictory and try to locate the reason of contradictoriness. Intuitively, it seems that the second sentence contradicts the first one, as the second one seems to convey that he has exactly three children and three is clearly not an even number. But if we believe that numerals have an at least semantics, having three kids is compatible with having four kids.

Let's see what the use of the Maxim of Quantity would derive in this case. The Maxim of Quantity requires the speaker to be as informative as possible, and hence if the speaker didn't utter any stronger alternative, it means he is not in a position to utter it, and this leads to the conclusion that he thinks any stronger alternatives are false. But what are

the stronger alternatives for the second sentence in (25)? Logically, the following alternatives are stronger:

(26)   John has 4 kids.

(27)   John has 5 kids....

But are they contextually stronger? In the context where the first sentence in (25) was uttered, the second sentence in (25) and its alternative in (26) are in fact contextually equivalent, they convey the same amount of information, that is that John has four or more children. But if so, the Maxim of Quantity cannot lead to an implicature that John does not have four children. In fact, the only implicature that can be generated is that John does not have five kids, which leads to the meaning "John has exactly four kids". But this meaning does not contradict the first sentence, so we would not be able to predict the incoherence of (25) by using the Gricean reasoning.

If we make an assumption that the process of implicature calculation is sensitive to logical entailment and not to entailment given contextual knowledge, then we would indeed be allowed to negate the logically stronger alternative in (26) and derive the right meaning "John has exactly three kids", which in combination with the first sentence in (25) would lead to a contradiction.

1.6   Obligatory implicatures

One of the characteristics that is commonly assigned to scalar implicatures is their optionality. Consider the following examples:

(28)   John talked to some of his friends. In fact, he talked to all of them.

(29)   John talked to some and possibly all of his friends.

The fact that the sequence of sentences in (28) is not contradictory shows that the calculation of the implicature in the first sentence is not obligatory. The optionality is not surprising from the Gricean point of view, as implicatures arise only in case certain assumptions hold, more specifically, if the speaker is opinionated about the stronger alternative and those alternatives are contextually relevant.

Under what conditions would we use the sequence in (28)? It could be an answer to the following question:

(30)   Did John talk to some of his friends?

(31)   Yes, he talked to some of his friends. In fact, he talked to all of them.

But this is exactly an environment in which the alternative "John talked to all of his friends" is not relevant (as made clear by the question under discussion), that's why the implicature is not generated. In (29) the speaker is not opinionated about the stronger alternative, which is signalled by the use of "possibly", hence the implicature is not generated and no contradiction arises.

A reasonable question to ask is whether we do expect to find cases of obligatory implicatures. It seems that from the Gricean perspective such an option is not predicted. Thus, if we indeed show that such cases exist, that can serve as an argument against (Neo)-Gricean theories and probably an argument in favor of a grammatical theory.

The claim that for certain items implicatures are obligatory was made by Chierchia 2013, Magri 2009, and Spector to appear.

Chierchia (2013) argues that polarity sensitive items (items like *any*) are associated with alternatives which trigger obligatory implicatures and those obligatory implicatures account for the distribution of such items, namely their ungrammaticality in episodic sentences and their licensing in DE and certain modal contexts.

Spector to appear accounts for the distribution of complex disjunctions (items like *soit...soit* in French, *ili...ili* in Russian etc.) appealing to the idea that those items trigger obligatory implicatures.

In this dissertation, we will be concerned with two phenomena which, as we will argue, also represent cases of obligatory implicatures. Before discussing them, let us summarize briefly the necessary assumptions we will be using throughout.

1.6.1   Presence/absence of $\mathcal{E}xh$

The most obvious way to encode the difference between optional and obligatory implicatures is to assume that the exhaustivity operator is optional in case of scalar items that trigger optional impicatures[3] and $\mathcal{E}xh$ is obligatory for items which lead to obligatory implicatures.

Thus, for a sentence with a scalar item *some* in (32), there are two available structures –

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[3] Magri (2009) takes a different perspective on the matter. He argues that the process of implicature calculation is obligatory, which means that the exhaustivity operator is obligatorily present at every scope site. Magri argues that the lack of implicatures in certain cases is not due to the optionality of *exh*, but rather it follows from the fact that alternatives are not relevant. He implements this by constraining the exhaustification operator by a contextually assigned variable R. The value of R is determined by the context on the one hand, but on the other hand, suitable assignments must satisfy certain grammatical postulates. I would like to remain silent on the issue of which is the right way of thinking about the exhaustification operator, but for the purposes of the discussion, I will assume that $\mathcal{E}xh$ is optional.

one with *Exh* as in (33) and this structure gives rise to the exclusivity implicature and the second one without *Exh* as in (34) – this structure does not lead to an implicature and is responsible for cases of cancellation like the one described in (28):

(32)   Some boys arrived.

(33)   *Exh* [Some boys arrived].

(34)   Some boys arrived.

For items that lead to obligatory implicatures (as we will show in Chapter 2, plural is an example of such an item), we will assume that they are obligatorily associated with *Exh*, as shown in (36):

(35)   Boys came.

(36)   *Exh* [Boys came]

(37)   *Boys came.

We will discuss how the presence of *Exh* is enforced in such cases in Chapter 2.

1.6.2   Pruning of alternatives

We will also make certain assumptions regarding what the domain of the exhaustification operator is. So far, the exhaustification operator was defined in the following way:

(38) $[\![\, Exh \,]\!] \, (A_{<st,t>})(p_{<s,t>})(w) \Leftrightarrow p(w) \wedge \forall q : q(w) \vDash p(w) \, [\neg q(w)]$

In other words, it takes a set of formally defined alternatives and negates those alternatives from this set which are stronger than the prejacent.

We are going to add one more assumption, namely that *Exh* can make reference to subsets of formally defined alternatives. We will call a mechanism of eliminating alternatives from a set of formally defined alternatives *pruning*[4] (cf. Fox & Katzir 2007). We will remain silent on the question of how exactly context decides which alternatives can be pruned but we would like to note that there are certain constraints on pruning. For example, one of the constraints which we will make use in the dissertation can be

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[4] Note that unlike Fox and Katzir 2011 who argue that pruning is based on relevance in the actual context (alternatives that are irrelevant in the actual context get pruned), we would like to assume that the pruning mechanism can also prune relevant alternatives as long as it is possible to find at least one potential context in which they can be made irrelevant

formulated as follows: the pruning mechanism cannot eliminate one of the symmetric alternatives[5] without also eliminating the other one. We will talk about pruning, constraints on it and possible ways of deriving those constrains in more detail in Chapter 3 of the dissertation.

For now let me give an example of where the pruning mechanism can be of use. Let's consider the following sentence:

(39)   John or Bill arrived.

The scalar item we are dealing in this case is disjunction. It is common to assume that disjunction has conjunction as its alternative. However, it was argued in certain works (Sauerland 2004) that the set of alternatives should include not only conjunction, but also both disjuncts[6]. If we adopt this assumption, the following problem arises: both disjuncts are stronger than the disjunction, thus they should be negated by the Exh operator, however, negating them would lead to a contradiction. So, the prediction is that uttering disjunction should be impossible, as it leads to contradiction.

(40)   John or Bill arrived and it's not the case that John arrived and it's not the case that Bill arrived and it's not the case that both arrived.

One way out of this problem is to use the pruning mechanism: if we prune individual disjuncts from the set of alternatives, the contradiction can be obviated and the sentence gets the "exclusivity" meaning usually associated with disjunction:

(41)   John or Bill arrived and it's not the case that both arrived.

As we said above, not every pruning is licensed. For example, the following situation is ruled out: we cannot prune one of the disjuncts and leave the second one and conjunction. The constraint we are going to use to rule this out will be discussed in Chapter 3. For now, let's just point out that such a pruning would lead to the meaning which is equivalent to the pruned alternative, and such a situation should be prohibited.

(42)   John or Bill arrived and it's not the case that both arrived and it's not the case that Bill arrived = John arrived.

---

[5] S_1 and S_2 are symmetric alternatives of S if S is equivalent to the disjunction of S_1 and S_2 and S_1 and S_2 contradict each other.

[6] This assumption is needed, for example, to explain why the sentence *Every student talked to Mary or Sue* has the following implicatures: a) It's not true that every student talked to Mary; b) It's not true that every student talked to Sue.

We should note that in order to solve the problem with disjunction, Fox 2007 argued that the exhaustivity operator (*Exh*) should be defined in such a way that it does not lead to a contradiction. He implements it by stating that *Exh* takes into account only "innocently excludable" alternatives. Fox proposes that an alternative to an assertion can be innocently excluded only if it is included in every maximal set of propositions in A such that its exclusion is consistent with the prejacent. Fox's definitions of innocently excludable (IE) alternatives and IE-based *Exh* operator are given below:

(43)   ⟦ *Exh* ⟧ $(A_{<st,t>})(p_{st})(w) = p(w) \wedge \forall q \in$ I-E(p,A) $[\neg q(w)]$

(44)   I-E$(p,A) = \cap \{A' \subseteq A$: A' is a maximal set in A, s.t., A'$^\neg \cup \{p\}$ is consistent$\}$
        A$^\neg = \{\neg p$: $p \in A\}$

In the case of disjunction, there are two such maximal sets: $\{\neg p, \neg(p \wedge q)\}$ and $\{\neg q, \neg(p \wedge q)\}$. The alternative which is included in both sets is p&q, so it is the only alternative which is innocently excludable. That accounts for the absence of the implicatures $\neg p$ and $\neg q$.

The question that arises at that point is what is the right way to go? Do we have to adopt an IE-based version of the *Exh* operator or do we want to stick to its more traditional version in combination with the pruning mechanism in order to account for the cases where implicatures are not calculated?

We are going to choose the second option for the following reason. Our analysis of the facts in Chapter 3 will be crucially based on the idea that the contradiction derived during the implicature calculation can lead to ungrammaticality. If we were to choose the IE-based version of *Exh*, we would never be able to derive a contradiction, as it is defined in such a way as to avoid contradictions. See Chierchia 2013 for a similar idea in relation to the account for NPI/FCI item distribution.

Now, coming back to the question of obligatory implicatures. We would like to think of obligatory implicatures as resulting from the interaction of two different types of constraints on the elimination of alternatives. One we have just mentioned. The other one has to do with the requirements of certain scalar items that are specified as obligatorily activating their alternatives (by that we mean that those alternatives cannot be eliminated from the set of ALT *Exh* operates on).

1.7   Overview

In what follows I focus on particular language phenomena and their relevance for the theory of scalar implicatures.

In Chapter 2, we will examine the behavior of bare plurals. The goal would be to account for why in certain environments they have the "more than one" component, in some other environments (DE) this component disappears and in yet others gets modified in an interesting way. We will show that the multiplicity component associated with plurals is a scalar implicature, moreover, it is an obligatory scalar implicature. A mechanism for deriving this implicature will be proposed, based on Zweig 2008.

In Chapter 3, we will consider number agreement properties of disjunctions. More specifically, we will try to account for the fact that disjunction with two singular disjuncts can lead to plural agreement, but this is only limited to certain environments (DE contexts and quantificational ones). The gist of the analysis we are going to offer is that the plural disjunction triggers two implicatures – the one which is generated by the plural feature; the second one is generated by disjunction. In cases where these two implicatures contradict each other, ungrammaticality arises. We will raise the question of why we do get ungrammaticality rather than implicature cancellation. We will argue that ungrammaticality relates to obligatory implicatures and explain the source of obligatoriness.

The analysis is thus going to capitalize on the assumption that obligatory implicatures do exist. Moreover, we will show that computation of obligatory implicatures may affect sentences' grammaticality. We will also see some support for the modularity hypothesis (implicature calculation will be shown to be blind to non-logical information). All those claims can be made sense of, if one treats implicature calculation as part of the grammar rather than a pragmatic process. In this way the dissertation can be taken as providing more evidence in favor of the grammatical theory of implicatures.

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Chapter 2 Plurals and Multiplicity

The idea to be pursued in this chapter is that the "multiplicity component" in the interpretation of plurals arises as a scalar implicature through negation of a stronger "atomicity" alternative provided by the singular counterpart. While by itself this idea may be not particularly original, I will show that it has non-trivial consequences for our understanding of how exactly scalar implicatures are computed. The discussion will mainly revolve around the theory of bare plurals developed in Zweig 2008. I will offer a modification of Zweig's proposal that gets better empirical coverage, in particular, in what concerns the interaction between bare plurals and quantifiers.

I will start by presenting arguments in favor of viewing the denotation of bare plurals as *weak*, or *number-neutral*, and the "multiplicity component" as a scalar implicature, with particular focus on dependent plurality (Section 2.1). Then I will review the core aspects of Zweig's theory relying on these insights and point at some problematic predictions that it makes (Section 2.2). After that I will propose a modification of Zweig's system designed to deal with the aforementioned problems (Section 2.3). Then I will discuss some novel predictions of the modified system (Section 2.4) and conclude with comparing it to other theories that view the basic meaning of plurals as weak (Section 2.5).

2.1 Multiplicity as a scalar implicature

In this section, I am going to review the main empirical arguments for analyzing bare plurals as number-neutral (cf. Krifka 2003, Sauerland 2003, Sauerland et al. 2005, Spector 2007). Furthermore, preparing the ground for a more technical discussion to follow, I will argue with Zweig 2008, 2009 that the *multiplicity* component in the semantics of bare plurals is a scalar implicature.

2.1.1   "More than one" vs. "one or more"

Let's begin with a simple case. If we take a sentence with an existentially interpreted bare plural, like the one in (45), we tend to infer that more than 1 dog is barking.

(45)   Dogs are barking.

Based on such examples, it could be plausible to assume that the multiplicity component ("two or more"/"more than one") is a part of the denotation of the bare plural. A possible denotation for *dogs* is shown in (46)[7]:

(46) $[\![\text{dogs}]\!] = \lambda P.\exists X\colon X \in D_e\, [\, \text{dog}(X) \wedge |X| > 1 \wedge P(X)]$

This denotation would work for sentences like (45), but it appears to be too strong, if we consider some other cases. One can note that in downward-entailing environments the multiplicity component disappears. For example, (47), where the bare plural is in the scope of negation, is not equivalent to (48), contrary to what we would predict if the multiplicity component was a part of the truth-conditional meaning of the bare plural.

(47)   I didn't see dogs on the beach.

(48)   I didn't see more than 1 dog on the beach.

Rather, (47) is synonymous with (49):

(49)   I didn't see one or more dogs on the beach.

Same point can be made about other downward-entailing (DE) environments, like antecedents of conditionals (50) and restrictors of universal quantifiers (51).

(50)   If I see dogs on the beach, I will report to the police.

(51)   Everybody who sees dogs on the beach, should report to the police.

Another environment where the multiplicity component goes away is *yes/no*-questions[8]. Consider the dialogue in (52)-(53).

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[7] We will discuss different options concerning how the bare plural gets the existential semantics in the appendix.

[8] For the moment, we are leaving the discussion of *wh*-questions, which show an interesting behavior, namely there is a difference between questions containing a single wh-word and other questions, see below:

(i)   Who saw dogs?

(ii)   Which boy saw dogs?

(52)   — Did you see dogs on the beach?

(53)   — Yes, I saw one.

The fact that (53) sounds as a natural answer to (52) shows that the bare plural *dogs* should be treated as being equivalent to "one or more dogs" rather than "more than one dog". If the multiplicity component were the part of the semantics of the bare plural, we would predict (52) to be equivalent to (54):

(54)   — Did you see more than one dog?

But then in a situation where a hearer saw just one dog, the appropriate answer should be (55), contrary to the fact.

(55)   — No, I saw one.

Thus, DE-environments and questions present a challenge for a view which treats bare plurals as having inherent multiplicity component ("more than one") and potentially supports view on which bare plurals are *number-neutral* ("one or more"). An obvious question that arises for such an approach is why we get a strengthened, multiplicity meaning in cases like (45).

Another case where bare plurals behave in a puzzling way is the *dependent plural* reading, which can be illustrated with the following example:

(56)   My three friends attend good schools.

The sentence (56) has a reading, according to which each of my three friends attends one or more good schools (it is not required that any of the friends attends more than one school, in other words, the "more than one" component is not distributed over), but there is an overall multiplicity condition which requires that more than one school be attended overall. In a situation in which the speaker knows that all of his three friends attend the same school, (56) is judged false. In such case (57) should be used.

(57)   My three friends attend a good school.

It seems that in (i) the multiplicity component goes away and the question is equivalent to "who saw one or more dogs", whereas in (ii), there is a multiplicity condition in the presupposition of the question, more specifically, the question seems to presuppose that there is exactly one boy that saw more than one dog and no other boy saw even one dog. How this peculiar pattern is derived is beyond the scope of the current work.

Again, on the one hand, we want to assign "one or more" semantics to bare plurals, but at the same time we need an account of where the overall multiplicity condition comes from.

Zweig (2008, 2009) suggests that the disappearance of the multiplicity component in DE-environments and the overall multiplicity condition associated with dependent plurals have the same source. Namely, he assumes that bare plurals do not have the "more than one" component in their denotation: they are number neutral predicates truth-conditionally and the "more than one" component arises as a scalar implicature, relying on the scalar relationship between the bare plural and its singular alternative. Just like it is the case with other known scalar implicatures, the effect of this particular implicature is wiped out in DE-environments. Accounting for how exactly this implicature comes about is less trivial and will need very specific assumptions about semantic composition and implicature calculation that I will lay out in Section 2.2.

2.1.2   Bare plurals are number-neutral

The idea that bare plurals are number-neutral, i.e. semantically they denote "one or more", is not a new one. On the one hand, it was proposed in earlier works discussing the phenomenon of dependent plurality (Chomsky 1975, Roberts 1990), however, as Zweig (2008) points out, none of those works accounts for the *overall multiplicity condition*.

On the other hand, there is also another body of work including Sauerland 2003, Krifka 2005, Sauerland et al. 2005, Spector 2007 who argue that bare plurals do not contain multiplicity in their denotation, but do so based on the behavior of bare plurals in downward-entailing environments and questions. We will discuss those analyses in more detail in Section 2.5. In anticipation, we will note that none of these authors offered an account of dependent plurals.

As far as I know, Zweig (2008, 2009) was the first one to argue that the two phenomena – the disappearance of the multiplicity in DE contexts and the overall multiplicity condition associated with dependent plurals – are connected and to give a unified account. One piece of evidence in favor of unification comes from the behavior of the overall multiplicity condition associated with dependent plurals in DE environments: it disappears just like it does in non-dependent cases. Consider (58):

(58)   If all my students attend good schools, I will be happy.

(58) does not have a meaning in (59), which shows that the overall multiplicity condition typically associated with dependent plurals is missing if the context is downward-entailing.

(59) #If all my students attend at least one good school and more than one school is attended overall, I will be happy.

Cf. the corresponding upward entailing (UE) sentence in (60), which has the meaning in (61):

(60) All my students attend good schools.

(61) All my students attend at least one good school and more than one school is attended overall.

Throughout the chapter, we will adopt the implementation of the singular/plural distinction in terms of the mereological theory of plurality (the same implementation is used in Zweig 2008, 2009). Following Link 1983, 1998, Hoeksema 1988, Landman 2000, singular NPs are taken to denote atomic individuals and plurals denote sums of individuals. We will use the $*$-*operator* (first introduced in Link 1983) to denote closure of a predicate under the sum operation. As we take bare plurals to be number-neutral, plural denotations include both atoms and non-atoms. In other words, if our domain contains three boys a, b and c, the denotations for *boy* and *boys* are as follows:

(62) $[\![\text{ boy }]\!] = \{a, b, c\}$

(63) $[\![\text{ boys }]\!] = *[\![\text{ boy }]\!] = \{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}$

2.1.3 The multiplicity component is an SI

Now, let's address the question of why whether we do get the "more than one" interpretation or not depends on the polarity: in DE environments, this component of meaning disappears; in UE environments, it is present. This fact is reminiscent of the behavior of scalar implicatures – they do disappear in DE contexts, which makes it plausible to assume that the multiplicity component should be treated as an implicature as well.

Zweig provides more evidence showing that the multiplicity component behaves as a classic scalar implicature, for example, its behavior in non-monotonic environments. As noted by Spector (2007), in non-monotone environments scalar items show an interesting behavior. Consider (64):

(64)   Exactly one student solved some of the problems.

This sentence has a meaning which is shown in (65):

(65)   Exactly one student solved some but not all of the problems and no other student
        solved any problems.

What is interesting about (65) is that the scalar implicature enters the positive part and
does not affect the negative part. If it did affect the negative part as well, we would get the
meaning in (66):

(66)   Exactly one student solved some but not all of the problems and no other student
        solved some but not all of the problems.

That we interpet (64) as (65) rather than as (66) can be shown by the following
scenario. Imagine John and Mary are both students. Mary solved all the difficult problems,
and John solved two of them. No other students solved any difficult problems. In this
scenario, (66) is true, but (65) is false. Speakers tend to judge (64) as false in such a
scenario.

As Zweig notes, we get an absolutely parallel behavior with the multiplicity
component of bare plurals. (67) should be paraphrased as (68) and not as (69):

(67)   Exactly one student solved difficult problems.

(68)   There exists one student who solved more than one difficult problem and no
        other student solved even one difficult problem.

(69)   There exists one student who solved more than one problem.

(69) is true if Bob solved one difficult problem and Mary solved two (and no one else
solved any); but (68) is false in that circumstance.

Now, if we adopt the assumption that the multiplicity condition is derived as an
implicature, we should show how exactly this implicature arises and it turns out to be not
such a trivial task. Let's describe the problem briefly. In order for an implicature to arise,
there should be a scalar relationship between alternatives, namely one of the alternatives
should be stronger than the other one. An obvious alternative to plural is singular. But
there is a problem with an entailment relationship, as the alternatives turn out to be
equivalent. To illustrate this, let's look at a sentence *Boys came*, which can be represented
as (70). A singular alternative is given in (71):

(70)   PL: $\exists X$ [*boy(X) $\wedge$ came(X)]

(71)   SG: $\exists X$ [*boy(X) $\wedge$ atom(X) $\wedge$ came(X)]

Obviously, (71) entails (70). But due to the distributivity of the predicate *come*, (70) also entails (71): the fact that there is a plurality of boys who came entails that there is an atomic boy who came. Thus, two alternatives turn out to be equivalent, and no implicature can be generated.

There were different attempts in the literature to solve this problem: in Sauerland 2003 and Sauerland et al. 2005 it is argued that the multiplicity associated with plurals does not arise as a result of scalar reasoning, but rather as a result of the Maximize Presupposition Principle. Spector 2007 argues that the multiplicity is a scalar implicature, but plural (70) is compared not to singular (71), but rather has a different alternative. Those approaches and problems they pose will be discussed in Section 2.5.

Zweig shows that the problem can be solved by using event semantics. He argues that the necessary scalar relationship does exist before the existential closure of the event argument and this is exactly the level at which the implicature is calculated. In the next section, we will show how exactly this is done.

2.2   Zweig 2008,2009 on bare plurals and their implicatures

As I have already mentioned, Zweig 2008, 2009 presents a unified account for both of the phenomena discussed in the previous section: the disappearance of the multiplicity component under negation and the overall multiplicity condition associated with dependent plurals. Let me first briefly introduce the main components of his proposal, each of which will be discussed in more details in the subsections below.

First, as we have already seen, Zweig assumes that bare plurals do not have the 'more than one' component in their denotation, that is they are number neutral predicates truth-conditionally, but the 'more than one' component arises as a scalar implicature.

Second, based on the similarity between dependent plural readings and cumulative readings (to be discussed in Section 2.2.1), he argues that whatever mechanism accounts for the cumulative readings can be used to account for the dependent plural readings. The crucial observation about cumulative readings is that the noun phrases involved are scopeless with respect to each other, thus Zweig's claim is that dependent plural readings can only arise in case when a bare plural and another element it depends on do not create a scopal dependency between each other. He chooses to use an event-based approach to cumulativity, which we will discuss shortly (Section 2.2.1).

Third, Zweig proposes a method for deriving the multiplicity implicature, which uses Chierchia (2004)'s system of implicature calculation and the assumption that implicatures can be calculated at the event predicate level; this is the level where the necessary scalar relationship between singular and plural alternatives arises (singular is stronger), giving rise to the implicature (see Section 2.2.2).

2.2.1 Events and Cumulativity

It has been noted by many researchers (see, for example, de Mey (1981), Roberts (1990), Beck (2000)) that dependent plurality is very similar to cumulativity. The typical example of a cumulative reading is given in (72):

(72)   Three women gave birth to five babies.

The sentence has a distributive reading, on which each of the three women gave birth to five babies, so in total there were fifteen babies born. But there is also another reading – which says three women were involved in giving birth, and five babies were born in total. This is a *cumulative* reading. One of the characteristics of a cumulative reading is that there is no scopal dependency between two plural DPs.

In case of (72) we can capture the cumulative reading by pluralizing a binary relation *give birth*. In order to do it, we need to generalize a *-operator to 2-place predicates. We will use the definition from Krifka (1986):

(73)   For any R, $[^*R](y)(x) = 1$ iff $R(y)(x)$ or $\exists x1x2y1y2$ $(x=x1+x2)$ & $(y=y1+y2)$ & $^*R(y1)(x1)$ & $^*R(y2)(x2)$

Thus the cumulative reading of (72) can be represented by the following LF:

(74) $\exists X$ $[^*woman(X)$ & $|X|=3$ & $\exists Y$ $[^*baby(Y)$ & $|Y|=5$ & *give birth(X)(Y)]]

For example, if the extension of *give birth* contains <mary, b1+b2 >, <sue, b3+b4>, <claire, b5>, the extension of **give birth* will also contain <mary+sue+claire, b1+b2+b3+b4+b5> and this will verify (74). However, note that this account works only because we are dealing with a pair of commutative quantifiers here – two existentials. A problem will arise in a case where we do get cumulative readings with distributive quantifiers like *every*, as in (75):

(75)   Three copy editors found every mistake in the manuscript.

In brief, the problem is that (75) has a cumulative reading, more specifically, the one that says that three copy editors between them found every mistake in the manuscript. The representation in (76) is not able to capture this reading:

(76)　　$\exists Y$ [three-copy-editors(Y) $\wedge$ $\forall x$[mistake(x) $\rightarrow$ *catch $(Y)(x)$]]

Schein (1993) and Kratzer (2000) argue that those readings present a challenge for event-less theories (but see Champollion 2010 for an opposite view) and thus serve as an argument in favor of event-based approaches. We will discuss such cases in Section 2.3.2.1 in more detail.

In this dissertation, we will follow Zweig and use an event-based approach to cumulativity. As we will see, the use of events gives us a way of deriving the multiplicity implicature associated with bare plurals. Below, I review some necessary assumptions of event-based approaches that we will need to appreciate the discussion to follow.

2.2.1.1　*Assumptions about events*

A common feature of different approaches to event semantics is that verb phrases are interpreted as predicates of *events* that are represented as variables of a special type s.

Once events have been introduced, there are several questions that arise. The first one is what exactly verbal denotations look like. There are different views on that matter. On one view, often called *Davidsonian* (after Davidson 1967), verbs denote relations between events and their arguments, so, for example, the denotation for a transitive verb *love* will look as in (77):

(77)　　a. $[\![\text{ love }]\!]_{\langle e,\langle e,\langle s,t\rangle\rangle\rangle} = \lambda x.\lambda y.\lambda e.\ \text{love}(e)(y)(x)$

　　　　b. $[\![\text{ [John love Mary]}_{vP}]\!]_{\langle s,t\rangle} = \lambda e.\ \text{love}(e)(\text{john})(\text{mary})$

　　　　c. $[\![\text{ [John loves Mary]}_S]\!]_t = 1$ iff $\exists e\ [\ \text{love}(e)(\text{john})(\text{mary})]$

On another view, called *Neo-Davidsonian*, verbs are treated as predicates over events as shown in (78) and arguments are introduced via thematic role predicates (Parsons 1990; Schein 1993):

(78)　　a. $[\![\text{ love }]\!] = \lambda e.\ \text{love}(e)$

　　　　b. $[\![\text{ [John love Mary]}_{vP}]\!]_{\langle s,t\rangle} = \lambda e.\ \text{love}(e) \wedge \text{Agent}(e)=\text{john} \wedge \text{Patient}(e)=\text{mary}$

　　　　c. $[\![\text{ [John loves Mary]}_S]\!]_t = 1$ iff $\exists e\ [\text{love}(e) \wedge \text{Agent}(e)=\text{john} \wedge \text{Patient}(e)=\text{mary}]$

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As you can see, what is assumed in both approaches is that there is a level of event predicate where all the arguments except the event argument have been introduced ((77) or, equivalently, (78)).

Kratzer (2000) takes an intermediate position: she assumes that verbs can denote relations between individuals and events, but the external argument (the Agent) has to be introduced separately.

For now, we will take the Davidsonian position (mostly, for the ease of exposition) and treat verbs as denoting relations between all of their thematic arguments and events (until section 2.3.2, where some arguments in favor of the Kratzerian approach will be introduced).

The second big question has to do with whether event arguments have or do not have to be explicitly realized in the syntax. We will assume that they are and that predicates over events (type $\langle s,t \rangle$) are created at LF via raising of the existential generalized quantifier over events (cf. *existential closure* in Landman 2000), whose semantics is given in (79).

(79) $[\![\exists \varepsilon]\!]_{\langle\langle s,t \rangle,t \rangle} = \lambda P_{\langle s,t \rangle}. \exists e_s [P(e)]$

The quantifier raising leaves a trace of type s and introduces a numerical index that binds it in accordance with the generalized rule of predicate abstraction ((80) below, adopted from Heim and Kratzer 1998: 186). See a sample LF in (81).

(80) Predicate Abstraction Rule (PA)
Let α be branching node with daughters β and γ, where β dominates only a numerical index λ_i. Then, for any variable assignment a, $[\![\alpha]\!]^a = \lambda x. [\![\gamma]\!]^{a[i \to x]}$.

(81) $[\![$ *John arrived* $]\!] = 1$ iff $\exists e_s [$ John arrived in $e]$

S_t

$\exists \varepsilon_{\langle\langle s,t \rangle t \rangle}$ $S_{\langle s,t \rangle}$ PA applies: $[\![S]\!]^g_{\langle s,t \rangle} = \lambda e_s. [\![VP]\!]_t^{g[i \to x]} = \lambda e_s.$ john arrived in e.

λ_7 VP_t

t_{7s} $VP_{\langle s,t \rangle}$

DP_e $V_{\langle e,\langle s,t \rangle\rangle}$

John $\lambda x_e. \lambda e_s. x$ arrived in e.

35
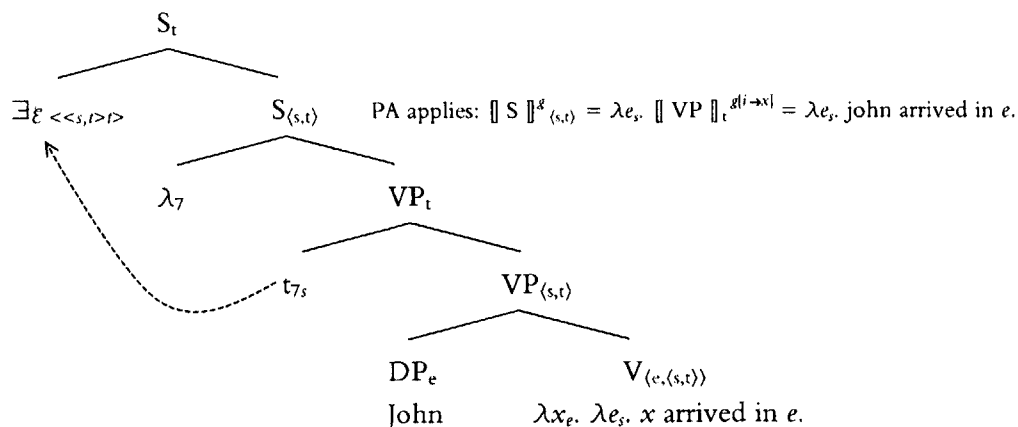
Obviously, the existential quantifier over events can be interpreted in situ, where it would combine with the predicate of the appropriate type $\langle s,t \rangle$. In fact, this is the way existential closure works in Landman 2000. While we don't seem to have an empirical argument for the proposed system with overt event variables and QR (see Kratzer 2000 for some notes on the matter), I will use it here for the purposes of our discussion[9].

2.2.1.2 *Representation of cumulative readings in an event-based system*

In an event semantics the cumulative reading of (72) can be captured in a following way:

(82) $\exists e[\exists X \ \exists Y \ [*woman(X) \wedge |X|=3 \wedge *baby(Y) \wedge |Y|=5 \wedge *give\_birth(e)(x)(y)]]$

Informally, it can be paraphrased as below:

(83)   There were some giving birth events in which three women did birth giving and five babies were born.

Dependent plural readings are similar to cumulative in that there is no scopal dependency between a bare plural and the other plural element. As we already mentioned before, the overall multiplicity component does not get distributed. Thus, it seems plausible to give dependent plural readings a similar treatment. More specifically, the sentence with a bare plural in (84) is given a representation in (85), which can be informally paraphrased with (86):

(84)   Three women gave birth to babies.

(85) $\exists e \exists X \exists Y[*woman(X) \wedge |X|=3 \wedge *baby(Y) \wedge |Y|>1 \wedge *give\_birth(e)(X)(Y)]$

(86)   There were some giving birth events in which three women gave birth and more than one baby was born.

The only difference between cumulative and dependent plural readings is that in case of dependent plurals, the "more than one" part, as we argued in the previous section, is *an implicature*. In the next section, we will provide a mechanism for deriving this implicature.

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[9] It would be straightforward to show in this system that generalized quantifiers over individuals (type $\langle et,t \rangle$) can take scope inside or outside the event predicate. In a system without overt event variables, all other things being equal, only the wide scope of the $\langle et,t \rangle$-quantifiers will be predicted. For a quantifier to take scope inside the event predicate, one would need to introduce a special rule that would shift the type $\langle e,st \rangle$ to $\langle \langle et,t \rangle, st \rangle$, a function that would be able to take the $\langle et,t \rangle$-quantifier as its argument to yield the event predicate $\langle s,t \rangle$ (Landman's (2000) LIFT rule).

2.2.2   Method of deriving the multiplicity implicature

Until now, we have presented several ingredients of Zweig's approach which will be crucial in accounting for the behavior of bare plurals. Let us repeat them once again. Bare plurals are number-neutral predicates, they do not have the "more than one" component in their denotation. The "more than one" component associated with plurals is a scalar implicature. Scalar implicatures are known to disappear in DE environments, that's why in such environments bare plurals lose the multiplicity component. The missing ingredient of the analysis is the method of deriving this implicature. This will be the purpose of this section.

Zweig uses Chierchia 2004 system of implicature calculation. According to Chierchia, implicature calculation process does not only happen at the global level. Thus it is opposed to the classical Neo-Gricean theories. Instead implicatures are computed compositionally and recursively along with the ordinary truth-conditional meaning.

At each calculation point (according to Chierchia, the relevant points are the scope sites – before the addition of each scoping operator), pairs of meanings are generated: the standard one and the enriched one, which is derived by adding the negation of the stronger alternatives to the standard meaning.

Let me show schematically how the system works. Here is an example with the scalar item *two*:

(87)   Every student met two professors.

We have two calculation points in this case: before the universal quantifier is added and after the universal quantifier is added to the structure.

At the first calculation point, before the universal quantifier is added to the structure, we have an LF as shown in (88):

(88) $\lambda y.\exists X[|X| \geq 2 \wedge {}^*professor(X) \wedge {}^*meet(y)(X)]$

We construct a set of alternatives by replacing the scalar item *two* with other elements of the scale associated with *two*. Some members of this set are given in (89)-(91):

(89) $\lambda y.\exists X[|X| \geq 1 \wedge {}^*professor(X) \wedge {}^*meet(y)(X)]$

(90) $\lambda y.\exists X[|X| \geq 3 \wedge {}^*professor(X) \wedge {}^*meet(y)(X)]$

(91) $\lambda y.\exists X[|X| \geq 4 \wedge {}^*professor(X) \wedge {}^*meet(y)(X)]$

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Note that at this level we are dealing with predicates and not with sentence meanings, thus which alternative is stronger is determined based on the set containment. The alternative in (90) is a subset of the set denoted by the alternative containing *two*[10], thus it is stronger (unlike the alternative in (89), which is a superset of the alternative containing *two*). The stronger alternative is negated, and it leads to the following enriched meaning (the set difference of (88) and (90)):

(92) $\lambda y. \exists X[|X| \geq 2 \wedge *professor(X) \wedge *meet(y)(X)] \wedge \neg \exists X [|X| \geq 3 \wedge *professor(X) \wedge *meet(y)(X)]]$

Crucially, we also keep the ordinary meaning[11]. Thus, before the universal quantifier is applied, the pair of meanings looks as follows:

(93) $\langle \lambda y.$ y met two or more professors, $\lambda y.$ y met exactly two professors$\rangle$

Next, we apply *every student* to each of those meanings. When it is applied to the enriched member of the pair, the following meaning is generated:

(94) $\forall y [student(y) \rightarrow \exists X[|X| \geq 2 \wedge *professor(X) \wedge *meet(y)(X)] \wedge \neg \exists X [|X| \geq 3 \wedge *professor(X) \wedge *meet(y)(X)]]$

Applying *every student* to the unenriched member of the pair in (93) leads to the following meaning:

(95) $\forall y [student(y) \rightarrow \exists X[|X| \geq 2 \wedge *professor(X) \wedge *meet(y)(X)]]$

Now, we are comparing (95) to the alternatives generated by replacing the scalar item *two* with other members of the scale associated with *two*, which are shown below:

(96) $\forall y [student(y) \rightarrow \exists X[|X| \geq 1 \wedge *professor(X) \wedge *meet(y)(X)]]$

(97) $\forall y [student(y) \rightarrow \exists X[|X| \geq 3 \wedge *professor(X) \wedge *meet(y)(X)]]$

Note that the alternative in (96) is entailed by (95), thus it is weaker. The alternative in (97), however, entails (95), which means it is stronger than (95). We negate the stronger alternative and get the following meaning:

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[10] Note that this holds only if we take distributivity into account. We will come back to the issue of whether distributivity should be taken into account or not during the implicature calculation process in Section 2.3.1.2.

[11] We will see the relevance of keeping the ordinary meaning when we will discuss DE environments.

(98) $\forall y$ [student(y) $\rightarrow$ $\exists X$ [|X|≥2 ∧ *professor(X) ∧ *meet(y)(X)]]

    ∧ ¬$\forall y$ [student (y) $\rightarrow$ $\exists X$ [|X|≥3 ∧ *professor(X) ∧ *meet(y)(X)]]

In the end of the semantic derivation what we get is a set of possible meanings. In case of (87) this set consists of the meanings we got in (94) and (98), which are represented informally in (100)-(101) and (99), which is the unstrengthened version of (87):

(99)   Every student met two or more professors.

(100) Every student met exactly two professors.

(101) Every student met two professors and it's not the case that every student met three professors.

Chierchia offers the following principle in order to decide which meaning is the right one:

(102) *Strongest Meaning Principle*
       In enriching a meaning, accord preference to the strongest meaning (if there is nothing in the context/common ground that prevents it).

Now, if we compare the meanings in (99), (100) and (101), it will be clear that (100) is stronger, thus it wins as the final sentence meaning.

Let's see what result the system gives for DE environments. Consider the sentence in (103):

(103) No student met two professors.

Again, there are two options: we can either compute the implicature at the first calculation point, namely before the quantifier is introduced, or postpone computing it. If we choose the first option, we will get the same enriched meaning as in (92), and after applying *no student*, we get the first possible meaning for (103), which is shown in (104) (paraphrased in (105)):

(104) ¬$\exists y$ [student(y) $\rightarrow$ $\exists X$[|X|≥2 ∧ *professor(X) ∧ *meet(y)(X)] ∧ ¬$\exists X$ [|X|≥3 ∧ *professor(X) ∧ *meet(y)(X)]]

(105) No student met exactly two professors.

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If we choose the second option, namely if we delay the implicature computation to the next calculation point (after the quantifier is applied), we will have the following structure:

(106) $\neg \exists y$ [student(y) $\rightarrow$ $\exists X[\,|X|{\geq}2 \wedge$ *professor(X) $\wedge$ *meet(y)(X)]]

The set of alternatives is generated:

(107) $\neg \exists y$ [student(y) $\rightarrow$ $\exists X$ [$|X|{\geq}1 \wedge$ *professor(X) $\wedge$ *meet(y)(X)]]

(108) $\neg \exists y$ [student(y) $\rightarrow$ $\exists X$ [$|X|{\geq}3 \wedge$ *professor(X) $\wedge$ *meet(y)(X)]]

The alternative in (107) is stronger than (106), thus negating it results in the meaning in (109) (paraphrased in (110)):

(109) $\neg \exists y$ [student(y) $\rightarrow$ $\exists X$ [$|X|{\geq}2 \wedge$ *prof(X) $\wedge$*meet(y)(X)]]
       $\wedge \neg\neg\exists y$ [student(y) $\rightarrow$ $\exists X$ [$|X|{\geq}1 \wedge$ *prof(X) $\wedge$*meet(y)(X)]]

(110) No student met two or more professors but there are students who met one professor.

The Strongest Meaning Principle (102) makes us compare (104) and (109) and choose the strongest one. In this case it is (109), and thus it wins as the sentence meaning.

Zweig notes that as Chierchia's system allows for implicature calculation to take place at scope points, it is reasonable to assume that the event predicate level provides one more site for the implicature calculation. We will see why this is a crucial ingredient of the proposal in the next section.

2.2.3   How the system works

In the previous section we introduced all the necessary ingredients of Zweig's analysis. In this section we will demonstrate how the facts presented in 2.1.1 are captured by the system.

2.2.3.1   *Accounting for the multiplicity in simple sentences*

The first observation we need to account for is why a bare plural ends up getting a "more than one" meaning in sentences like (111):

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(111) Dogs are barking.

In Section 2.1 it was shown that bare plurals have a number-neutral semantics, and thus (111) can be represented as having the following LF:

(112) $\exists e \exists X[*dog(X) \wedge *bark(e)(X)]$

Note that (112) is compatible with a scenario in which just one dog is barking. We also showed that the multiplicity component associated with a bare plural is a scalar implicature. What we need to demonstrate now is how exactly this implicature comes about. The most obvious thing to do is to check what would happen if we were to calculate the implicature at the sentence level. In order to derive an implicature, we first need to determine what an alternative to (112) looks like. It is reasonable to assume that the bare plural *dogs* has a singular form *a dog* as its alternative. So, the alternative to (112) looks as follows (remember that we assumed that singular asserts atomicity):

(113) $\exists e \exists X[*dog(X) \wedge atom(X) \wedge *bark(e)(X)]$

As already sketched in 2.1.3, the two alternatives entail each other. It is obvious that (113) entails (112). But on the other hand, (112) entails (113). Let's demonstrate it more explicitly. Imagine a situation in which two dogs A and B are barking. (112) is true in this situation – there is an event of barking, the agent of which is a plurality of dogs (namely, A and B). But (113) is true in this situation as well. Due to the distributive nature of the predicate *bark*, if there is an event of two dogs barking, then there are also events with atomic dogs as agents, namely an event where A is barking and an event where B is barking. Each of these events verifies (113).

Thus, we showed that the singular alternative is equivalent to the plural one and cannot be negated, which means the process of implicature calculation is vacuous at that level – the enriched meaning of (111) is equivalent to its unenriched meaning in (112). Thus it is predicted that (111) must be true in a situation in which only one dog is barking, whereas in fact it is not judged as true in such a situation.

But, as Zweig points out, there is one additional site for the implicature calculation, namely before the existential closure of the event variable. At that level the sentence denotes (114) and its singular alternative is as in (115):

(114) $\lambda e. \exists X[*dog(X) \wedge *bark(e)(X)]$

(115) $\lambda e. \exists X [*dog(X) \wedge atom(X) \wedge *bark(e)(X)]$

Both (114) and (115) denote sets of events and it can be shown that the set in (115) is a subset of (114). If an event belongs to the set in (115), it automatically belongs to the set in (114) ((115) contains events with atomic agents, whereas (114) contains events with both atomic and non-atomic agents). However, the opposite is not true. Consider an event in which two dogs A and B are barking. This event, which has a plural agent, belongs to the set in (114), but it does not belong to the set in (115), as (115) only contains events with atomic agents. The crucial assumption we are making use of at that point is that each event has a unique agent (Landman 2000). Thus, if an event has a plural entity as its agent, it is not true that atomic parts of this plural entity are also considered agents of this event.

We showed that (115) is a subset of (114), so we exclude it and get the following enriched meaning:

(116) $\lambda e.\exists X[*dog(X) \wedge *bark(e)(X)] \wedge \neg\exists X[*dog(X) \wedge atom(X) \wedge *bark(e)(X)] =$
$= \lambda e.\exists X [*dog(X) \wedge |X|>1 \wedge *bark(e)(X)]$

Applying the existential closure (our existential quantifier over events) gives us the following meaning:

(117) $\exists e\exists X[*dog(X) \wedge |X|>1 \wedge *bark(e)(X)]$

(117) correctly captures the meaning of (111).

So as we have just shown, we get the right meaning for sentences like (111), if we calculate the implicature before the existential closure of the event argument, namely at the event predicate level. The question that arises is what forces us to calculate the implicature at this level, in other words, is there any principle which blocks implicature calculation at a later stage.

In Zweig's system no such principle is needed, as he uses Chierchia's mechanism of implicature calculation, where at every scopal point the derivation splits into two branches – one where the implicature is calculated and the second one where it is not. If it was not calculated at the first level, it has an option of being calculated at the next calculation point etc. In the end we have a set of meanings, among which the strongest one is chosen.

Let's come back to our sentence in (112). The first calculation level is the event predicate level. The derivation splits into two branches: the first one gives the enriched meaning shown in (118); the second one is the usual unenriched meaning (119):

(118) $\lambda e.\exists X [*boy(X) \wedge |X|>1 \wedge *came(e)(X)]$

(119) $\lambda e.\exists X [*boy(X) \wedge *came(e)(X)]$

Trying to calculate an implicature at the next level, namely after the event closure, does not change anything, since, as we showed above, at that level the alternatives become equivalent, so the implicature cannot be generated.

So in the end we have a set of meanings consisting of (120) and (121):

(120) $\exists e \exists X[*boy(X) \wedge |X|>1 \wedge *came(e)(X)]$

(121) $\exists e \exists X [*boy(X) \wedge *came(e)(X)]$

The Strong Meaning Principle makes us choose the stronger meaning, namely the meaning in (120), as a final sentence meaning.

2.2.3.2   *DE-entailing environments*

Let's now see what happens in downward-entailing sentences like (122):

(122)   It is not the case that dogs are barking.

Before proceeding to the derivation, we should note that we adopt a common assumption that negation outscopes the event quantifier (cf. Schein 1993, Landman 2000).

There are three possible places to calculate an implicature: below the event closure, above the event closure and above the negation. Before event closure applied, we have the same event predicate, as we had for the corresponding positive sentence in the previous section, and thus we get the same enriched meaning at that level, shown in (123):

(123) $\lambda e.\exists X[*dog(X) \wedge |X|>1 \wedge *bark(e)(X)]$

After we apply existential closure and negation, we get the first potential meaning:

(124) $\neg \exists e \exists X[*dog(X) \wedge |X|>1 \wedge *bark(e)(X)]$

If we chose the second path, namely if we didn't calculate the implicature at the event predicate level and postponed it to the point after the existential closure applied, it wouldn't change anything, as after the event closure happened, the singular and plural alternatives become equivalent and no implicature is generated. That would give us the second possible meaning for our sentence:

(125) $\neg \exists e \exists X[*dog(X) \wedge *bark(e)(X)]$

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We also have an option to choose the third path and postpone the implicature calculation to the point after negation applied, but this will give us the meaning identical to the one we got in (125), as there would be no stronger alternative at that level and no implicature can be generated.

The Strong Meaning Principle makes us compare the meanings in (124) and (125) and choose the stronger one. It is obvious that (125) is stronger than (124), as (124) rules out scenarios in which more than 1 dog is barking, whereas (125) rules out scenarios in which any number of dogs are barking. Thus, (125) is chosen as the final sentence meaning, and in such a way the absence of the multiplicity condition in DE contexts is accounted for.

2.2.3.3 Dependent plural readings

Finally, let's turn to sentences that contain another plural argument and show how Zweig's system accounts for dependent plural readings these sentences can get. First, we should note that sentences with plural arguments (definite or indefinite DPs) are ambiguous: they can get either a cumulative or a distributive interpretation. For example, (126) can be interpreted as either (127) or (128):

(126) Two boys wrote three books.

(127) *Cumulative reading*: two boys were involved in writing, and three books were written in total.

(128) *Distributive reading*: two boys each wrote three books.

In the previous section, we discussed how the cumulative interpretation is captured. As for the distributive one, Zweig assumes that it arises due to an insertion of a silent distributive operator.

What we will show below is that dependent plural readings arise only when plural DPs are interpreted non-distributively. When a plural DP gets a distributive interpretation, the multiplicity gets distributed as well. Let's discuss those cases in turn.

Consider (129):

(129) My three friends attend good schools.

First, let's consider a non-distributive reading of the DP "my three friends". At the event predicate level we have the following:

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(130) $\lambda e.\exists Y[*good\_school(Y) \land *attend(e)(\sigma^{12}*X(my\_friend(X)))(Y)]$

   (Presupposition: $|\sigma*X(my\_friend(X))|=3$)

We compare it with the singular alternative in (131), in which the bare plural *good schools* is replaced with a singular form *a good school*:

(131) $\lambda e.\exists Y[*good\_school(Y) \land atom(Y) \land *attend(e)(\sigma*X(my\_ friend(X)))(Y)]$

   (Presupposition: $|\sigma*X(my\_friend(X))|=3$)

By the same logic we used in Section 2.2.3.1 for the simple sentence, (131) is stronger than (130), so it is negated, and the following meaning arises:

(132) $\lambda e.\exists Y[*good\_school(Y) \land |Y|>1 \land *attend(e)(\sigma*X(my\_friend(X)))(Y)]$[13]

   (Presupposition: $|\sigma*X(my\_friend(X))|=3$)

After existential closure is applied, we get the following:

(133) $\exists e.\exists Y[*good\_school(Y) \land |Y|>1 \land *attend(e)(\sigma*X(my\_friend(X)))(Y)]$

   (Presupposition: $|\sigma*X(my\_friend(X))|=3$)

This is the first potential meaning for our sentence in (129). However, there is also a second option: we can postpone the implicature calculation to the later point, namely after event closure happened. Zweig argues (p.130 in his dissertation) that if we were to calculate the implicature above the event closure, no enrichment would ever take place, as the two alternatives would be equivalent, just as we saw for the sentence in (111). However, it seems that this is not right. Let's look at (134) and its singular alternative in (135):

(134) $\exists e\exists Y [*good\_school(Y) \land *attend(e)(\sigma*X(my\_friend(X)))(Y)]$

(135) $\exists e\exists Y [*good\_school(Y) \land atom(Y) \land *attend(e)(\sigma*X(my\_friend(X)))(Y)]$

It is obvious that (135) entails (134). But it is not true that (134) entails (135). Imagine the following scenario: I have three friends A; B and C. A attends school a; B attend school b; C attends school c. Then there is an event satisfying the condition in (134) in which my friends A⊕B⊕C attend good schools $a⊕b⊕c$, but there is no event satisfying

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[12] This LF makes use of Link's σ–operator, which in this case maps the individuals in the set denoted by *my friend* to their supremum.

[13] I omit some intermediate steps of the calculation.

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(135): there is no single school which all of the three friends attend. So (135) is stronger than (134), thus it is negated, and the following meaning arises:

(136) $\exists e.\exists Y[*good\_school(Y) \wedge *attend(e)(\sigma^*X(my\_friend(X)))(Y)]$ $\wedge$

$\neg\exists e.\exists Y[*good\_school(Y) \wedge atom(Y) \wedge *attend(e)(\sigma^*X(my\_friend(X)))(Y)]$

(Presupposition: $|\sigma^*X(my\_friend(X))|=3$)

The meaning in (136) is stronger than the meaning in (133). Let's consider the following scenario. Suppose that all of my three friends attend two schools, a morning school and an afternoon school. They all attend the same afternoon school but different morning schools. The empirical question is whether the sentence in (129) is true in this scenario. Note that this scenario is compatible with (133), but ruled out by (136), as (136) requires that there is no event in which the three friends attend the same school.

As (136) is stronger than (133), Zweig's system predicts that (136) should become a final sentence meaning and (129) must be judged false in the scenario discussed above. However, it seems to me that the sentence is not false in this scenario, which shows that the reading in (133) is available. If this is indeed so, then cases of this sort are problematic for Zweig's system.

Let's consider a second possible reading of (129). As we pointed out in the beginning of the section, sentences with plural indefinite and definite DPs also lead to distributive readings. Zweig captures the distributive reading of (129) by introducing a silent distributive operator that quantifies over atomic parts, as shown in (137)[14]. Note that the minute we introduce the distributor, the DP has to be interpreted above the event quantifier (due to the uniqueness of thematic roles, as we will demonstrate more explicitly in the next section):

(137) $\forall x \leq \sigma^*X(my\_friend(X)) \wedge atom(x) \rightarrow \exists e\exists Y [*school (Y) \wedge *attend (e, x, Y)]$

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[14] Note that this is not an uncontroversial assumption. Certain authors (see Kratzer 2004, for example) assume that the source of distributive readings in sentences with plural DPs is a star operator on its sister node. Thus the distributive interpretation of (129) can be captured in the following way:

(iii) $*(\lambda x \lambda e\exists Y [*school(Y) \wedge *attend (e, x, Y)]) (\llbracket my\ friends \rrbracket)$

If the *-operator is the right way of deriving distributive readings, then we wouldn't get the distributed multiplicity, unlike what we get in (137). The singular alternative to (iii) looks as shown below:

(iv) $*(\lambda x \lambda e\exists Y [*school(Y) \wedge atom(Y) \wedge *attend(e, x, Y)]) (\llbracket my\ friends \rrbracket)$

Negating it leads to the following meaning:

(v) $*(\lambda x \lambda e\exists Y [*school (Y) \wedge |Y|>1 \wedge *attend (e, x, Y)]) (\llbracket my\ friends \rrbracket)$

Note that (v) covers the dependent plural reading.

If we were to calculate an implicature at the level of the lower event predicate, we would trap the multiplicity below the subject. Let's show it explicitly. The lower event predicate looks as follows:

(138) $\lambda e.\exists Y$ [*school(Y) $\wedge$ *attend(e, x, Y)]

The singular alternative to (138) is shown in (139):

(139) $\lambda e.\exists Y$ [*school (Y) $\wedge$ atom(Y) $\wedge$ *attend (e, x, Y)]

(139) is stronger than (138), thus negating it leads to the following meaning:

(140) $\lambda e.\exists Y$ [*school (Y) $\wedge$ |Y|>1 $\wedge$ *attend (e, x, Y)]

After we apply existential closure and the universal quantifier, we get (141):

(141) $\forall x \leq \sigma$*X(my_friend(X)) $\wedge$ atom(x) $\rightarrow$ $\exists e \exists Y$[*school(Y) $\wedge$ |Y|>1 $\wedge$ *attend(e, x, Y)]

(141) gives us the distributed multiplicity, namely, it requires that each of the three friends attend more than one school. Other derivations would be identical to the unenriched meaning in (137), as after the event closure happened, the singular and the plural alternatives become equivalent and the implicature cannot be generated (similar to what we saw with (111) in Section 2.2.3.1). Thus, the strong meaning principle will make us choose (141) as the final sentence meaning.

Above we considered dependent plural readings with sentences containing plural definite DPs. We should note that indefinite DPs (which we assume have the denotation as the one shown in (142) for *three friends*) function in a similar fashion – we would get the dependent plural reading if an indefinite DP is interpreted non-distributively and we would get the distributed multiplicity if the indefinite DP is interpreted distributively.

(142)   [[three friends]] = $\lambda P.\exists X$ [*friend(X) $\wedge$ |X|=3 $\wedge$ P(X)]

2.2.3.4   *Absence of dependent plural readings with every*

As was noted by de Mey 1981, bare plurals in the scope of a universal quantifier *every* do not give rise to dependent plural readings. Let's look at (143):

(143)   Every dentist has scary chairs.

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(143) can only mean that each of the dentists has more than one chair. This fact is not very surprising in light of the fact that universal quantifiers do not lead to cumulative readings either.

(144) Every dentist has five scary chairs.

(144) can only mean that each of the dentists has five chairs. It cannot mean 'every dentist has at least one chair and overall five chairs are involved'.

Just to repeat once again what we showed in the previous section, in Zweig's system dependent plural readings can only arise if there is no distributive operator involved (see Section 2.2.3.3 for more details).

Now, Zweig, following Landman 2000 and Schein 1993, assumes that quantifiers have a traditional semantics, they are elements of type $\langle\langle e,t\rangle,t\rangle$. The denotation for *every dentist*, for example, is as given in (145):

(145) [[every dentist]] = $\lambda P.\forall x$ [dentist(x) → P(x)]

He also claims that singular universal quantifiers cannot be interpreted below the event predicate, i.e. they must always scope above the event quantifier (namely, the only available LF for (143) is (146) – (147) is ruled out):

(146) $\forall y$ [dentist(y) → $\exists e\exists X$ [*chair(X) ∧ *has(e)(y)(X)]]

(147) * $\exists e\forall y$ [dentist(y) → $\exists X$ [*chair(X) ∧ *has(e)(y)(X)]]

The fact that the LF in (147) is ruled out can be given an independent motivation. Since roles are required to be unique (Landman 2000), this means that it is impossible for several dentists to be both, separately, the agents of the event, as (147) requires. Thus, (147) leads to a contradiction except for the special case where there is exactly one dentist.

If (146) is the only possible LF for (144), the fact that *every* does not lead to dependent plural readings is easily captured. Let's see how.

First let's check what will happen if we calculate the implicature below the event closure. The event predicate in (148) has a singular alternative in (149), which is stronger, thus if we negate it, we will get the meaning in (150). And after the quantifier is applied, the whole sentence will get the meaning in (151), which is a non-dependent plural meaning: every boy read more than 1 book.

(148) $\lambda e.\exists X$ [*book(X) ∧ *read(e)(y)(X)]

(149) $\lambda e.\exists X\ [^{*}\text{book}(X) \land x \text{ is atomic} \land {}^{*}\text{read}(e)(y)(X)]$

(150) $\lambda e.\exists X\ [^{*}\text{book}(X) \land |X|>1 \land {}^{*}\text{read}(e)(y)(X)]$

(151) $\forall y\ [\text{boy}(y) \rightarrow \exists e \exists X\ [^{*}\text{book}(X) \land |X|>1 \land {}^{*}\text{read}(e)(y)(X)]$

If we were to calculate the implicature above the event closure, we would again see that the two alternatives, which are given in (152)-(153), become equivalent, thus no implicature is generated and the sentence is predicted to mean "for every boy x, x read one or more books". The Strong Meaning Principle makes us choose the meaning in (151).

(152) $\exists e \exists X\ [^{*}\text{book}(X) \land {}^{*}\text{read}(e)(y)(X)]$

(153) $\exists e \exists X\ [^{*}\text{book}(X) \land X \text{ is atomic} \land {}^{*}\text{read}(e)(y)(X)]$

2.2.3.5   *Quantifiers like all and most: a problem for Zweig's theory*

Zweig's theory relies crucially on the similarity between dependent plural and cumulative readings, and Zweig's claim is that dependent readings, just like cumulative readings, arise only when there is no scopal dependency created between a bare plural and another plural. However, there are certain cases where the similarity between dependent plural and cumulative readings breaks down and such cases present a challenge to this approach.   More specifically, the sentences with *all*-DPs and *most*-DPs do allow for dependent plural readings, but do not give rise to cumulative readings. Let's look at the sentences in (154)-(155):

(154)   All the boys attend good schools.

(155)   All the boys attend five good schools.

The sentence in (154) has a dependent plural reading, namely the one which says that each of the boys attends at least one good school and overall more than one school is attended.

However, the corresponding sentence with a numeral instead of a bare plural does not have a cumulative reading[15] – (155) cannot mean 'each of the boys attends at least 1

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[15] We will discuss the issue of availability of different types of readings for *all* with different types of predicates in Section 2.3.2.3.

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good school and overall 5 schools are attended'. It can only have a distributive reading — for each of the boys there are 5 schools he attends.

So we can describe the problem with *all* in the following way. If we were to say that *all* is a distributive quantifier, just like *every*, then the absence of the cumulative readings would not be surprising, however, we would also make an incorrect prediction that dependent plural readings should be unavailable.

If we were to give a semantics to *all* which does not contain the distributive quantifier part, then we would be able to account for dependent plural readings, but the lack of cumulative readings would be mysterious.

Zweig is aware of this problem and he offers a solution, choosing the second option we described above. He assumes that *all* is not a distributive quantifier. Rather he gives it a denotation, which is similar to the denotation of existential quantifiers[16], as shown in (156) (compare it to the denotation of the numerical DP in (158)):

(156) $[\![$ all the boys $]\!] = \lambda\phi.\ \exists X[\,|X| = |\text{boy}|\ \wedge\ {}^*\text{boy}(X)\ \wedge\ {}^*\phi(X)]$

(157) $[\![$ all the boys $]\!] = \lambda\phi.\ \exists X[\,|X| = |\text{boy}|\ \wedge\ {}^*\text{boy}(X)\ \wedge\ \phi(X)]$

(158) $[\![$ three boys $]\!] = \lambda\phi.\ \exists X[\,|X| = |3|\ \wedge\ {}^*\text{boy}(X)\ \wedge\ \phi(X)]$

The proposed difference between *all the boys* and the numerical DP *three boys*, in addition to the cardinality, is that *all* obligatorily pluralizes the predicate to which it is attached, as shown by a star operator on the predicate in (156), and he argues that this is exactly this obligatory pluralization that accounts for the lack of cumulative readings with *all*. But this solution does not work technically. As Champollion points out in his dissertation, pluralizing the predicate in (156) does not rule out the cumulative interpretation. Pluralizing the predicate extends the original extension. Therefore, the denotation in (156) is a superset of (157) and any verb phrase whose denotation is contained in (157) is also contained in (156). Thus there is nothing in the denotation of (156) that would block the cumulative interpretation (the problem is that the *-operator does not distribute down to atoms and this is exactly would be needed for ruling out cumulative readings).

In the next section, I would like to offer a different solution to the puzzle discussed in this section. The solution will be based on three modifications of Zweig's analysis. First,

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[16] An equivalent but probably more appropriate formalization that makes it similar to the definite DP 'the boys' is given below:

(vi) $[\![$ all the boys $]\!] = \lambda\phi.\ {}^*\phi(\sigma^*\text{boy})$

we will modify the assumptions on the implicature calculation process. I will argue that we should drop Chierchia's system of the implicature calculation, which requires implicatures be calculated as locally as possible, as long as it does not weaken the overall meaning. Instead, I will argue that implicatures can be calculated at any level and the choice between meanings we get at different levels is not regulated by the strong meaning principle. Second, I will argue, following Schein 1993 and Kratzer 2000, that quantifiers should be given a more complex denotation. Third, I will offer a new denotation for *all*. Finally, it will be shown how putting all those assumptions together accounts for the fact that sentences with *all* give rise to dependent plural readings. The moment we drop the assumption that implicatures must be calculated as locally as possible, we will be able to account for the fact that *all* gives rise to dependent plural readings by giving it a denotation that contains a universal quantification part and thus accounts for a number of facts, which show that *all* is a distributive quantifier, including the absence of cumulative readings.

2.3   A new look on dependent plurals and quantifiers

2.3.1   New assumptions on Implicature Calculation

According to Chierchia's system, scalar items enter the sentence meaning both with its plain and enriched meaning. By default the strong meaning is used unless we are dealing with cases of implicature cancellation (when the alternative is not relevant or the speaker is uncertain whether it's true or not).

Such a view on the implicature calculation process is potentially problematic. The main problem for this view is that it does not predict global implicatures in sentences that contain several scalar items (see also Chierchia, Fox and Spector 2012).

Let's just give several empirical facts that point into the direction that implicature calculation must not always be local. First, consider (159):

(159)   You must read some of the books.

(160)   You must read some but not all of the books.

Chierchia's system predicts (159) to get the meaning in (160), however, as noted in Chierchia, Fox and Spector 2012, even if this reading exists, it is much less natural than the other reading, which says "you must read some of the books and you are not required to read all of the books".

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A similar point was made about sentences with scalar items in the scope of *every* like (161):

(161)   Every boy read some of the books.

Sentences like (161) were argued to have a reading given in (162), which is weaker than the one that is predicted by the Strong Meaning Principle, shown in (163) – the reading which can be captured by calculating the implicature at the global level. The reading in (163) is much harder to get, as was confirmed experimentally in Chemla and Spector 2010.

(162)   Every boy read some books but it is not the case that every boy read all of the books.

(163)   Every boy read some but not all of the books.

Taking into account the problems discussed above, it seems reasonable to abandon Chierchia's (2004) view of implicature calculation. Let's instead assume, following Fox 2007, that implicatures are brought about by a covert exhaustivity operator *Exh* akin to *only* (see discussion in Chapter 1). This operator takes a proposition, called the prejacent, and a set of alternatives and asserts the prejacent and negates all the alternatives that are stronger than the prejacent. Thus, if we have a sentence (164) with a scalar item *some* and assume that *some* has *all* as an alternative, the result of applying *Exh* to (164) will be as shown in (165):

(164)   John ate some of the cookies.

(165) $[\![$ *Exh* [John ate some of the cookies] $]\!]$ = 1 iff John ate some of the cookies and didn't eat all of the cookies.

Now, the prediction is that sentences with several scalar items should have different possible interpretations depending on where the exhaustification operator is inserted. For example, for (166) we can imagine two possible structures – one with *Exh* inserted at the root level as in (167) and the second one with *Exh* inserted below the universal quantifier. as in (168):

(166)   Every boy did some homework.

(167)   *Exh* ($[\![$ Every boy did some homework$]\!]$) = 1 iff every boy did some of the homework but it is not the case that every boy did all of the homework.

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(168) [[Every boy]] $(\lambda x.$ $\acute{E}xh$ ([[did some homework]] $(x)))$ = 1 iff every boy did some and not all of the homework.

As we already mentioned in Chapter 1, the application of $\acute{E}xh$ is not completely free. We adopted a following simplified version of Fox and Spector 2009's constraint:

(169) $\acute{E}xh$ is not allowed to weaken the overall meaning (a sentence with $\acute{E}xh$ cannot be entailed by the minimal modification in which $\acute{E}xh$ is deleted).

Let's look at the sentence in (170). If we were able to apply $\acute{E}xh$ under negation, we would predict the sentence to have the meaning in (171). However, this reading is not available.

(170) Sue didn't talk to John or Bill.

(171) [[NOT [$\acute{E}xh$ [Sue talked to John or Bill]]] =
       = [[Sue didn't talk to John or Bill and not both]] =
       = [[John either talked to neither John or Bill or to both]].

Note that the exhaustified meaning in (171) is weaker than the unexhaustified meaning in (170), thus inserting $\acute{E}xh$ weakens the overall meaning, and this is ruled out by (169).

2.3.1.1   A note on obligatoriness of the multiplicity implicature

Zweig assumes that the multiplicity component associated with plurals behaves as a run-of-the mill implicature, namely it can be cancellable. But it seems that this component does not behave as traditional scalar implicatures do in certain environments, more specifically, it is harder to cancel it in some of the environments in which other implicatures get cancelled.

To show this, let's compare the behavior of the multiplicity condition and the implicature associated with a scalar item *some* in a context where the alternative giving rise to the implicature is made irrelevant.

(172) Context: In order to graduate from this department, you need to meet regularly with some of the professors.
       A: Do you think John will graduate?
       B: Yes, he talked regularly to some of the professors. More precisely, he talked to all of them.

(173) Context: In order to graduate from this department, students are required to meet
       regularly with professors.

    A: Do you think John will graduate?

    B: #Yes, he talked to professors regularly. More precisely, he talked to just one.

The fact that B's answer in (172) is not contradictory shows that the implicature associated with *some* can be cancelled. However, B's answer in (173) sounds contradictory, which shows that the implicature associated with plural cannot be cancelled in the same environment.

Another environment where implicatures get cancelled is when the speaker is ignorant about whether the stronger alternative is true.

Again, the fact that the implicature associated with *some* can be cancelled when the speaker is ignorant about the stronger alternative is demonstrated by the following example:

(174) John talked to some and possibly all of the students.

Zweig points out that the same holds for the multiplicity implicature in dependent plural sentences:

(175) All his friends attend good schools, possibly the same one.

I think we can come up with contexts where this will also happen in simple sentences:

(176) Context: The speaker comes into the house and sees children toys all over the
       place.

    A: There are children in the house.

In (176) the speaker does not obviously know whether it is just one kid or more than one, but still the sentence with a bare plural seems appropriate in this context.

Now, if we take the facts in (172)–(173) as showing that there is a difference between a multiplicity implicature and other implicatures, we should find a way to encode this difference in the implicature calculation system. But note if there is really a difference between cases where the singular alternative is irrelevant (the multiplicity is obligatory in this case) and when the speaker is ignorant about whether the singular alternative is true

(the multiplicity seems to be cancellable), then we should give an account of what is going on in the ignorance cases[17].

In Zweig's system a way to encode the difference between obligatory and optional implicatures would be to assume that in case of obligatory implicatures the strong meaning principle is obligatory, meaning the implicature is calculated at every level, as long as it does not weaken the overall meaning. I would like to argue that this is not the right way to think about obligatory implicatures. I will present my take on obligatory vs. optional implicatures distinction in the next section.

2.3.1.2 Obligatory vs. optional implicatures

Now, when we have a distinction between scalar items (like *some* or *or*) that lead to optional implicatures and scalar items (like *plural*) that lead to obligatory implicatures, we need to find a way to incorporate this distinction into the implicature calculation system. Let us summarize briefly the necessary assumptions we will be using throughout.

We will assume that unlike items that trigger optional implicatures, items that trigger obligatory implicatures are obligatorily associated with exh. For example, for a sentence with plural in (177), the only available structure is the one in (178) (the exh-less one in (179) is out):

(177) Boys came.

(178) *Exh* [boys came]

(179) *Boys came.

Second, as we discussed in Chapter 1, we are taking a view on *Exh* according to which *Exh* can make reference to subsets of formally defined alternatives. In other words, we can prune alternatives from the set *Exh* operates on. Thus, we should rule out a situation when an item which leads to an obligatory implicature is in the scope of *Exh*, but the restrictor of *Exh* is empty (meaning the alternatives were pruned).

We will assume that items that lead to obligatory implicatures (items like plural) must be in the scope of the exhaustivity operator and moreover the restrictor of *Exh* must obligatorily contain the singular alternative, in other words, the singular alternative cannot

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[17]In the end we would like to say that the ignorance cases should be treated as cases of obligatory implicatures which are derived by exhaustifying above the silent universal epistemic modal. The mechanism for deriving this implicature should be the same as the one which derives Sauerland's readings (see Section 2.4.4 for details).

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be pruned. Thus, for plural, for example, there is only one possible structure shown in (180); the option in (181), where the singular alternative is pruned, is not available:

(180) $[\![\mathcal{E}xh_{\{SING\}}[\text{P-PLUR are Q}]]\!] = [\![\text{P-PLUR}]\!]([\![Q]\!]) \wedge \neg [\![\text{P-SING}]\!]([\![Q]\!])$

(181) $[\![\mathcal{E}xh_{\{\emptyset\}}[\text{P-PLUR are Q}]]\!] = [\![\text{P-PLUR}]\!]([\![Q]\!])$

More specifically, we will state the following requirement for the scalar item *plural*:

(182) Plural must be c-commanded by the exhaustification operator, whose restrictor contains the alternative obtained by replacing plural with the singular.
        $[\mathcal{E}xh_{\{SING\}}[...\text{-PLUR} ...]]$

With those assumptions at hand, let's see how we can capture the basic cases. Let' s start with a sentence in (183):

(183) Dogs are barking.

There are two possible sites for the insertion of the exhaustification operator: below the event closure and above the event closure. If we were to apply $\mathcal{E}xh$ at the lower level, namely at the level of the event predicate, we would derive the multiplicity, just like Zweig did. At that level, the sentence denotes (184) and the singular alternative looks as is shown in (185):

(184) $\lambda e.\exists X [*\text{dog}(X) \wedge *\text{bark}(e, X)]$

(185) $\lambda e.\exists X [*\text{dog}(X) \wedge \text{atom}(X) \wedge *\text{bark}(e, X)]$

The singular alternative is stronger, thus applying the exhaustification operator at that level returns the following result:

(186) $\mathcal{E}xh (\lambda e.\exists X [*\text{dog}(X) \wedge *\text{bark}(e, X)]) = \lambda e.\exists X [*\text{dog}(X) \wedge |X| > 1 \wedge *\text{bark}(e, X)]$

After closing the event argument, we get the following meaning:

(187) $\exists e \exists X [*\text{dog}(X) \wedge |X| > 1 \wedge *\text{bark}(e, X)]$

(187) correctly captures the meaning of (183).

But now we also have a second option, namely we can apply the exhaustification operator at the event closure level. Just to remind, at that level the sentence denotes (188):

(188) $\exists e \exists X$ [*boy(X) $\land$ *came(e, X)]

The singular alternative is as shown in (189):

(189) $\exists e \exists X$ [*boy(X) $\land$ atom(X) $\land$ *came(e, X)]

As was shown in Section 2.2.3.1, (188) and (189) are equivalent to each other, thus the singular alternative is not stronger than the plural one and the exhaustification would be vacuous, returning (188). Note that the requirement of plural is satisfied in this case – it is in the scope of *Exh* and the restrictor of *Exh* contains the alternative obtained by replacing plural with its singular scalemate, even though this alternative does not get negated by *Exh*. So, if we were to apply exhaustification at this level, we would predict (183) to mean "1 or more dogs are barking" and thus be true in a situation in which only one dog is barking. This is not an available reading, which means we need to block this possibility somehow. There are at least two possible ways to do that. First, we could constrain the application of *Exh* in such a way that it is not allowed to be vacuous. However, such a move would be not desirable, since, as we will see below, we want to allow this possibility in order to account for DE contexts.

Let's now discuss the second option. Exhaustification in (188) is vacuous just because the two alternatives are equivalent, but note that they are equivalent only if we take into account the distributivity information. The fact that the predicate *bark* is distributive allows us to conclude that (188) entails (189). If we didn't take into account the distributivity character of the predicate, then such an entailment wouldn't hold. Let's make an assumption that the implicature calculation process is blind to the distributivity information. Some evidence in favor of the assumption that scalar implicatures are blind to common knowledge can be found in Magri 2009 and Fox and Hackl 2006. In this case the singular alternative (189) is stronger than the plural one. Hence, the exhaustification operator would negate it, leading to the following meaning:

(190) $\exists e \exists X$ [*dog(X) $\land$ *bark(e, X)] $\land$ $\neg \exists e \exists X$ [*dog(X) $\land$ atom(X) $\land$ *bark(e, X)]

(190) states that there exists an event in which a plurality of dogs were barking, but there is no event in which atomic dogs were barking. This contradicts the contextual knowledge and is thus ruled out.

Thus, for simple sentences like (183) we always get two possible structures: one is with *Exh* inserted below the event closure and the second one is with *Exh* inserted above the event closure. The first one gives us the right meaning, and the second one is ruled out due to the contradiction with the world knowledge.

Let's now turn to the downward-entailing sentence:

(191) It is not true that dogs are barking.

We have three potential sites for the insertion of *Exh*: below the event closure, above the event closure and above negation.

If we applied *Exh* at the lowest level, we would get the strengthened meaning equivalent to what we got in (186). After applying the event closure and negation:

(192) $\neg \exists e \exists X$ [*dog(X) $\wedge$ |X|>1 $\wedge$ *bark(e, X)]

(192) gives us the meaning "It is not true that more than one dog is barking".

As we said above, this is not an attested reading. Otherwise, the sentence would be predicted to be true in a situation in which only one dog is barking. But this is correctly ruled out by the economy constraint offered in (169). Inserting *Exh* at that level leads to a meaning which is weaker than the meaning we would get without *Exh* (it's not true that one or more dogs are barking), and this is blocked.

If we applied exhaustification above the event closure, we would derive a tautology, thus this reading is unavailable.

Finally, let's check what would happen if *Exh* was inserted above negation. At that level the singular alternative (194) is entailed by the prejacent, thus *Exh* won't take it into consideration and the exhaustified meaning will be equivalent to the unexhaustified one:

(193) $\neg \exists e \exists X$ [*dog(X) $\wedge$ *bark(e, X)]

(194) $\neg \exists e \exists X$ [*dog(X) $\wedge$ X is atomic $\wedge$ *bark(e, X)]

Note that the requirement of the plural is satisfied in this case. The restrictor of *Exh* contains the singular alternative, but it does not get negated by *Exh*, as *Exh* only negates stronger alternatives.

Thus, we correctly predict that the multiplicity component goes away in DE environments and the only available meaning for (191) is "it is not true that one or more dogs are barking".

Now, it is time to see whether we make the right predictions for dependent plural sentences like (195):

(195) My three friends attend good schools.
       The LF is given below:

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(196) $\exists \mathcal{E} \, [\lambda e. \exists Y [\text{*good\_school}(Y) \wedge \text{*attend}(e)(\sigma^*\text{my\_friend})(Y)]]$
     (Presupposition: $|\sigma^*\text{my\_friend}|=3$)

There are two places where the exhaustification operator can be inserted. If we were to apply it at the event predicate level, the result of exhaustification, given the alternative in (197), would be as shown in (198):

(197) $\lambda e. \exists Y \, [\text{*good\_school}(Y) \wedge \text{atom}(Y) \wedge \text{*attend}(e)(\sigma^*\text{my\_friend})(Y)]$

(198) $\mathcal{E}xh \, (\, \lambda e. \exists Y [\text{*good\_school}(Y) \wedge \text{*attend}(e)(\sigma^*\text{my\_friend})(Y)] \,) =$
     $= \lambda e. \exists Y \, [\text{*good\_school}(Y) \wedge |Y|>1 \wedge \text{*attend}(e)(\sigma^*\text{my\_friend})(Y)]$
     (Presupposition: $|\sigma^*\text{my\_friend}|=3$)

After applying event closure:

(199) $\exists e \exists Y \, [\text{*good\_school}(Y) \wedge |Y|>1 \wedge \text{*attend}(e)(\sigma^*\text{my\_friend})(Y)]$
     (Presupposition: $|\sigma^*\text{my\_friend}|=3$)

The second possibility is to apply $\mathcal{E}xh$ above the event closure. The singular alternative is as shown in (200). It is stronger than the prejacent, thus it gets negated, leading to (201):

(200) $\exists e \exists Y [\text{*good\_school}(Y) \wedge \text{atom}(Y) \wedge \text{*attend}(e)(\sigma^*\text{my\_friend})(Y)]$

(201) $\mathcal{E}xh \, (\exists e \exists Y [\text{*good\_school}(Y) \wedge \text{*attend}(e)(\sigma^*\text{my\_friend})(Y)]) =$
     $= \exists e \exists Y [\text{*good\_school}(Y) \wedge \text{*attend}(e)(\sigma^*\text{my\_friend})(Y)])$
     $\wedge \neg [\exists e \exists Y \, [\text{*good\_school}(Y) \wedge \text{atom}(Y) \wedge \text{*attend}(e)(\sigma^*\text{my\_friend})(Y)]]$

Our theory predicts that both readings should be available, whereas, as was discussed in Section 2.2.3.3, Zweig's theory predicts that the reading in (201) should be the only available reading. As we demonstrated in section 2.2.3.3, the reading in (199) is available, hence Zweig's theory makes a wrong prediction. However, it is harder to check whether the reading in (201) is an available reading. We will leave it as a question for further research.

2.3.2   Quantifiers and Dependent plural readings

In this section, we will discuss Kratzer/Schein's argument in favor of a more complex denotation for universal quantifiers, which is based on their ability to give rise to

cumulative readings. Next, we will show that adopting such a semantics gives us a way of accounting for the puzzling behavior of *all:* namely, its ability to give rise to dependent plural readings but not to cumulative ones.

2.3.2.1   *Kratzer/Schein semantics for quantifiers*

It has been noted in Schein 1993 that sentences with universal quantifiers like *every* can have cumulative readings. Let's look at (202) (example from Kratzer 2000):

(202)   Three copy editors caught every mistake in the manuscript.

Kratzer claims that (202) can have a reading, which can be paraphrased as "between them, three copy editors found all the mistakes in the manuscript". The sentence under this reading will be true, for example, in a situation where there were three mistakes in the manuscript and the copy editor A found one mistake, copy editor B found two of them and copy editor C found all of them. The reading entails that each of the copy editors found at least one mistake and each of the mistakes was found by at least one copy editor.

This reading is hard to represent, as *every* is a distributive quantifier. Neither (203) nor (204) captures the reading correctly: (203) says that every mistake was caught by each of the three copy editors; (204) says that for each mistake there is a plurality of three copy editors who caught it:

(203) $\exists X [$ 3_copy_editors(X) $\wedge \forall y$ [mistake(y) $\rightarrow \exists e$ [catch(e)(X)(y)]]]

(204) $\forall y$ [mistake(y) $\rightarrow \exists X$ [3_copy_editors(X) $\wedge \exists e$ [catch(e)(X)(y)]]]

Kratzer offers the following representation for this reading:

(205) $\exists e \exists X [3\_copy\_editors(X) \wedge agent(X)(e) \wedge \forall y[mistake(y) \rightarrow \exists e'[e' \leq e \wedge catch(y)(e')]]]$
        $\wedge \exists y$ [mistakes(y) $\wedge$ catch(y)(e)]

The first (non-emphasized) part says that three copy editors were the agents of an event in which every mistake was caught. Kratzer argues that we also need a condition (emphasized) which states that this event is not just an event in which every mistake was caught, but an event of catching mistakes. This guarantees that nothing irrelevant gets included in this event. (This will exclude scenarios in which one copy editor found all the mistakes and two others did something else).

A crucial ingredient of the representation given in (205) is the fact that the agent role is introduced above the event quantifier associated with the verb. By introducing it at that

level, we get an opportunity to refer to the agent of the big event consisting of smaller subevents that *every* quantifies over and in such a way the cumulative reading is captured.

Crucially, Kratzer assumes that only agents are introduced as theta roles and themes can only be introduced as arguments of the verb. In such a way the asymmetry between sentences with *every* in subject and object position is captured. Unlike *every* in object position, *every* in subject position does not lead to cumulative readings – (206) cannot mean 'every copy editor found at least one mistake and overall 500 mistakes were found'. The unavailable reading would have a representation as in (207), but as we said above, themes cannot be introduced higher than the verb (cannot modify an event argument which is different from the one introduced by the verb):

(206) Every copy editor found 500 mistakes.

(207) $\exists e \exists X$ [500_mistakes(X) $\land$ theme(X)(e) $\land$ $\forall y$[copy_editor(y) $\rightarrow$ $\exists e'[e' \leq e \land$ find(e') $\land$ agent$(y)(e')$]]]

Coming back to the representation in (205), the question that arises is how to get this compositionally. More specifically, where does the emphasized condition come from? Should it be treated as a part of the quantifier's denotation, as shown in (208)?

(208) [[every mistake]] $= \lambda R.\lambda e.\forall y$ [mistake(y) $\rightarrow$ $\exists e'$ $[e' \leq e \land R(y)(e')]]$ $\land$ $\exists z$ [mistakes(z) $\land$ R$(z)(e)$

I would like to argue that this condition comes from a different source and the denotation for a quantifier should look as shown in (209). By deriving this condition from some other source, we maintain a more traditional denotation for a universal quantifier. The difference between this denotation and a more traditional one is that now the quantifier introduces its own event argument and existential quantification over its subevents:

(209) [[every mistake]] $= \lambda R \lambda e.\forall y$ [mistake(y) $\rightarrow$ $\exists e'$ $[e' \leq e \land R(y)(e')]]$

Coming back to the question of where the emphasized condition in (205) comes from, it seems plausible to assume that it is a result of the exhaustification of (202) repeated below associated with the numeral:

(210) $\exists e \exists X$[3_copy_editors(X) $\land$ agent(X)(e) $\land$ $\forall y$[mistake$(y)$$\rightarrow$$\exists$e'[e'$\leq$e $\land$ catch$(y)(e')$]]]

Let's consider the following alternatives to (210):

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(211) $\exists e \exists X[2\_copy\_editors(X) \wedge agent(X)(e) \wedge \forall y[mistake(y) \rightarrow \exists e'[e' \leq e \wedge catch(y)(e')]]]$

(212) $\exists e \exists X[4\_copy\_editors(X) \wedge agent(X)(e) \wedge \forall y[mistake(y) \rightarrow \exists e'[e' \leq e \wedge catch(y)(e')]]]$

The alternative in (211) is stronger than (210) (the one in (212) is weaker than the prejacent, as if there is an event where 3 copy editors were the agents of the plural event where every mistake was caught, we will always be able to find an event where 4 copy editors were the agent of the same event by adding one more copy editor doing no matter what), so when we exhaustify with respect to this alternative, we negate it and get the following:

(213) $\exists e \exists X[3\_copy\_eds(X) \wedge agent(X)(e) \wedge \forall y[mistake(y) \rightarrow \exists e'[e' \leq e \wedge catch(y)(e')]]]$
       $\wedge \neg \exists e \exists X[2\_copy\_eds(X) \wedge agent(X)(e) \wedge \forall y[mistake(y) \rightarrow \exists e'[e' \leq e \wedge catch(y)(e')]]]$

Negating (211) ("it's false that two copy editors were the agents of an event in which every mistake was caught") guarantees that each one of the three copy editors was involved in the process of catching mistakes and thus we are ruling out the possibility of the sentence being true in a situation in which two copy editors found all the mistakes and the third one did some irrelevant things.

We can give some more evidence in favor of the fact that this condition should be treated as an implicature. More specifically, we will show that in certain contexts where implicatures are not calculated this condition seems to go away. For example, if we take a sentence with a modal like the one in (214), it is ambiguous between two interpretations, given in (215)-(216).

(214) You are required to read 3 books.

(215) You are required to read 3 books and you are not required to read 4 books.

(216) You are required to read 3 and not 4 books.

Now, let's come back to cumulative readings in sentences with *every*. Imagine the following scenario. There is a competition going on among teams consisting of copy editors and there is a following rule "In order to get a prize, it is required that three copy editors find every mistake in the manuscript." The question is whether the condition we are interested in, shown in (217), is part of the denotation of the sentence or an implicature.

(217) In order to get a prize, it is required that three and **not two copy editors** find every mistake in the manuscript.

It seems to me that in a situation in which two copy editors found all the mistakes, the team will get a prize, which shows that the "not two"-part is an implicature and it is allowed to be not calculated in this context, similar to what we see in (215).

2.3.2.2 *Every and dependent plural readings*

Let's come back to the observation that sentences with *every* do not give rise to dependent plural readings. (218) can only mean "each of the boys wore more than one sweater".

(218) Every boy wore sweaters.

Let's check whether we still manage to account for this, if we adopt the semantics for *every boy* given in (219):

(219) $[\![$ every boy $]\!]$ = $\lambda P.\lambda e.\forall y$ [boy(y) $\rightarrow$ $\exists e'[$ $e' \leq e$ $\land$ P(e')(y)]]

The LF for (218) is given below:

(220) $\exists e \forall y$ [boy(y) $\rightarrow$ $\exists e'[$ $e' \leq e$ $\land \exists X$ [*wear(e')(X) $\land$ *sweater(X) $\land$ *agent(e)(y)]]]

We have three possible sites for the insertion of the exhaustification operator: at the lowest event predicate level, at the highest event predicate level and above the event closure.

As we showed in the previous section, exhaustifying at the lowest event predicate level gives us the meaning "for every boy x, x wore more than one sweater ".

Now, we should check what would happen if we were to exhaustify at the highest event predicate level. At that level (218) denotes (221):

(221) $\lambda e.$ $\forall y$ [boy (y) $\rightarrow$ $\exists e' \exists X$ [$e' \leq e$ $\land$ *wear(e')(y)(X) $\land$ *sweater(X)]

The singular alternative to (221) is given below:

(222) $\lambda e.$ $\forall y$ [boy (y) $\rightarrow$ $\exists e' \exists X$ [$e' \leq e$ $\land$ *wear(e')(y)(X) $\land$ *sweater(X) $\land$ atom(X)]

The singular alternative is stronger than the plural one (as the distributivity information is not present yet), so we negate it. However, we do get a contradiction, when the contextual information comes in, as we get the following meaning "for every boy there is an event which is an event of wearing a sweater or sweaters, but not for every

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boy there is an event of wearing an atomic sweater", which is contradictory due to the distributitivy of the predicate *wear*. Exhaustifying above the event closure would lead to the same result. So no additional readings are derived, which is good.

2.3.2.3   *All and dependent plural/cumulative readings*

Let us remind ourselves why Zweig's theory had problems with accounting for sentences containing *all*. The main intuition behind Zweig's analysis is that dependent plural readings are a subtype of cumulative readings, and both arise when there is no scopal dependency created between the bare plural and another DP the bare plural depends on. However, as Zweig points out, there is an exception to this generalization. More specifically, sentences involving *all*-DPs and *most*-DPs allow dependent plural readings but they do not allow cumulative readings, as demonstrated below:

(223)   All the boys wrote dissertations.   dependent plural

(224)   All the boys wrote 5 dissertations.   *cumulative

If we treat *all* as a distributive quantifier quantifying over atoms like *every*, we would not be able to account for the availability of dependent plural readings – the multiplicity will be trapped below the event quantifier and will get distributed by *all*. However, if we assume that *all* should be rather treated similar to a definite DP, the fact that cumulative readings are not available with *all* remains unaccounted for. I would like to argue that this problem does not arise in our modified version of Zweig's theory. The two components that are important for accounting for such a behavior of *all* are the following. First, we assume that we do not need to compute the multiplicity implicature as locally as possible. Second, we assume that *all* is a quantifier, but it is an unusual quantifier – it has two parts in its denotation, which makes it both distributive and cumulative. On the one hand, it contains the universal quantification part, which makes it similar to *every* and which is responsible for the absence of cumulative readings. But on the other hand, unlike *every*, there is also a second conjunct in its denotation that refers to the big event and asserts that there is a relation that holds between this event and the sum of the boys (this part is equivalent to what we would assign to a definite DP *the boys*).

In this section, we will first provide some evidence in favor of the fact that *all* is a distributive item, similar to *every*. In the next section, we will offer a new denotation for *all* that captures this fact and will show how this new denotation helps in accounting for the availability of dependent plural readings with *all*.

There is a class of collective predicates with respect to which *all* behaves similar to distributive items like *every/each*. These predicates are known as pure cardinality predicates

(Dowty 1987) and numerous-type predicates (Champollion 2010). Some examples include *be numerous, be a large group, be a couple etc.*

Those predicates can lead to collective interpretations when combined with definite plurals, as in (225). Moreover, it is the only available interpretation, as it does not make sense to apply the predicate *be numerous* to individual boys. When the predicate is combined with *every*, the collective interpretation is not available and thus the sentence is ruled out, as in (226):

(225)   The boys are numerous.

(226)   *Every boy is numerous.

Note that the ungrammaticality of (226) does not show that *every* is incompatible with this type of predicates in general, but rather that it does not license the collective interpretation. In sentences with group nouns *every* is fine, as shown below:

(227)   Every committee is numerous.

(227) is grammatical, but the only available interpretation in this case is the distributive one.

If we combine *all* with predicates like *be numerous*, it will become obvious that *all* shows absolutely the same behavior, as *every*:

(228)   *All the boys are numerous.

(229)   All the committees are numerous.

The ungrammaticality of (228) shows that the collective interpretation is blocked. (229) is good only under the distributive interpretation.

The parallel behavior of *all* and *every* with respect to the absence of the collective interpretations with pure cardinality predicates makes it hard to maintain an analysis according to which *all*-DP is treated just like a definite DP and motivates treating *all* in an analogous way as *every*.

2.3.2.4   Denotation for All

I argue that the denotation for *all* should look as follows:

(230)   ⟦ all the boys ⟧ = $\lambda P.\lambda e.P(e)(\sigma^*boy) \wedge \forall y[(y \leq \sigma^*boy \wedge atom(y) \rightarrow \exists e'[e' \leq e\ P(e')(y)]]$

As was shown in the previous section, based on the unavailability of collective interpretations with *numerous*-type predicates, *all* should be treated as a distributive item. We encode this by introducing the distributive quantification in its denotation. This part of the denotation is what *every* and *all* have in common. However, we also add a second conjunct to the denotation of *all*, which makes reference to the big event containing the smaller events the universal quantifier quantifies over and asserts that the relation holds between this event and the sum of the elements referred to by the complement of *all*. This conjunct is the proposed difference between the denotations of *all* and *every*. And as we will show below, this conjunct is crucial in accounting for the possibility of dependent plural readings with *all*.

Let's show how entertaining such a denotation for *all* can help us account for the possibility of dependent plural readings and the absence of cumulative ones. Note that the crucial thing is that we do allow implicatures to be calculated at any level and we do not have strong meaning principle regulating the choice of the meaning. If we adopted the denotation in (230) but kept the strong meaning principle, it woudn't make a difference, as the minute we have universal quantification involved, we would trap the multiplicity condition below it and this meaning would be stronger than any other meaning, so we wouldn't predict any dependent plural readings with *all*, similar to what we get with *every*.

Let's consider (231):

(231) All the boys attend good schools.

We have several places where the exhaustivity operator can be inserted. We'll see below that applying it at a lower level won't give rise to a dependent plural reading. The lowest implicature calculation site looks as follows:

(232) $\lambda e.\exists X[{}^*\text{school}(X) \wedge {}^*\text{attend}(e)(y)(X)]$

The singular alternative to (232) is as shown in (233):

(233) $\lambda e.\exists X[{}^*\text{school}(X) \wedge \text{atom}(X) \wedge {}^*\text{attend}(e)(y)(X)]$

As we showed before, the singular alternative is stronger than the plural one, thus *Exh* will negate it, leading to the following meaning:

(234) $\lambda e.\exists X[{}^*\text{school}(X) \wedge |X| > 1 \wedge {}^*\text{attend}(e)(y)(X)]$

After we apply *all* and close the event argument, we get the following:

(235) $\exists e\exists X[\text{*school}(X) \wedge |X|>1\ \text{*attend}(e)(\sigma\text{*boy})(X)] \wedge \forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow$
$\exists e'[e'\leq e \wedge \exists Z\ [\text{attend}(e')(y)(Z) \wedge \text{*school}(Z) \wedge |Z|>1]]]$

This gives us the non-dependent plural reading: the sentence will be true in a situation in which each of the boys attends more than one good school.

Let's check what we would predict, if we were to apply $\mathcal{E}xh$ at the level of the higher event predicate. The sentence at that level denotes (236):

(236) $\lambda e.\exists X[\text{*school}(X) \wedge \text{*attend}(e)(\sigma\text{*boy})(X)] \wedge \forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow$
$\exists e'[e'\leq e \wedge \exists Z\ [\text{attend}(e')(y)(Z) \wedge \text{*school}(Z)]]]$

The singular alternative for (236) looks as follows:

(237) $\lambda e.\exists X[\text{*school}(X) \wedge \text{atom}(X) \wedge \text{*attend}(e)(\sigma\text{*boy})(X)] \wedge \forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow$
$\exists e'[e'\leq e \wedge \exists Z\ [\text{attend}(e')(y)(Z) \wedge \text{*school}(Z) \wedge \text{atom}(Z)]]]$

It can be shown that (237) is stronger than (236), thus exhaustifying at that level will negate the stronger alternative and will lead to the following meaning:

(238) $\lambda e.\exists X[\text{*school}(X) \wedge \text{*attend}(e)(\sigma\text{*boy})(X)] \wedge \forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow$
$\exists e'[e'\leq e \wedge \exists Z\ [\text{attend}(e')(y)(Z) \wedge \text{*school}(Z)]]] \wedge [\neg\exists X[\text{*school}(X) \wedge \text{atom}(X) \wedge$
$\text{*attend}(e)(\sigma\text{*boy})(X)] \vee$
$\neg\forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow \exists e'[e'\leq e \wedge \exists Z[\text{attend}(e')(y)(Z) \wedge \text{*school}(Z) \wedge$
$\text{atom}(Z)]]]] =$

(239) $\lambda e.\exists X[\text{*school}(X) \wedge \text{*attend}(e)(\sigma\text{*boy})(X)] \wedge \forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow$
$\exists e'[e'\leq e \wedge \exists Z[\text{attend}(e')(y)(Z) \wedge \text{*school}(Z)]]] \wedge \neg\exists X[\text{*school}(X) \wedge \text{atom}(X) \wedge$
$\text{*attend}(e)(\sigma\text{*boy})(X)] \vee$
$\exists X[\text{*school}(X) \wedge \text{*attend}(e)(\sigma\text{*boy})(X)] \wedge \forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow \exists e'[e'\leq e \wedge \exists Z$
$[\text{attend}(e')(y)(Z) \wedge \text{*school}(Z)]]] \wedge \neg\forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow \exists e'[e'\leq e \wedge \exists Z$
$[\text{attend}(e')(y)(Z) \wedge \text{*school}(Z) \wedge \text{atom}(Z)]]] =$

(240) $\lambda e.\exists X[\text{*school}(X) \wedge |X|>1 \wedge \text{*attend}(e)(\sigma\text{*boy})(X)] \wedge \forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow$
$\exists e'[e'\leq e \wedge \exists Z\ [\text{attend}(e')(y)(Z) \wedge \text{*school}(Z)]]] \vee$
$\exists X[\text{*school}(X) \wedge \text{*attend}(e)(\sigma\text{*boy})(X)] \wedge \forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow \exists e'[e'\leq e \wedge \exists Z$
$[\text{attend}(e')(y)(Z) \wedge \text{*school}(Z)]]] \wedge \neg\forall y\ [y\leq\sigma\text{*boy} \wedge \text{atom}(y) \rightarrow \exists e'[e'\leq e \wedge \exists Z$
$[\text{attend}(e')(y)(Z) \wedge \text{*school}(Z) \wedge \text{atom}(Z)]]]$

Let's show that (240) is contextually equivalent to (241):

(241) $\lambda e.\exists X[*school(X) \wedge |X|>1 \wedge *attend(e)(\sigma*boy)(X)] \wedge \forall y [y{\leq}\sigma*boy \wedge atom(y) \rightarrow$
$\exists e'[e'{\leq}e \wedge \exists Z [attend (e')(y)(Z) \wedge *school(Z)]]]$

The second disjunct in (240) is contradictory the minute the world knowledge information comes in (as we get the following meaning "For every boy there is an event where he attended one or more good schools but it's not true that for every boy there was an event where he attended one good school"), thus it should be false, making the meaning in (239) equivalent to (241).

Note that (241) correctly captures the *dependent plural* reading of (231): it says that there is a big event the agent of which is the sum of boys and the theme is more than one good school and each one of the boys attends one or more good schools.

We just showed that if we adopt a denotation for *all* offered in (230), we can easily account for the possibility of dependent plural readings. But crucially we should also assume that we are free to insert *Exh* at any level. If we were to follow Zweig in assuming that the strong meaning principle governs the implicature calculation process, then we wouldn't make the right prediction, as the strong meaning principle would make us go for the strongest meaning, which is the meaning in (235), and thus we wouldn't predict dependent plural readings to be possible with *all*.

We should also check what we would get if we were to exhaustify at the highest level, namely after the event closure.

(242) $\exists e \exists X[*school(X) \wedge *attend(e)(\sigma*boy)(X)] \wedge \forall y [y{\leq}\sigma*boy \wedge atom(y) \rightarrow$
$\exists e'[e'{\leq}e \wedge \exists Z [attend (e')(y)(Z) \wedge *school(Z)]]]$

The singular alternative is in (243):

(243) $\exists e \exists X[*school(X) \wedge atom(X) \wedge *attend(e)(\sigma*boy)(X)] \wedge \forall y [y{\leq}\sigma*boy \wedge atom(y) \rightarrow$
$\exists e'[e'{\leq}e \wedge \exists Z [attend (e')(y)(Z) \wedge *school(Z) \wedge atom(Z)]]]$

Remember that in section 2.3.1.2 we made an assumption that *Exh* is blind to the distributivity information and thus the alternative in (243) is stronger than (242). Negating it leads to the following meaning:

(244) $\exists e \exists X[*school(X) \wedge *attend(e)(\sigma*boy)(X)] \wedge \forall y [y{\leq}\sigma*boy \wedge atom(y) \rightarrow$
$\exists e'[e'{\leq}e \wedge \exists Z [*attend (e')(y) (Z) \wedge *school(Z)]]] \wedge$
$\neg\exists e \exists X[*school(X) \wedge atom(X) \wedge *attend(e)(\sigma*boy)(X)] \wedge \forall y[y{\leq}\sigma*boy \wedge atom(y) \rightarrow$
$\exists e'[e'{\leq}e \wedge \exists Z [*attend (e')(y)(Z) \wedge *school(Z) \wedge atom(Z)]]]$

Again, similar to what we did above, it can be shown that (244) is contextually equivalent to (245):

(245) $\exists e \exists X[*school(X) \wedge *attend(e)(\sigma*boy)(X)] \wedge \forall y [y \leq \sigma*boy \wedge atom(y) \rightarrow$
$\exists e'[e' \leq e \wedge \exists Z [*attend (e')(y) (Z) \wedge *school(Z)]]] \wedge$
$\neg \exists e \exists X[*school(X) \wedge atom(X) \wedge *attend(e)(\sigma*boy)(X)]$

The meaning in (245) is stronger than the meaning in (241) (see a similar discussion in Section 2.3.1.2) and we will leave the question of whether this reading is available for future research.

Thus, we accounted for the fact why dependent plural readings with *all* are possible. The denotation in (230) also lets us capture the impossibility of cumulative readings with *all*. Consider (246) and its LF in (247):

(246) All the boys attend 5 good schools.

(247) $\exists e \exists X[*attend(e)(\sigma*boy)(X) \wedge 5\_schools(X)] \wedge \forall y [y \leq \sigma*boy \wedge atom(y) \rightarrow$
$\exists e' [e' \leq e \wedge \exists Z [attend(e')(y)(Z) \wedge 5\_schools(Z)]]]$

(247) requires that every boy attend 5 good schools but also that the theme of the big event which contains all those small events is 5 schools, which is only possible if all the boys attend the same 5 schools. Thus the cumulative reading, which can be formulated in the following way – each of the boys attends at least 1 good school and overall 5 good schools are attended – is correctly ruled out.

Let us now turn to the following question. Sentences with *all* can also get a distributive reading. It can be easily shown if we use a singular indefinite:

(248) All the boys attend a good school.

(248) can be true in a situation in which each of the boys attends a different good school. The question that arises is whether we capture this reading, if we use the denotation for *all* offered in (230). Wouldn't we end up requiring that there should be one school referred to overall, similar to what we got in (247)?

I would like to argue that the source of the distributivity does not come from *all* in this case, but rather from the plural feature on DP. I follow Kratzer 2007 in assuming that DPs with plural agreement features can pluralize adjacent verbal projections. In this sense the source of distributivity in case of (248) is the same as in case without *all*:

(249) The boys attend a good school.

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The denotation of the predicate that was obtained by starring the subject's sister constituent is given below:

(250) $*(\lambda x.\lambda e.\ \exists y\ [\text{good\_school}(y)\ \&\ *\text{attend}(e)(x)(y)])$

If we consider a situation with 3 boys: John, Bill and Fred and John attends school 1, Bill attends school 2 and Fred attends school 3, the extension of the starred predicate will contain $<j,\ e_1>$, $<b,\ e_2>$, $<f,\ e_3>$, $<j\oplus b,\ e_1\oplus e_2>$, $<b\oplus f,\ e_2\oplus e_3>$ ... and, crucially, $<j\oplus b\oplus f,\ e_1\oplus e_2\oplus e_3>$. In such a way the distributive interpretation of (248) is captured.

Kratzer assumes that starring of a plural DP's sister node is obligatory. I would like to point out that we wouldn't want to make this assumption. Otherwise, we would loose our account of dependent plurality with *all*. Let's demonstrate it.

Let's assume that (251) has a representation in (252). Then, if we were to apply an exhaustivity operator at the lower event predicate level, we would trap multiplicity below the universal quantifier and thus would get the distributed multiplicity, similar to what we got in (235). The presence of the star wouldn't make a difference in this case. If we were to exhaustify higher, the sentence with the plural (252) would be equivalent to its singular alternative in (253) and no implicature could be derived.

(251)   All the boys attend good schools.

(252)   ([[all the boys]]) $(*(\lambda x.\lambda e.\ \exists Y\ [*\text{good\_school}(Y)\ \&\ *\text{attend}(e)(x)(Y)]))$

(253)   All the boys attend a good school.

(254)   ([[all the boys]]) $(*(\lambda x.\lambda e.\ \exists Y\ [*\text{good\_school}(Y)\ \&\ \text{atom}(Y)\ \&\ *\text{attend}(e)(x)(Y)]))$

So I would like to argue that there are two possible LFs available for a sentence like (251). The first one does not have a star operator below *all*-DP and this LF gives rise to a dependent plural reading, which is derived as was shown above for (231). The second LF is the one where the sister of *all-DP* is pluralized, and this LF accounts for distributive readings.

2.3.2.5   Explaining the difference between gather-type and numerous-type predicates: Collective predication and sum/group distinction

In this section, we are going to address the following question: if *all* is a distributive quantifier, why is it compatible with certain collective predicates (predicates like *gather*, *meet*)? As we saw above, the collective interpretation of *numerous*-type predicates is

blocked both by *each/every* and *all*. With predicates of the *gather* type the situation is a bit different: *every/each* block the collective interpretation of *gather*-type predicates, whereas *all* does not block it:

(255)   The students gathered in the hall.   *distributive, collective

(256)   All the students gathered in the hall.   *distributive, collective

(257)   *Every student gathered in the hall.   *distributive, *collective

In this respect *all* behaves more like a definite DP.

There are several types of approaches to the *numerous/gather*-type predicate distinction. For the purposes of the discussion, we will adopt Champollion's 2010 approach.

Champollion proposes to treat *gather* and *numerous*-type predicates as representing two different types of collective predicates. One type of collectivity, which he calls thematic, is defined by the presence of certain entailments about the plural individual which cannot be induced based on what is known about atomic individuals this plural individual consists of. The examples of such entailments are collective responsibility, collective action and collective body formation. We are not going to discuss those entailments in detail, but rather give an example of one case of such entailments, more specifically, an example of collective responsibility from Landman 2000, given in (258):

(258)   The gangsters killed the rivals.

For the sentence to be true, it is not required that every individual is directly involved in the action, but rather that they do share the responsibility for the action. Landman offers to model the collective interpretation of predicates that license such non-inductive entailments by using groups, which are constructed from corresponding sums with the help of a group-formation operator ↑. Unlike sums, groups do not have an internal structure and are thus treated as impure atoms.

The second type of collectivity, which is called non-thematic, does not have anything to do with such entailments. It is rather characterised by the fact that the predicate does not distribute down to individual atoms. For example, the predicate *be numerous* can apply only to sums, but never to individual atoms.

According to Champollion, the difference between *gather*-type predicates and *numerous*-type predicates can be reduced to the difference between thematic and non-thematic collectivity: *gather*-type predicates can be thought of as instances of thematic collectivity, whereas *numerous*-type predicates as cases of non-thematic collectivity.

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The distinction between *numerous*-type and *gather*-type predicates is captured in the following way. Definite and indefinite noun phrases are taken to be ambiguous between a group and a sum interpretation. Only *gather*-type predicates can apply to events whose agents are groups (impure atoms). Predicates like *be numerous* can only apply to sums. Thus, for a gather-type predicate we have two available LFs (one is with the sum interpretation of the DP and the other one with the group interpretation), whereas for a numerous-type predicate only one LF (with the sum interpretation of the DP), as shown below:

(259) The boys gathered.

(260) $\exists e$ *gather$(e)(\sigma^*$boy$)$

(261) $\exists e$ *gather$(e)(\uparrow\sigma^*$boy$)$

(262) The boys are numerous.

(263) $\exists e$ *numerous$(e)(\sigma^*$boy$)$

Let's now come back to the difference between numerous and gather-type predicates with respect to their compatibility with *all*, namely the fact that *all* is compatible with gather-type predicates but not with numerous-type predicates, as shown below:

(264) All the boys gathered.

(265) *All the boys are numerous.

As we said above, definite DPs are taken to be ambiguous between a group and a sum interpretations. It means that *all the boys* will also be ambiguous. The definition we gave earlier, repeated below, used the sum interpretation of the DP:

(266) ⟦ all the boys ⟧ = $\lambda P.\lambda e.P(e)(\sigma^*boy) \wedge \forall y[(y\leq\sigma^*$boy $\wedge$ atom$(y) \rightarrow$
$\quad \exists e'[e'\leq e \ P(e')(y)]]$

Now, we should also add a group interpretation of "the boys":

(267) ⟦ all the boys ⟧ = $\lambda P.\lambda e.P(e)(\uparrow\sigma^*boy) \wedge \forall y[(y\leq\uparrow\sigma^*$boy $\wedge$ atom$(y) \rightarrow$
$\quad \exists e'[e'\leq e \ P(e')(y)]]$

Thus, for the sentence with a gather-type predicate (268) we have two available LFs shown in (269) and (270):

(268)   All the boys gathered.

(269) $\lambda e.$*gather$(e)(\sigma$*boy$) \land \forall y[(y\leq\sigma$*boy $\land$ atom$(y) \to \exists e'[e'\leq e$ *gather$(e')(y)]]$

(270) $\lambda e.$*gather$(e)(\uparrow\sigma$*boy$) \land \forall y[(y\leq\uparrow\sigma$*boy $\land$ atom$(y) \to \exists e'[e'\leq e$ *gather$(e')(y)]]$

In the case of (269) the universal quantification fails, as it is impossible for the atomic individuals to gather. The LF in (270) is felicitous - the universal quantification introduced by *all* is trivially satisfied[18].

Unlike gather-type predicates, numerous-type predicates can only apply to sums, thus the only available LF for (271) is the one in (272) and it is infelicitous for exactly the same reason as the LF in (269):

(271)   All the boys are numerous.

(272) $\lambda e.$*numerous$(e)(\sigma$*boy$) \land \forall y[(y\leq\sigma$*boy $\land$ atom$(y) \to \exists e'[e'\leq e$
        *numerous$(e')(y)]]$

The other question is why there is a contrast between *all* and *every* with respect to their behavior with *gather*-type predicates, namely the contrast shown below:

(273)   All the boys gathered.

(274)   *Every boy gathered.

This contrast follows from the fact that 'all the boys' contains the ambiguous DP (and exactly the availability of the group interpretation of 'the boys', which is derived by using the $\uparrow$-operator, makes (273) felicitous), whereas 'every boy' does not contain any constituent to which the $\uparrow$-operator could be applied.

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[18] Note that this account does not capture the difference between a sentence with *all* and the corresponding sentence without *all*:

(vii)   All the boys gathered.

(viii) The boys gathered.

. This difference was called the maximality effect of *all* (Dowty 1987) and non-maximality of definite plurals (Brisson 1998). The claim is that the *all*-sentence does not allow for exceptions, unlike the definite plural sentence. Dowty 1987 and Brisson 1998 built their analyses based on this difference. However, as Champollion notes, the behavior of *all* might not be linked to maximality effects, because other quantifiers such as *most* pattern just like *all*, but do not involve maximality effects.

Interestingly, we correctly do not predict dependent plural readings with collective predicates. As we said, we treat all the DPs as ambiguous between a sum and a group interpretation. Let's consider (275):

(275)   All the boys built rafts.

On the sum interpretation of *the boys*, this sentence can get a dependent plural reading, if we apply *Exh* at the level of the higher event predicate (276).

(276) $\lambda e.\exists X[*raft(X) \wedge *build(e)(\sigma*boy)(X)] \wedge \forall y \ [y \leq \sigma*boy \wedge atom(y) \rightarrow \exists e'[e' \leq e \wedge \exists Z$
        $[build \ (e')(y)(Z) \wedge *raft(Z)]]]$

The derivation will be completely parallel to the one we showed in (240). What interests us here is a group interpretation of *the boys*, the one that leads to a collective interpretation of (275). Let's see what will happen in this case, if we exhaustify at the level of the higher event predicate. The sentence at that level denotes (277):

(277) $\lambda e.\exists X[*raft(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \wedge \forall y \ [y \leq \uparrow\sigma*boy \wedge atom(y) \rightarrow$
        $\exists e'[e' \leq e \wedge \exists Z \ [build \ (e')(y)(Z) \wedge *raft(Z)]]]$

As the universal quantifier has only one instance, the group itself, we can rewrite (277) in a simplified form:

(278) $\lambda e.\exists X[*raft(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \wedge \exists e'[e' \leq e \wedge \exists Z \ [build \ (e')(\uparrow\sigma*boy)(Z) \wedge *raft(Z)]]$

The singular alternative for (277) is shown below:

(279) $\lambda e.\exists X[*raft(X) \wedge atom(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \wedge \exists e'[e' \leq e \wedge \exists Z \ [build (e')(\uparrow\sigma*boy)(Z) \wedge *raft(Z) \wedge atom(Z)]]$

When we negate the singular alternative and close the event argument, we do get the following:

(280) $\lambda e.\exists X[*raft(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \wedge \exists e'[e' \leq e \wedge \exists Z \ [build \ (e')(\uparrow\sigma*boy)(Z) \wedge *raft(Z)]] \wedge$

        $\neg [\exists X[*raft(X) \wedge atom(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \wedge \exists e'[e' \leq e \wedge \exists Z \ [build (e')(\uparrow\sigma*boy)(Z) \wedge *raft(Z) \wedge atom(Z)]]] =$

(281)　$\lambda e.\exists X[*raft(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \wedge \exists e'[e' \le e \wedge \exists Z$ [build $(e')(\uparrow\sigma*boy)(Z) \wedge$ *raft(Z)]] $\wedge$

$[\neg \exists X[*raft(X) \wedge atom(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \vee \neg\exists e'[e' \le e \wedge \exists Z$ [build $(e')(\uparrow\sigma*boy)(Z) \wedge *raft(Z) \wedge atom(Z)]]] =$

(282)　$\lambda e.\exists X[*raft(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \wedge \exists e'[e' \le e \wedge \exists Z$ [build $(e')(\uparrow\sigma*boy)(Z) \wedge$ *raft(Z)]] $\wedge \neg \exists X[*raft(X) \wedge atom(X) \& *build(e)(\uparrow\sigma*boy)(X)] \vee$

$\exists X[*raft(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \wedge \exists e'[e' \le e \wedge \exists Z$ [build $(e')(\uparrow\sigma*boy)(Z) \wedge$ *raft(Z)]] $\wedge \neg \exists e'[e' \le e \wedge \exists Z$ [build $(e')(\uparrow\sigma*boy)(Z) \wedge *raft(Z) \wedge atom(Z)]]$

(283)　$\lambda e.\exists X[*raft(X) \wedge *build(e)(\uparrow\sigma*boy)(X) \wedge |X| > 1] \wedge \exists e'[e' \le e \wedge \exists Z$ [build $(e')(\uparrow\sigma*boy)(Z) \wedge$ *raft(Z)]] $\vee$

$\exists X[*raft(X) \wedge *build(e)(\uparrow\sigma*boy)(X)] \wedge \exists e'[e' \le e \wedge \exists Z$ [build $(e')(\uparrow\sigma*boy)(Z) \wedge$ *raft(Z)]] $\wedge \neg \exists e'[e' \le e \wedge \exists Z$ [build $(e')(\uparrow\sigma*boy)(Z) \wedge *raft(Z) \wedge atom(Z)]]$

(283) is equivalent to following meaning "the group of boys built more than one raft".

We should note that there is another approach in the literature that tries to capture the difference between *gather*-type and *numerous*-type predicates wrt to their compatibility with *all*. Taub (1989) made the following generalization regarding the type of collective predicates that do and do not allow *all*. She argued that the collective predicates that disallow *all* are collective predicates that are states and achievements, while the collective predicates that allow *all* are accomplishments and activities. Based on this generalization, Brisson (2003) gave an account of the difference between those predicates that license *all* and those that do not in terms of different structure those predicates have. More specifically, Brisson assumes that unlike states and achievements, accomplishments and activities project an additional level of verbal structure, a separate event predicate which Brisson labels 'DO'. Her analysis in a nutshell is as follows: "all" is a modifier of the distributive operator[19]. Thus, when there is *all* in a sentence, there must be a distributive operator as well. But what does the distributive operator distribute over when we have a collective predicate as in (284):

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[19] We are not going to discuss what exactly the semantics of this modifier is. See Brisson 2003 for more details.

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(284) All the boys gathered.

In case of gather-type predicates (accomplishments and activities) which have DO part, the distributor takes scope only above the DO part (resulting in making sure that every boy took part in the gathering event) and thus the collective reading arises. In case of achievements and states, as there is no DO predicate, the distributor takes scope over the VP and thus the classical distributive reading arises.

We are not going to discuss whether Taub/Brisson's account fares better than Champollion's and we will leave the question of whether our account is compatible with Brisson-type approach as a topic for future research.

2.4   New predictions

2.4.1   A note on subject/object asymmetry

Zweig in his dissertation notes that there is a subject-object asymmetry regarding the availability of dependent plural readings with *every*. He compares the following pair of examples:

(285)   In last night's chess tournament, every left-handed player won games.

(286)   In last night's chess tournament, left-handed players won every game.

He argues that (285) with *every* in subject position can only get a non-dependent plural reading: for each left-handed player, there were multiple games that he won. However, the corresponding sentence with the quantifier in object position does allow for a dependent plural reading, more specifically, it means that for every game there was at least one left-handed player who won it. It does not require that any game was won by more than one player.

Zweig points outs that his system does not capture the difference between subject and object quantifiers, namely it predicts (286) to lack a dependent plural reading just as (285), as after *every game* QRs above the event quantifier, the multiplicity condition will be trapped below, leading to the following interpretation:

(287)   For every game there is more than 1 player who won it.

Zweig does not provide any solution to this contrast. He speculates that the contrast can be due to the fact that a quantifier in the object position can be interpreted in situ

(below the event quantifier), whereas a quantifier in the subject position obligatorily has to move out.

Interestingly, as we showed in section 2.3.2.1, quantifier *every* in object position, unlike *every* in subject position, can give rise to cumulative readings (see (288)-(289)). So again we see a parallel between the availability of cumulative and dependent plural readings.

(288)   Three copy editors found every mistake in the manuscript.

(289)   Every copy editor found 100 mistakes.

The presence of such readings was one of the reasons for adopting a more complex semantics for quantifiers (repeated in (290)) and the idea that agents can be introduced higher in the structure (so they are able to modify an event argument different from the one introduced by the verb):

(290)   [| every mistake |] = $\lambda R.\lambda e.\forall y$ [mistake$(y) \to \exists e'$ [$e' \leq e \land R(y)(e')$]]

As Kratzer argues, themes are not allowed to modify an event argument different from the one introduced by the verb, that's why cumulative readings are unavailable for sentences like (289).

Now, we can check whether this new denotation can also capture the contrast between the availability of dependent plural readings with object *every* and the absence of such readings with subject *every*.

With this assumption that agents can be introduced above in the structure, we do predict dependent plural readings with objects. Let's see how exactly it happens. At the event predicate level, (291) denotes (292):

(291)   Boys read every book.

(292) $\lambda e.\exists X$ [*boy$(X) \land$ *agent$(X)(e) \land \forall y$[book$(y) \to \exists e'[e' \leq e \land$ read$(e')(y)]$]]]

The singular alternative is given in (293):

(293) $\lambda e.\exists X$ [*boy$(X) \land$ atom$(X) \land$ *agent$(e)(X) \land \forall y$[book$(y) \to \exists e'[e' \leq e \land$ read$(e')(y)]$]]]

After negating the stronger alternative and closing the event argument, we get the following:

(294) $\exists e \exists X$ [*boy$(X) \land |X| > 1 \land$ *agent$(e)(X) \land \forall y$[book$(y) \to \exists e'[e' \leq e \land$ read$(e')(y)]$]]]

(294) guarantees that the agent of the big event is not atomic, which is precisely the overall multiplicity condition associated with dependent plurals. As we see, for the possibility of dependent plural readings, it is necessary for a bare plural to scope above the universal quantifier. Separation of the agent role gives us the necessary configuration. The introducing of the theme role above the universal quantifier is not allowed, thus no dependent plural readings are predicted, and this prediction is borne out.

2.4.2   Dependent Plurality with Adverbials

In addition to sentences which contain a bare plural and another plural DP, dependent plural readings also arise in sentences containing a bare plural and a quantificational adverb, as shown in (295):

(295)   Jack always wears suits.

(295) requires that Jack wears different sweaters but it does not require that he wears more than one at a time.

Before looking at adverbials like *always* in more detail, let's first examine the behavior of adverbials which contain nouns marked for number like *every Tuesday, on Tuesdays, on the last 3 Tuesdays* etc. It seems plausible to expect that such adverbials will show exactly the same behavior we saw in Section 2.2.3 with nominal DPs depending on the number of the noun. More specifically, dependent plural readings should be available if a bare plural is in the scope of an adverbial containing a plural noun like "on the last three Tuesdays", but it should be ruled out if it's in the scope of an adverbial containing a singular noun like "last Tuesday" or a universal quantifier like "every Tuesday". It seems that these predictions are borne out. Consider the following sentences:

(296)   Last Tuesday John wore ties.

(297)   On 3 Tuesdays John wore ties.

(298)   Every Tuesday John wears ties.

(296) can only mean "John wore more than one tie", similar to (299). (297) can have a dependent plural reading: on each of the three Tuesdays John wore one tie and overall more than one tie was worn (cf.(300)). The sentence with a universal quantifier (298) seems to require that John wear more than one tie every day (cf. (301)).

(299) My friend wore ties last night.

(300) My 3 friends wore ties last night.

(301) Every friend of mine wore ties last night.

If we assume that the adverbials *every Tuesday* and *on three Tuesdays* have the same semantics as corresponding nominals shown below, then the facts will fall out:

(302) [[every Tuesday]] = $\lambda P.\lambda e.\ \forall y\ [\text{Tuesday}(y)\rightarrow\exists e':\ e'\le e \wedge P(e')(y)]]$

(303) [[three Tuesdays]] = $\lambda P.\exists Y\ [*\text{Tuesday}(Y) \wedge |Y| = 3 \wedge P(Y)]$

Just like with usual nominal DPs, there is a parallel between the availability of dependent plural and cumulative readings: we do get cumulative readings with numerical adverbials like *on 3 days*, but not with universally quantified ones like *every day*:

(304) On 3 days John wrote 3 papers.   cumulative

(305) Every day John wrote 3 papers.   * cumulative

Let's also say some words about the behavior of frequency adverbials of the *always* type, which include *often, usually, rarely, constantly, regularly, daily* etc. First of all, we should note that those adverbials do not give rise to cumulative readings.

(306) John always wears 5 sweaters.

(306) does not have a cumulative interpretation that could be paraphrased in the following way: "John always wears at least one sweater and overall 5 sweaters are involved". Thus, in order to account for the possibility of dependent plural readings with such adverbials, we cannot use the analysis in terms of cumulativity, which was appropriate for accounting for dependent readings with numerical adverbials.

However, note that the behavior of *always* strikingly reminds of how the quantifier *all* behaves — both license dependent plural readings with bare plurals, whereas neither licenses cumulative ones with numeral DPs, as demonstrated below:

(307) All the boys wore sweaters.   dependent plural

(308) All the boys wore 5 sweaters.   * cumulative

So we can try to extend the analysis we proposed to account for the possibility of dependent plural readings with *all* to *always*. In a sense we can treat *always* as equivalent to "on all the (relevant) occasions" and give it the following semantics:

(309) $[\![$ always$_C$ $]\!]$ $=\lambda P.\lambda e.$ P(e) $\wedge$ $\forall e' {\le} e$ P(e')

It introduces universal quantification over events, but moreover it also refers to the big event which is the sum of smaller events quantified over and asserts that the predicate holds both for the small events and for the big event.

Let's see how such a denotation can help us get the dependent plural reading. Consider (310):

(310)   John always wears sweaters.

At the higher event predicate level (310) has the following LF:

(311) $\lambda e.$ $\exists X$ [*wear(e, j, X) $\wedge$ *sweater(X)] $\wedge$ $\forall e' {\le} e$ $\exists X$ [*wear(e', j , X) $\wedge$ *sweater(X)]

The singular alternative looks as follows:

(312) $\lambda e.$ $\exists X$ [*wear(e, j, X) $\wedge$ *sweater(X) $\wedge$ atom(X)] $\wedge$ $\forall e' {\le} e$ $\exists X$ [*wear(e', j, X) $\wedge$ *sweater(X) $\wedge$ atom(X)]

The singular alternative is stronger than the plural one, thus the *Exh* operator negates it, and the following meaning arises:

(313) $\lambda e.$ $\exists X$ [*wear(e, j, X) $\wedge$ *sweater(X)] $\wedge$ $\forall e' {\le} e$ $\exists X$ [*wear(e', j , X) $\wedge$ *sweater(X)]
$\wedge$

$\neg$ [$\exists X$ [*wear(e, j, X) $\wedge$ *sweater(X) $\wedge$ atom(X)] $\wedge$ $\forall e' {\le} e$ $\exists X$ [*wear(e', j, X) $\wedge$ *sweater(X) $\wedge$ atom(X)]] =

(314) $\lambda e.$ $\exists X$ [*wear(e, j, X) $\wedge$ *sweater(X)] $\wedge$ $\forall e' {\le} e$ $\exists X$ [*wear(e', j , X) $\wedge$ *sweater(X)]
$\wedge$

[$\neg \exists X$ [*wear(e, j, X) $\wedge$ *sweater(X) $\wedge$ atom(X)] $\vee$ $\neg \forall e' {\le} e$ $\exists X$ [*wear(e', j, X) $\wedge$ *sweater(X) $\wedge$ atom(X)]]] =

(315) $\lambda e.$ $\exists X$ [*wear(e, j, X) $\wedge$ *sweater(X)] $\wedge$ $\forall e' {\le} e$ $\exists X$ [*wear(e', j , X) $\wedge$ *sweater(X)]
$\wedge \neg \exists X$ [*wear(e, j, X) $\wedge$ *sweater(X) $\wedge$ atom(X)] $\vee$

$\exists X$ [*wear(e, j, X) $\wedge$ *sweater(X)] $\wedge$ $\forall e' \leq e$ $\exists X$ [*wear(e', j , X) $\wedge$ *sweater(X)] $\wedge$

$\neg \forall e' \leq e$ $\exists X$ [*wear(e', j, X) $\wedge$ *sweater(X) $\wedge$ atom(X)]]]]

The second disjunct is a contextual contradiction, hence (315) is contextually equivalent to (316):

(316) λe. $\exists X$ [*wear(e, j, X) $\wedge$ *sweater(X) $\wedge$ $|X|>1$] $\wedge$ $\forall e' \leq e$ $\exists X$ [*wear (e', j, X) $\wedge$ *sweater(X)]

(316) gives the dependent plural reading – it requires that the number of sweaters in a big event be more than 1, but there is no requirement that at any particular time more than 1 sweater is worn.

Again, in order to be able to account for the dependent plural readings, we have to assume crucially that the *Exh* operator can be inserted at any level. Exhaustifying at the higher event predicate level gives us the relevant interpretation. Exhaustifying at the lower level gives the non-dependent reading. Zweig's system would incorrectly predict the non-dependent reading to be chosen as the only available reading, as it would be the strongest.

Let's also point out that sentences with *always* can have distributive readings. For example, (317) has a reading where *always* distributes over sweaters.

(317) John always wears a sweater.

I can see two ways of how we can account for this fact: we can either assume that there are two variants of *always*: one is the one we offered in (309) and the second one is more like a distributive quantifier *every*. Another way is to assume that *always*, just like *all*, has an option of pluralizing its sister node.

Another type of adverbials which license dependent plural readings are for-adverbials:

(318) John kicked balls for 20 minutes.

If we use the semantics for *for*-adverbials independently proposed in Kratzer 2007, we would be able to predict the possibility of dependent plural readings. Let's see how exactly. The denotation for *for* is as shown below:

(319) $\lambda P.\lambda e$. P(e) $\wedge$ e = $\sigma e'$ [P(e') $\wedge$ e'<e] $\wedge$ $f_{minute}(e) = 20$

In order to get a dependent plural reading, we need to exhaustify at the higher event predicate level, similar to what we did with *always*. (318) at the higher event predicate level denotes the following:

(320) $\lambda e.\ \exists X\ [*ball(X) \wedge *kick(e)(j)(X) \wedge e = \sigma e'\ [\exists Y\ [*ball(Y) \wedge *kick(e')(j)(Y) \wedge e'<e]]$
$\wedge f_{minute}(e) = 20]$

Its singular alternative is shown in (321):

(321) $\lambda e.\ \exists X\ [*ball(X) \wedge atom(X) \wedge *kick(e)(j)(X) \wedge e = \sigma e'\ [\exists Y\ [*ball(Y) \wedge atom(Y) \wedge$
$*kick(e')(j)(X) \wedge e'<e]] \wedge f_{minute}(e) = 20\ ]$

The singular alternative is stronger than the plural one, thus we negate it and get the following meaning:

(322) $\lambda e.\ \exists X\ [*ball(X) \wedge |X|>1 \wedge *kick(e)(j)(X) \wedge e = \sigma e'\ [\exists Y\ [*ball(Y) \wedge$
$*kick(e')(j)(Y) \wedge e'<e]] \wedge f_{minute}(e) = 20]$

Kratzer points out that we might want to split the denotation in (319) into two parts, as shown below, following the analysis of durational adverbs in van Geenhoven (2004):

(323) $\lambda P.\lambda e.\ P(e) \wedge e = \sigma e'\ [P(e') \wedge e'<e]$

(324) $\lambda e.f_{minute}(e) = 20$

It might be plausible to assume that the denotation of the adverbial proper is as in (324) and what we see in (323) is the denotation of the non-overt inflectional head, which is responsible for iterativity.

(325) $[\![\ ITER\ ]\!] = \lambda P.\lambda e.\ P(e) \wedge e = \sigma e'\ [P(e') \wedge e'<e]$

For our purposes it is not very relevant which analysis might be the correct one.

I just wanted to point out that one more environment where we do get dependent plural readings is habituals, as in (326):

(326) John wears sweaters.

(326) requires than more than one sweater be involved overall, but it does not require that at any particular time John wears more than one sweater. We are not going to go into complicated issues having to do with the semantics of habituals, but it might be plausible to hypothesize that habituals and iteratives share a piece of structure, more specifically, they both contain a head responsible for iterativity. Unlike iteratives, habituals also have a modal component, which might be coming from a modal somewhere higher in the

structure. If this is the right way to think about habituals, then we can account for the possibility of dependent plural reading with habituals in the same way as for iteratives. Exhaustifying at the level of the event predicate introduced by the iterative head should give us the right result.

2.4.3 Modals and dependent plural readings

In this section, we are going to look at one more type of quantificational environment — modals and address a question of whether we do get dependent plural readings with them. Consider (327):

(327) You should wear sweaters at the party tomorrow.

If a dependent plural readings with modals were possible, we would predict the sentence (327) to be true in a situation where in all the possible worlds compatible with the requirements the hearer wears at least one sweater as long as there is more than one sweater involved overall.

However, the sentence is not judged true in such a situation. It rather requires that in every possible world compatible with the requirements John wear more than one sweater. The fact that dependent plural readings are not possible with modals probably shows that modal quantifiers should be treated like a distributive quantifier *every* and not like *all*. For example, the denotation for a deontic *should* is as follows:

(328) [should] $= \lambda P_{<s,t>}$. $\forall w'$ compatible with the requirements in w P (w')

Now, let's demonstrate what readings we predict by exhaustifying at different levels. First, let's apply the *Exh* operator at the level of the lower event predicate, which is given below:

(329) λe. $\exists X$ [*wear(e, john, X) & *sweater(X)]

The singular alternative to (329) looks as follows:

(330) λe. $\exists X$ [*wear(e, john, X) & *sweater(X) & atom(X)]

The singular alternative is stronger than the plural one, so *Exh* negates it, giving rise to the following meaning:

(331) λe. $\exists X$ [*wear(e, john, X) & *sweater(X) & |X|>1]

After applying the existential closure and the modal, we get (332):

(332) $\forall w'[w'$compatible with the requirements in $w \rightarrow \exists e \exists X$ [*wear(e, john, X) & *sweater(X) & $|X|>1$ in w']]

Applying *Exh* anywhere higher in the structure won't give rise to any additional readings, as it will lead to a contradiction, similar to what we saw with the nominal universal quantifier *every*. Thus, the only reading we predict for a sentence like (327) is the distributed multiplicity one: in every accessible world John wears more than one sweater at the party.

2.4.4 A note on Sauerland's readings

Throughout the chapter, we were mostly concerned with the distribution of dependent plural readings. The dependent plural reading was defined in the following way: the bare plural in the scope of another plural has an at least semantics (one or more), but there is an overall multiplicity requirement — overall there have to be multiple things referred to. We discussed different environments in which such readings arise. More specifically, we showed that such readings arise in the scope of definite and indefinite plural DPs, in the scope of adverbials like *always*, in the scope of the object *every*, with quantifiers like *all* and *most*. We also gave an explanation of why there is contrast between subject *every* and *all* with respect to the availability of dependent plural readings. The claim was that in case of subject *every*, unlike *all*, the sentence obligatorily has a reading according to which every boy wore multiple sweaters.

(333) All the boys wore sweaters last night.

(334) Every boy wore sweaters last night.

In this section, I am going to address a question of whether a bare plural in the scope of some quantificational operator can have a weaker reading. For a sentence with a universal quantifier *every* as the one in (335) such a reading can be informally represented as shown in (336):

(335) Every boy read books last night.

(336) Every boy read books last night and it is not the case that every boy read just one book last night.

Sauerland (2003) (see also Sauerland et al. 2005) argues that similar readings arise with definite DPs in the scope of a universal quantifier (hence I adopt the term Sauerland readings). Consider (337):

(337)   Every student brought his sisters to the party.

Sauerland's claim is that (337) is true in a situation as long as every student brought all his sisters and at least one of the students has more than one sister. His analysis in terms of presuppositional treatment of number features, which we will discuss in Section 2.5, can derive this fact.

The question that I would like to raise in this regard is whether we do get such weaker readings with bare plurals and if yes, how such readings can be derived in our system. Let's consider the behavior of a bare plural in the scope of the following quantificational operators: universal quantifier *every* (338), quantificational adverb (339) and a universal modal (340).

(338)   Every professor in our department has students.

(339)   David meets with students every day.

(340)   You should bring friends to the party.

It seems that the default interpretation for (338) is the one where the multiplicity is distributed over by the universal quantifier, namely the one that asserts that every professor has more than one student. The question is whether the sentence is considered to be true in a situation in which there are some professors who have one student and there is one (or more) who has more than one, similar to what Sauerland argues for definite plurals. Zweig thinks that this is not an available interpretation for (338), but some speakers tend to agree that the sentence should be judged true in such a situation.

It seems to me that with other quantificational operators, like adverbials and modals, the judgements are sharper. (339) seems to be true in a situation in which there is at least one day when David meets more than one student and on other days it can be the case that he meets just one student. Similarly, the sentence with a modal (340) does not seem to require that you bring more than one friend.

If it is indeed the case that sentences with a bare plural in the scope of a quantificational element can get a reading which requires that at least for one element from the restrictor of the quantifier the "more than one" condition holds, there should be a way to generate such readings. Let's show that the system as formulated till now does not allow to generate such readings.

The semantics for the universal quantifier we offered in Section 2.3.2.1 is as follows:

(341) ⟦ every boy ⟧ = λP. λe. ∀y [boy(y) → ∃e'≤e P(e')(y)]

As we demonstrated in Section 2.3.2.1, the only reading we can generate in this case is the "universal multiplicity" reading. We do get it, if we apply the exhaustivity operator at the level of the lower event predicate.

Applying *Exh* anywhere above that level leads to a contradiction. For example, if we try to apply it at the level of the higher event predicate, we will have the LF in (342) and its singular alternative is as in (343):

(342) λe. ∀y [boy (y) → ∃e'≤e ∃X *eat(e')(y)(X) ∧ *cookie(X)]

(343) λe. ∀y [boy (y) → ∃e'≤e ∃X *eat(e')(y)(X) ∧ *cookie(X) ∧ atom(X)]

Let me remind what our assumptions on the implicature calculation process are. We assumed that the process is blind to non-logical information, in particular, to the distributivity of the predicate. Thus, if we ignore the distributivity, the singular alternative is stronger than the plural one and the *Exh* operator will negate it, and the following meaning will arise:

(344) λe. ∀y [boy (y) → ∃e'≤e ∃X [*eat(e')(y)(X) ∧ *cookie(X)]] ∧ ¬[∀y [boy (y) → ∃e'≤e ∃X [*eat(e')(y)(X) ∧ *cookie(X) & atom(X)]]]

We claimed that the meaning in (344) contradicts with the world knowledge, namely it is impossible for someone to eat cookies without eating a cookie, and is thus ruled out. Let's try to locate what the problem is and what direction one can go in order to solve it.

For there not to be a contradiction, we should somehow guarantee that we are comparing our sentence with the alternative which is equivalent in meaning to (345):

(345) Every boy ate exactly one cookie.

If it was somehow possible to make sure that the events the quantifier quantifies over are maximal, i.e., do not contain anything else in them, then we would be able to get the necessary entailment relationship between the alternatives (the singular would be stronger than the plural one) and the implicature could be generated.

How can we get the desired result? We can try to modify our assumptions about event semantics a bit, namely let's assume that existential closure does not only close the event variable, but also asserts that the event is maximal, which is expressed in (346):

(346) $[\![\exists \varepsilon_{MAX}]\!]_{\langle\langle s,t\rangle,t\rangle} = \lambda P_{\langle s,t\rangle}. \exists e_s [P(e) \wedge \forall e'[P(e') \rightarrow e' \leq e]]$

Now, let's modify our alternatives in (342)-(343) based on the definition of the existential closure given above:

(347) $\lambda e. \forall y [boy (y) \rightarrow \exists e' \leq e \exists X [^{*}eat(e')(y)(X) \wedge {}^{*}cookie(X)] \wedge \forall e'' \exists X[^{*}eat(e'')(y)(X)$
$\wedge {}^{*}cookie(X) \rightarrow e'' \leq e']]$

(348) $\lambda e. \forall y [boy(y) \rightarrow \exists e' \leq e \exists X [^{*}eat(e')(y)(X) \wedge {}^{*}cookie(X) \wedge atom(X)] \wedge \forall e'' \exists X$
$[^{*}eat(e'')(y)(X) \wedge {}^{*}cookie(X) \& \wedge atom(X) \rightarrow e'' \leq e']]$

Informally, what (347) says is the following: for every boy there is a maximal event in which he ate a cookie or cookies. The corresponding singular alternative says: for every boy there is a maximal event in which he ate a cookie[20]. The singular alternative is stronger than the plural one, and negating it leads to the following:

(349) $\lambda e. \forall y [boy (y) \rightarrow \exists e' \leq e \exists X [^{*}eat(e')(y)(X) \wedge {}^{*}cookie(X)] \wedge \forall e'' \exists X[^{*}eat(e'')(y)(X)$
$\wedge {}^{*}cookie(X) \rightarrow e'' \leq e']] \wedge$
$\neg \forall y [boy(y) \rightarrow \exists e' \leq e \exists X [^{*}eat(e')(y)(X) \wedge {}^{*}cookie(X) \wedge atom(X)] \wedge \forall e'' \exists X$
$[^{*}eat(e'')(y)(X) \wedge {}^{*}cookie(X) \& \wedge atom(X) \rightarrow e'' \leq e']]$

Note that (349) is not a contradiction anymore:

(350) $\lambda e. \forall y [boy (y) \rightarrow \exists e' \leq e \exists X [^{*}eat(e')(y)(X) \wedge {}^{*}cookie(X)] \wedge \forall e''[\exists X$
$^{*}eat(e'')(y)(X) \wedge {}^{*}cookie(X) \rightarrow e'' \leq e']] \wedge [\exists y [boy(y) \wedge \neg \exists e' \leq e \exists X [^{*}eat(e')(y)(X) \wedge$
$^{*}cookie(X) \wedge atom(X)] \wedge \forall e'' \exists X [^{*}eat(e'')(y)(X) \wedge {}^{*}cookie(X) \wedge atom(X) \rightarrow e'' \leq e']]$

Informally, (350) says "for every boy there is a maximal event where he ate a cookie or cookies and there is a boy for whom it is not the case that there is maximal event where he ate a cookie", which means that there is a boy for whom there is an event in which he ate more than one cookie.

The questions that one would like to investigate further are thus the following: whether such weaker readings are available in the first place, whether there is a difference between modals/adverbials and nominal quantifiers in this respect (are they really harder

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[20] Let me just point out an obvious trouble such a move would create. Now a sentence with a singular "every boy ate a cookie" will mean "every boy ate exactly one cookie", but obviously we do not want have "exactly one" as part of the semantic meaning of the singular. It is rather an implicature. The task for the future research is, thus, to understand how we can get the results I am getting in this section without making this harmful move.

for nominal quantifiers?). The fact that for modals such readings are easier to get can probably be related to the fact that modals resist local implicatures in their scope:

(351) You are required to talk to some students.

The most natural reading of (351) is the one in (352). The reading in (353), which we get by exhaustifying below the modal, is much less available, if it is available at all, unless the scalar item is stressed:

(352) You are required to talk to some and not required to talk to all of the students.

(353) You are required to talk to some but not all of the students.

Hence, if it is really the case that modals for some reason resist local implicatures, the most prominent reading we get is the Sauerland one, whereas with nominal quantifiers both readings are available and the stronger one (predicted by Zweig) might be more preferred. But then it's interesting to understand why different scalar items behave differently in this respect: with *plural*, the embedded implicature (Zweig's reading) is more preferred than the global one (Sauerland's reading); for *some*, it was argued that it is the other way around (the global implicature is easier to get that the local one for sentences like *Every boy read some books*).

2.5   Previous approaches to semantics of plurals

In this section we will discuss two previous approaches to the semantics of plurals advanced in Sauerland 2003 and Sauerland et al. 2005, on the one hand, and Spector 2007, on the other hand. The main difference of Sauerland's approach from Zweig's is that he treats numbers features as presuppositions and he argues that the pragmatic principle Maximize Presupposition is responsible for their distribution, but as we will see below, it comes out quite similar to Zweig's approach. Spector derives the multiplicity associated with plurals as a scalar implicature, but he proposes a rather different mechanism of calculating this implicature. The main claim of his approach is that an alternative to plural is not singular, but an enriched version of the singular (exactly one), which is derived as a result of scalar relationship between singular and other numerals (two, three, etc). In other words, singular does not only have plural as its alternative, but it is also involved in a scale with numerals. The multiplicity arises as a result of a higher-order implicature (by comparing plural with the exhaustified version of the singular). As we will show below, both approaches seem to give correct predictions regarding the behavior of

bare plurals in DE environments, but neither approach can account for the dependent plural readings.

2.5.1   Sauerland's account of singular/plural

As we mentioned above, Sauerland gives a presuppositional account of number features. According to him, the singular feature contributes an atomicity presupposition, namely it requires that its complement refer to a single atomic entity. Plural does not have any presupposition of its own. The proposed semantic contribution of number features is shown in (354)–(355):

(354) $[\![$ SING $]\!]$ (x) is defined only if #x=1

   $[\![$ SING $]\!]$ (x) = x wherever it is defined

(355) $[\![$ PLUR $]\!]$ (x) is always defined

   $[\![$ PLUR $]\!]$ (x) = x wherever it is defined

The use of singular/plural is regulated by a pragmatic principle of Maximize Presupposition (Heim 1991) which says that among two alternative morphological forms, the one with a stronger presupposition must be used whenever its presupposition is satisfied.

We should note from the beginning that Sauerland built his analysis primarily to account for the behavior of e-type elements like DP coordinations and pronouns. The main claim of the proposal is that semantically contentful number features are contained in the φ-head which takes DP as its complement and that [Pl] on nouns is not interpreted, but it is rather a reflex of syntactic agreement with a φ-head, just like [Pl] on verbs.

Let's demonstrate how his analysis works for definites.

(356)   Jack met the student.

(357)   Jack met the students.

The idea is that the number on the noun is not interpretable, but there is a freely available *-operator that can apply to any predicate and close it under sum formation. The definite determiner *the* picks out the maximal entity satisfying its complement. If only one student is salient, the presupposition of the singular is satisfied, and (356) can be used in this situation. (357) is blocked, as plural can be used only when the presupposition of the singular is not satisfied, which does not hold in this case. However, if there are two

students who are salient, the DP refers to the plurality of these two students, thus the presupposition of the singular is not satisfied and the use of the singular is blocked, licensing the use of the plural (357).

While Sauerland's account seems to work well for coordinations, pronouns and definites, it is not straightforwardly extendable to account for the behavior of existential quantifiers or existential bare plurals. Sauerland made an attempt to extend it to existential quantifiers. Let's look at it in more detail. As φ can only take an argument of type e, quantifiers cannot be interpreted within φP and therefore they must scope out from the position below φ.

Thus for sentences in (358)- (359), we will have the representation in (360):

(358)   Some egg is still hidden.

(359)   Some eggs are still hidden.

(360)   [some egg] λx. SING/PLUR (x) is still hidden

Number features are interpreted as presuppositions. Thus, the question arises as to how presuppositions are projected from the scope of an existential. Sauerland assumes that there is no projection and that the presupposition becomes part of the assertion. Thus we get the following meanings for (358)-(359):

(361)   There is an atomic entity that is an egg and that is still hidden.

(362)   There is some entity that consists of one or more eggs and is still hidden.

The two representations are equivalent: the singular entails the plural, but the plural also entails the singular, as *being hidden* is a distributive predicate. In neither case does the interpretation of the entire sentence have a presupposition, thus the maximize presupposition principle cannot be used straightforwardly. Sauerland proposes the following principle (363), which is supposed to account for why the number marking does make a difference in positive sentences (358)-(359), but not in the corresponding negative sentences (364)- (365):

(363)   Maximize Presupposition applies to the scope of an existential if this strengthens the entire utterance.

(364)   I didn't find any egg.

(365)   I didn't find any eggs.

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Let's see how the application of the principle in (363) helps to account for (358)-(359). The scope of an existential for the sentence with a singular (358) looks as shown in (366) and for the plural alternative as shown in (367):

(366) $\lambda x.$ SG (x) is still hidden

(367) $\lambda x.$ x is still hidden

Sauerland does not make it clear how the Maximize Presupposition principle exactly works at this level. But we could probably reason along the following lines. At the predicate level the singular is stronger than the plural, as the set in (366) contains only atomic entities, whereas the set in (367) contains both atoms and non-atoms. And thus negating the stronger alternative would lead to the following result:

(368) $\lambda x.$ $|x| > 1$ & hidden(x)

After we apply the existential quantifier, we will get the following meaning:

(369) $\exists X$ [*egg(X) & $|X| > 1$ & hidden(X)]

(369) correctly captures the multiplicity meaning associated with (359).

As for the DE cases like the one in (365), if we use the same mechanism, we would end up getting a meaning which is weaker than the one we would get if we didn't apply this reasoning. The principle in (363) rules out such a situation. Hence, (365) does not get strengthened.

We should note that Sauerland's assumptions are very similar to Zweig's in several respects. More specifically, both of them use the idea that implicature calculation/Maximize Presupposition application can take place at the predicate level – this is the level at which the plural and singular are not equivalent to each other (for Zweig it is the event predicate that is important, as he uses events; for Sauerland it is the predicate of individual level). Second, both of them seem to appeal to some version of the strong meaning principle, which requires us to compute an implicature /use the maximize presupposition if it leads to a stronger meaning (as in DE contexts it would lead to a weaker meaning, the multiplicity does not arise in such environments).

The analysis offered by Sauerland to account for the behavior of existential quantifiers does not seem to be straightforwardly extendable to bare plurals, if we adopt a common view that bare plurals don't have inherent existential semantics[21].

Even if we could find a way to extend it to bare plurals, it would fail to account for the dependent plural readings in sentences like the following:

(370)   All my friends attend good schools.

As we already mentioned, Sauerland's proposal is very similar to Zweig's and it shares the same problem, namely the strongest meaning principle (which Sauerland has in the form of (363)) will select the distributed multiplicity reading, namely the one that requires that each of the friends attend more than one good school.

2.5.2   Spector 2007: multiplicity as a higher-order implicature

Similar to Zweig, Spector argues that the multiplicity component associated with plurals is a scalar implicature and offers a mechanism for deriving it. The main claim of the analysis is that this implicature arises based on the comparison of the plural not with the singular alternative, but with an enriched version of the singular. More specifically, if we have a sentence in (371), we do compare it with (372) and not with (373):

(371)   John saw boys.

(372)   John saw exactly one boy.

(373)   John saw a boy.

This is the crucial ingredient of the analysis, as if we were to compare (371) with (373), we wouldn't be able to derive any implicature, as two alternatives are equivalent[22]. However, (372) is stronger than (371), thus it is negated, leading to the "more that one" implicature, as shown below:

(374)   John saw boys = John saw boy or boys and he didn't see exactly 1 boy = John saw more than one boy.

The question is how come (371) competes with (372) and not with (373).

---

[21] See Appendix for more details on the matter.

[22] Again, this holds under the assumption that the distributivity of the predicate is taken into account.

Spector uses a mechanism of higher-order implicatures. The basic idea is that computation of implicatures should take into account not only the literal meaning of its competitors, but also their enriched meanings. A crucial assumption is that singular is invoved in two scales: on the one hand, it is an alternative to plural; one the other hand, it also forms a scale with numerals <*a, two, three..*>. Thus, first the "exactly one" meaning for singular is derived (based on the negation of the *two*-alternative) and after that the multiplicity implicature is generated, based on the relationship between plural and this enriched version of the singular. Let's see how the system works, using the following three sentences.

(375)   John saw a horse.

(376)   John saw horses.

(377)   John saw several horses.

The literal meanings of these sentences are as in (378)-(380):

(378)   John saw at least one horse.

(379)   John saw at least one horse.

(380)   John saw at least two horses.

The set of scalar alternatives for these three sentences is as follows:

(381)   {John saw a horse, John saw horses, John saw several horses}

(382)   {John saw horses, John saw a horse}

(383)   {John saw several horses}

Next, we compute level-1 implicatures. Note that we get an enriched meaning only in the case of (375), as there is an alternative in the set which is stronger than the literal meaning, namely John saw several horses, thus we negate it and get the meaning in (384). In case of (376)-(377), we get the unenriched meanings in (385)-(386), as the set in (382) contains alternatives which are equivalent and the set in (383) contains only one alternative:

(384)   John saw exactly one horse.

(385) John saw at least one horse.

(386) John saw at least two horses.

After computing first-level implicatures, we turn to the sets of level 1-alternatives, which are enriched versions of the sets in (381)-(383):

(387) {John saw exactly one horse; John saw at least one horse; John saw at least two horses}

(388) {John saw exactly one horse; John saw at least one horse}

(389) {John saw at least two horses}

The second-level implicatures look as follows:

(390) Jack saw exactly one horse.

(391) Jack saw at least one horse but not exactly one horse.

(392) Jack saw at least two horses.

Thus, we get the meaning in (391) for the sentence with the plural *Jack saw horses*. It can also be shown that all the other iterations won't add anything new to the meaning, as none of the sentences have any alternatives that are stronger.

In downward-entailing contexts no implicatures are predicted, as there are no alternatives that are stronger than the literal interpretation neither for the sentence with the singular nor for the sentence with the plural:

(393) Jack didn't see a horse.

(394) Jack didn't see horses.

(395) {Jack didn't see a horse; Jack didn't see horses; Jack didn't see several horses}

(396) {Jack didn't see a horse; Jack didn't see horses}

In (395) one alternative is equivalent to the literal meaning and the second one is weaker. In (396) the alternative is equivalent to the literal meaning. Thus the lack of implicatures in DE contexts is predicted.

Spector does not offer any account of dependent plurals, but he points out in a footnote that his analysis is compatible with an account of dependent plurals as a specific instance of cumulative interpretations. It seems to me that Spector will inherit Zweig's problem, namely he won't be able to account for dependent plural readings in sentences with *all*:

(397)   All my friends attend good schools.

As we mentioned several times in the dissertation, sentences with *all* do not give rise to cumulative interpretations, thus a cumulativity-based account of dependent plurality cannot be used in this case. At the moment, I do not see how the difference between *every* and *all* with respect to the availability of dependent plural readings can be captured in his system.

Appendix: Existential BP and its relation to other readings

English bare plurals can have at least three interpretations: kind, generic and existential, which are illustrated by the following three sentences in (398)-(400):

(398) Dinosaurs are extinct.

(399) Dogs bark.

(400) Dogs are barking.

The first two readings can be grouped together as general statements applying to a whole class, whereas the third reading describes properties of some members of the class at a particular time.

Even though the first two readings seem very similar to each other, there are reasons not to lump them together. As was pointed out in many works (see Dayal 2011, for example), the crucial difference between (398) and (399) has to do with the fact that the property described in (399) can be related to individual instances of a kind (401), whereas it is impossible to do so with the property in (398) :

(401) Fido barks.

(402) *Fido is extinct.

There have been many attempts in the literature to account for the different interpretations of bare plurals (Carlson 1977, Chierchia 1998, Krifka 2003, and many others). The questions that were addressed are the following: is each of these readings associated with a different denotation for a bare plural? Or should BP have a uniform semantics and the source of the ambiguity comes from a different source? What reading is the basic one? And how are all the readings related to each other?

On the first glance it seems very tempting to equate BP in its existential use to indefinites, as (400) can be easily paraphrased by (403):

(403) Some dogs are barking.

However, it has been noted in Carlson 1977 that there are crucial differences between

BPs and indefinites. One of the major differences concerns the scopal properties of bare plurals and indefinites. Existential BPs can only take narrow scope, whereas indefinites can also get a wide scope. For example, (404) allows for two interpretations: it can either mean that there is a particular book on caterpillars and it was read by everyone or it can mean that everyone read a different book on caterpillars. However, the corresponding sentence with a bare plural (405) does not license a wide scope interpretation – the sentence cannot mean that there are books that everyone read:

(404) Everyone read a book on caterpillars.

(405) Everyone read books on caterpillars.

A similar point can be made with sentences containing negation.

(406) John didn't read a book on caterpillars.

(407) John didn't read books on caterpillars.

(406) has two possible interpretations – the indefinite *a book* can either take a wide scope over negation, leading to the meaning "there is a book on caterpillars that John didn't read" or it can be interpreted below negation, leading to "it is not true that John read any book on caterpillars". (407), however, lacks a reading where the bare plural takes a wide scope. Thus, any approach that takes existential BP to be equivalent to existential quantifiers, has to explain why they exhibit different scopal properties demonstrated above.

Approaches to the semantics of bare plurals

The first very influential paper on the topic, Carlson 1977, assigns a uniform semantics to bare plurals, more specifically, Carlson argues that bare plurals always denote kinds. A kind is an entity of type e, that corresponds to a whole species or type of thing. Whether we get a universal (Carlson takes generic and kind readings to be the same phenomenon) or an existential interpretation of the bare plural depends exclusively on the nature of the predicate it combines with: if the predicate is individual-level, the bare plural is interpreted generically, as in (408); if the predicate is stage-level, an existential interpretation of the bare plural arises, as in (409).

(408) Policemen are tall.

(409) Policemen are available.

According to Carlson, stage-level predicates introduce as a part of their meanings existential quantifiers, that is, existential readings of BP's comes from this existential quantifier introduced by the predicate and is not part of the meaning of the BP itself. In such a way an obligatory narrow scope of BP is captured.

Carlson's idea that the distribution of generic/existential readings correlates with stage-level/individual-level distinction was later criticized. In particular, Diesing (1992) and Kratzer (1995) suggest that subjects of stage-level predicates do not obligatorily have an existential interpretation, but are, in fact, ambiguous between existential and generic interpretations. For example, (410) with a stage-level predicate *be available* can have two interpretations shown in (411):

(410)   Firemen are available.

(411)   a. There are available firemen.
        b. Firemen have the property that they are available.

Two other theories of Bare Plurals (Chierchia 1998 and Krifka 2003) use type-shifting in order to account for different readings of BP.

According to Chierchia, BP start out as properties, but they are type-shifted to kinds. He proposes two type-shifters, the "down" operator ∩, and the "up" operator ∪, which turn a property into a kind and vice versa, respectively. So in cases of direct kind predication like (398) BPs denote kinds.

To get an existential reading, Chierchia uses a Derived Kind Predication rule, which is formulated as follows:

(412)   Derived Kind Predication (DKP): If P is a predicate that selects for non-kind individuals, and k denotes a kind, then $P(k) = \exists x\ [\cup k(x) \wedge P(x)]$

Thus, when a bare plural (which is a kind-denoting argument) is given to a predicate that selects for non-kind individuals, an existential quantifier over the members of that kind will be inserted, fixing the mismatch. Chierchia also makes an assumption that this rule should be applied locally, thus guaranteeing the narrow scope of existential bare plurals.

Krifka's approach uses the same type-shifters and he also assumes that BP denote properties, but the difference is that he does not consider one of the readings to be more basic than the other one. Thus, to get a kind reading, type-shifting to kinds is applied and to get an existential reading, type-shifting to existentials is applied (there is no intermediate stage where BP denote kinds, unlike what Chierchia proposes). Again, the narrow scope of BPs is accounted for by appealing to the locality of type-shifting.

There are also ambiguity approaches which posit that bare NPs are ambiguous between kind and an indefinite, as has been suggested by Wilkinson (1991) and Gerstner-Link and Krifka (1993).

The question that arises is how generic readings of bare plurals should fit into the picture. Many authors assume that generic readings should be treated as existential bare plurals within the scope of a null generic operator (Chierchia 1998, Krifka 2004)

For the purposes of the present work, we are going to make the following assumption regarding the denotation of BPs.

In the following discussion, we will ignore the kind reading of BPs and we will assume that it is derived in a different way than the other readings (by having the BP denote a kind). We will assume that in both existential and generic readings BP denote properties and we will follow Zweig in using the following type-shifting rule:

(413)   Bare Plural Existential Closure:

(414) $\lambda X[*\varphi(X)] \Rightarrow \lambda \psi_{\langle e,t \rangle} \exists X[*\varphi(X) \ \& \ \psi(X)]$

The discussion in Chapter 2 only deals with existential BPs, but the hope is that the analysis can be extended to account for generic readings as well (under the assumption that generic readings are cases of existential BPs in the scope of the generic operator).

Chapter 3   Plural Disjunction:
Obligatory Implicatures
and Grammaticality

In this chapter, I am going to use the theory of scalar implicatures to account for the puzzling agreement behavior of disjunctive noun phrases. Using data from Russian where number agreement with disjunctions varies in different environments, I will show that this variability follows from the analysis of disjunctive NPs as existential generalized quantifiers and general principles of implicature computation we have argued for in the previous chapter.

In some (but not all!) environments plural verbal agreement with a subject-disjunction is possible, even though both disjuncts are singular. It will be shown that plural agreement is restricted to downward-entailing and quantificational contexts.

If disjunctive NPs are thought of as predicates, then the behavior of *plural* disjunctions can be likened to the behavior of existential bare plurals (see Chapter 2). However, the fact that we are dealing with disjunctive NPs adds a new twist: there will be two scalar items involved now, not only the plural feature, but also the disjunction itself. The plural feature triggers a *multiplicity implicature* along the lines of the modification of Zweig 2008 we have argued for in Chapter 2, while the disjunction triggers an *exclusivity implicature*. We will see that the plural feature on a disjunctive NP will be licensed as long as these two implicatures don't give rise to a contradiction.

Thus, this study presents an interesting case of interaction of scalar implicature computation and grammar. The grammaticality of sentences with subject-disjunction will depend on whether their strengthened meanings are contradictory or not. Crucially, this dependency can only be possible if at least some implicatures are *obligatory* (i.e. cannot be canceled).

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The chapter is structured as follows. In Section 3.1 I will introduce the puzzle, namely the distribution of plural disjunctions in Russian. Then I will sketch informally an implicature-based account (Section 3.2). After that I will propose a formal account and use it to analyze several particular cases (Section 3.3). The implications of the proposal for the theory of scalar implicatures will be discussed in Section 3.4. I will also point at similarities between the distribution of plural disjunctions and the distribution of certain indefinite pronouns (Section 3.5), and have a short discussion of plural disjunctions cross-linguistically (Section 3.6). Section 3.7 concludes the chapter[23].

3.1 The puzzle

We will now focus on the distribution of number agreement with disjunctive noun phrases. It is a well-known fact that agreement with disjunction shows a great amount of variability (see Morgan 1985, Peterson 1986, Jennings 1994, Eggert 2002 for English). I will mainly discuss the facts from Russian (although see Section 3.6), where morphology allows us to see verbal number agreement in all of the environments we will be concerned with.

It has been noticed that number agreement with disjunctive NPs in Russian seems variable or, as Crockett (1976) puts it, "erratic" (see also Skoblikova 1959): sometimes only singular agreement is possible, sometimes plural as well, sometimes plural becomes the preferred option.

For the purposes of this work, I will limit my attention to disjunctive NPs containing two *singular* disjuncts. I will assume that when such disjunctions agree with the verb in plural, it reflects the fact that the disjunction bears an interpretable plural number feature[24].

I propose that the decisive factor in choosing the agreement feature on a disjunction is the semantic environment in which the disjunction occurs.

In non-quantificational upward-entailing environments, like the episodic sentence in (415), only singular agreement is possible:

(415)   Petja   ili Vasja   prišël-Ø /*prišl-i.
        Petja   or Vasja   came-SG/*came-PL
        'Petja or Vasja came.'

---

[23] Some of the results have been already reported in Ivlieva 2012a,b.

[24] The moment we take into consideration disjunctions in which at least one of the disjuncts is plural, it will be harder to see if the plural agreement on the verb is agreement with an interpretable feature of the disjunction or it is really *closest conjunct agreement* or it relies on some idiosyncratic strategy of feature conflict resolution. These options have in fact been attested in Russian (Skoblikova 1959, Crockett 1976).

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In downward-entailing environments and *yes/no*-questions, plural agreement is possible, and maybe even preferred:

(416) *Negation*[25]

Ja ne dumaju, čto Petja ili Vasja prišl-i/?prišël-∅.

I not think that Petja or Vasja came-PL/?came-SG

'I don't think that Petja or Vasja came.'

(417) *Conditionals*

Esli Petja ili Vasja prid-ut/ët, ja budu ochen' schastliva.

If Petja or Vasja come.FUT-PL/SG I will.be very glad

'If Petja or Vasja come/comes, I will be very glad.'[26]

(418) *Restrictors of universal quantifiers*

Každyj iz tex, k komu Petja ili Vasja prišl-i/??prišël-∅ v gosti,

everyone from those to whom Petja or Vasja came-PL/??came-SG in guests

byl im rad.

was them glad

'Everyone of those whom Petja or Vasja came to visit was glad to receive them.'

(419) *Yes/no-questions*

Petja ili Vasja prišl-i/??prišël-∅ ?

Petja or Vasja came-PL/??came-SG

'Is true that Petja or Vasja came?'

In quantificational environments, plural agreement is possible, too. Cf. examples below in which disjunctions are used under nominal quantifiers, frequency adverbials, bouletic predicates and modals.

(420) *Nominal quantifiers*

Ran'še vse turniry "Bol'šogo šlema" vyigryval-∅/-i

earlier all tournaments.ACC Grand Slam.GEN won-SG/-PL

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[25] The negation has to be non-local. In the presence of the clausemate negation, the negative concord item *ni... ni* ('not... not') must be used instead of *ili* ('or').

[26] Cf. also an example cited in Skoblikova 1959:

(ix) A esli [Darja Vasil'jevna ili Anton Ivanovič] zagljanut(PL), Elizaveta Stepanovna kinets'a zatvorjat' framugi, dver'. (*V. Kočetov*).

'And if Daria Vassilievna or Anton Ivanovich would peep in, Elizaveta Stepanovna would rush to shut the window frames and the door.'

Federer ili Nadal'.

Federer or Nadal

'Earlier, all the *Grand Slam* tournaments were won by Federer or Nadal.'

(421) *Frequency adverbials*

Každyj vtornik   Petja ili Vasja prixodil-$\emptyset$/-i   ko mne na rabotu.

every Tuesday   Petja or Vasja came-SG/-PL   to me   on work

'Every Tuesday Petja or Vasja came to my office.'

(422) *Bouletic predicates*

Ja xoču, čtoby Petja ili Vasja prišl-i/prišël-$\emptyset$ ko mne v gosti.

I want that   Petja or Vasja came-PL/came-SG to me in guests

'I want Petja or Vasja to visit me.'

(423) *Modals*

Doma   dolžn-y/dolžen-$\emptyset$ byt'   Petja ili Vasja.

at.home must-PL/must-SG be   Petja or Vasja

'Petja or Vasja must be at home.'[27]

(As noted in Skoblikova 1959 and Crockett 1976, plural disjunctions are also licensed in generic statements. Although we won't consider those in this dissertation, I believe that the analysis that I am going to propose for other has potential of being extended to generics. I will leave it for future research).

While the fact that plural disjunctions are licensed in DE-environments could be tentatively taken as evidence that scalar implicatures are somehow important, quantificational environments seem trickier to make sense of.

Interestingly, in quantificational cases, there is a noticeable difference between singular and plural agreement with respect to possible interpretations. Plural agreement forces the narrow scope interpretation of disjunction. For example, the sentence in (421)

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[27] Crockett (1976) notices a similar effect of the imperative (which must have modal force). She cites the following example:

(x)   Posmotrite xotja by, kak tesno i melko pečatajutsja(PL) teper' 'Nedelya' ili 'Filosofskij slovar'' izdanija 1972 goda.

'Just look at how close and small *Nedelja* or *Dictionary of Philosophy* of 1972 are printed now.'

Here is her take on this data point: "the disjunction is conditioned by the imperative, for in the indicative mood this disjunction would not make any sense (cf. [*] 'Nedelya' ili 'Filosofskij slovar'' pečatajutsja teper' tesno i melko; 'Nedelya or Dictionary of Philosophy are printed now in close and small print'). Only a conjunction would make sense in the indicative mood; cf. 'Nedelya' i 'Filosofskij slovar'' pečatajutsja teper' tesno i melko; 'Nedelya and Dictionary of Philosophy are printed now in close and small print')."

with plural agreement cannot be used in a scenario where it was the same person who came every day and the speaker is ignorant about his identity. In such a scenario a sentence with a singular agreement must be used, as demonstrated by the following example:

(424)　Každyj　vtornik　Petja ili Vasja prixodil-Ø/*-i ko mne na rabotu —
　　　　every　Tuesday　Petja or Vasja came-SG/*-PL to me on work
　　　　ja　ne　pomnju,　kto　imenno.
　　　　I　not　remember　who　exactly
　　　　'Every Tuesday Petja or Vasja came to my office.'

In what follows, I will propose that the distribution of plural disjunctions can indeed be given an implicature-based account. In a nutshell, I will argue that plural disjunctions trigger two implicatures: the familiar *multiplicity* implicature, coming form the plural feature, and the *exclusivity* implicature, coming from the scalar item *ili* 'or'. The fact that plural disjunctions are blocked in cases like (415) will be attributed to the impossibility of having a non–contradictory meaning for such sentences after implicature computation. Downward–entailing and quantificational environments will be shown to be exactly the contexts in which the two implicatures don't give rise to contradictions.

3.2　Informal　Proposal　(Preliminary　Assumptions　and Analysis in a Nutshell)

As we already discussed, it is clear that in a disjunction with two singular disjuncts plural agreement on the verb cannot be the result of local agreement with either of these disjuncts. Thus, it seems plausible to make an assumption that plural agreement on the verb comes from the plural feature on the disjunction. Why would there be a number feature? It wouldn't be so surprising if disjunctions were nominal predicates, like the ones discussed in the previous chapter. We can also assume that this predicate combines with a covert existential quantifier and gets an existential force[28]. This predicate is marked for number, it can be either singular or plural, and the number feature projects the way it normally does in GQs like *some boy* or *some boys*. The structure is given below:

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[28] Another possible option is that similar to existential bare plurals, disjunctions start out as predicates and get their existential force through a type-shifting mechanism (see Appendix in Chapter 2 for more details).

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(425)

```
          QP
        /    \
     some     NP
            /    \
        /‾‾|‾‾\   [SG]/[PL]
       A   OR  B
```
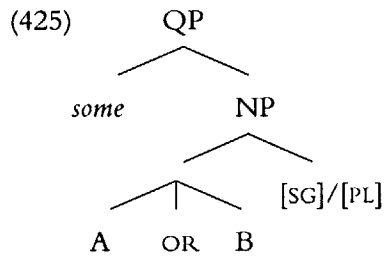
An obvious question to ask is what the semantics of the number feature is. In the previous chapter, we assumed that numberless nouns denote sets of atomic individuals, the singular feature is vacuous and the plural feature denotes the closure of the predicate under sum formation. For instance, if our domain contains three boys a, b and c, the denotations for *boy* and *boys* are as follows:

(426)   [[boy]] = {a, b, c}

(427)   [[boys]] = *[[boy]] = {a, b, $a \oplus b$, $b \oplus c$, $a \oplus b \oplus c$}

Similarly, if we assume that disjunction is a predicate, namely the one shown in (428), the disjunction with a plural feature will denote a predicate closed under sum:

(428)   [[A or B]] = [[[A or B]-sg]] = {a, b} = $\lambda x. x$ is a or x is b

(429)   [[[A or B]-pl]]   = *[[A or B]] = {a, b, $a \oplus b$}
        = *($\lambda x. x$ is a or x is b) = $\lambda x. x$ is a or x is b or x is $a \oplus b$

Now let me present an intuition behind an analysis we are going to pursue. In the previous chapter, we argued that plural is a scalar item and it gives rise to a multiplicity implicature in appropriate contexts. As we know, disjunction is also a scalar item and it is usually associated with an exclusivity implicature, namely speakers tend to interpret the sentence with a disjunction (430) as in (431):

(430)   Petja or Vasja came.

(431)   Petja or Vasja came and it's not true that Petja and Vasja came.

It is plausible that a sentence with a plural disjunction would normally have two implicatures: the one that is generated by the plural feature (multiplicity) and the one generated by disjunction (exclusivity). For example, the two implicatures of a sentence like (415) with a plural disjunction ((432) below) would be as in (433):

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(432) [Petja or Vasja]PL came.

(433) a. It's not true that only one of the boys came. (*multiplicity*)
       b. It's not true that both Petja and Vasja came (*exclusivity*)

It is obvious that in this case the two implicatures taken together contradict the asserted disjunctive meaning: *Petja or Vasja or both came*; and I would like to argue that this clash is the reason of why the plural feature on disjunction and hence the plural agreement on the verb is blocked.

Note that if the feature on the disjunction were singular (which is actually the only grammatical option for (415)), there won't be any contradiction. Since the plural alternative is logically weaker, the implicature won't be generated. All we will have would be an exclusivity implicature, and hence the strengthened meaning in (432).

Now, let's consider (421)/(434) as an example of one of the quantificational environments, in which, as we now know, the plural disjunction is licensed.

(434) Every Tuesday [Petja or Vasja]PL came.

In this case two scalar items lead to the following two implicatures:

(435) a. It's not true that every Tuesday Petja came and it's not true that every
           Tuesday Vasja came. (overall, both Petja and Vasja came)   (*multiplicity*)

       b. Every Tuesday P. or V. came and it's not true that every Tuesday Petja and
           Vasja came.   (*exclusivity*)

The two implicatures shown in (435) are consistent with the assertion that *every Tuesday Petja or Vasja or both came*, and seem to lead to the right meaning: both boys have to come overall, but on no Tuesday, both boys have to come.

The distribution of plural disjunctions is conditioned by what implicatures are generated and whether they lead to a contradictory strengthened meaning. If the implicatures do not give rise to a contradiction, plural agreement is fine; but when there is a contradiction and no possibility of getting rid of troublesome alternatives before computing implicatures, ungrammaticality results!

To make this intuition work, we will have to have a theory in which (at least some) scalar implicatures are not optional in a Gricean way. If they were, there would be a way to "save" any sentence like the one in (432) by simply not computing one or both of the implicatures. Since it is apparently not an option, some implicatures would have to be

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obligatory. I will argue that obligatoriness of implicatures can come from at least two sources: a) certain scalar items are specified as having alternatives which have to be used by the exhaustification operator (this is what we argued for the plural in Chapter 2); b) there are certain constraints on pruning of alternatives, which can eventually lead to implicatures being obligatorily generated.

3.3   Formal Analysis

In this section, I am going to offer a formalization of the informal intuition sketched in the previous section. In order to do that, I will explicitly lay out my assumptions on the implicature calculation process. First, I assume that scalar implicatures are brought about by a covert exhaustivity operator *Exh*, relativized to particular scalar alternatives, that we have already seen in use in the previous chapter. *Exh* can apply either at a sentence level (436) or at a predicate level ((436) for event predicates):

(436)   a. $[\![\, Exh_{\mathrm{ALT}} \,]\!] \; = \lambda P_t. \; P \wedge \forall Q: Q \in \mathrm{ALT} \wedge Q \vDash P \; [\neg Q]$

   b. $[\![\, Exh_{\mathrm{ALT}} \,]\!] \; = \lambda P_{\langle s,t \rangle}. \; \lambda e. \; P(e) \wedge \forall Q: Q \in \mathrm{ALT} \wedge Q \subseteq P \; [\neg Q(e)]$

Second, as we will be dealing with two scalar items (namely, the plural feature (PL) and the predicative disjunction (OR)), we need to make assumptions regarding how the set of alternatives is defined in this case. I will assume, following Sauerland (2004), that the set of alternatives for a sentence with two occurrences of a scalar item $\varphi(X, Y)$, where X is an element of the scale Q_X and Y an element of the scale Q_Y, is defined as follows:

(437) $\mathrm{ALT}(\varphi(X, Y)) = \{ \; \varphi(X', Y') \, | \, X'$ an element of Q_X, Y' an element of $Q_Y \}$

As argued in the previous chapter, the plural feature (PL) and the singular feature (SG) form a scale. As for the predicative disjunction [A OR B], I would like to assume it has the non-boolean conjunction [A⊕B] defined in (438) as its alternative:

(438) $A_{\langle e,t \rangle} \oplus B_{\langle e,t \rangle} = \lambda x_e. \exists y_e, z_e \; [x = y \oplus z \wedge A(y) \wedge B(z)]$ (cf. Krifka 1990)[29]

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[29] Here are some examples from Krifka 1990 that are supposed to serve as evidence for the existence of non-boolean conjunction which applies to $\langle e,t \rangle$ predicates:

(xi)   John and Mary are husband and wife.

(xii)   The flag is green and white.

For the details I refer the reader to Krifka's paper. Also see Hoeksema 1988.

My assumptions about event semantics remain the same as in the previous chapter (see Section 2.2.1.1 for details).

3.3.1 Non-quantificational, non-DE cases

Now let's see how these assumptions taken together allow us to explain for the data in Section 3.1. First, let's examine the ungrammatical "non-quantificational" case repeated below:

(439) * [Petja ili Vasja] prišl-i.
    [Petja OR Vasja]-PL came-PL
    'Petja or Vasja came.'

The ungrammaticality of such sentences is due to the fact that their implicatures give rise to a contradiction. Here is how it works.

Exhaustification operator $\mathcal{E}xh$ can apply at several levels. If it applies at the topmost, propositional level, its prejacent will have the denotation in (440).

(440) $\exists e \exists x.[[x{=}p \vee x{=}v \vee x{=}p{\oplus}b] \wedge {}^*came(e, x)]$

We are dealing with two scalar items: OR and PL associated with two scales $\{OR, \oplus\}$ and $\{PL, SG\}$, respectively. Based on (437), the alternatives $\mathcal{E}xh$ operates on will be the following:

(441) a. $\exists e \exists x.[[x{=}p \vee x{=}v] \wedge {}^*came(e, x)]$ [SG, OR]
    b. $\exists e \exists x.[[x{=}p{\oplus}b] \wedge {}^*came(e, x)]$ [PL, $\oplus$]

In Chapter 2, we showed that the implicature calculation is blind to the non-logical information, more specifically, it is blind to the distributivity of the predicate. Thus, when we compute an implicature, we do not have the information that *come* is a distributive predicate and at that moment each of the alternatives is stronger than the prejacent. Negating both of them leads to the following strengthened meaning:

(442) $\exists e \exists x.[[x{=}p \vee x{=}v \vee x{=}p{\oplus}v] \wedge {}^*came(e, x)] \wedge$

     $\wedge \neg \exists e \exists x.[[x{=}p \vee x{=}v] \wedge {}^*came(e, x)] \wedge$ *(muliplicity)*

     $\wedge \neg \exists e \exists x.[x{=}p{\oplus}v \wedge {}^*came(e, x)]$ *(exclusivity)*

See a more detailed derivation below:

(443) $\exists e \exists x. [[x=p \lor x=v \lor x=p \oplus v] \land {}^*came(e, x)]$ $\land$

    $\land \neg\exists e \exists x. [[x=p \lor x=v] \land {}^*came(e, x)] \land$ EXCLUSIVITY

     $\land \neg\exists e \exists x. [x=p \oplus v \land {}^*came(e, x)]$ MULTIPLICITY

$\mathcal{E}xh_{\{SG, \oplus\}}$ $\exists e \exists x. [[x=p \lor x=v \lor x=p \oplus v] \land {}^*came(e, x)]$

      $\exists \varepsilon$ $\lambda e. \exists x. [[x=p \lor x=v \lor x=p \oplus v] \land {}^*came(e, x)]$

          λe_7 $\exists x. [[x=p \lor x=v \lor x=p \oplus v] \land {}^*came(e_7, x)]$

            $\lambda P. \exists x. [[x=p \lor x=v \lor x=p \oplus v] \land P(x)]$ $\lambda x. {}^*came(e_7, x)$

            some $\lambda x. x=p \lor x=v \lor x=p \oplus v$ came
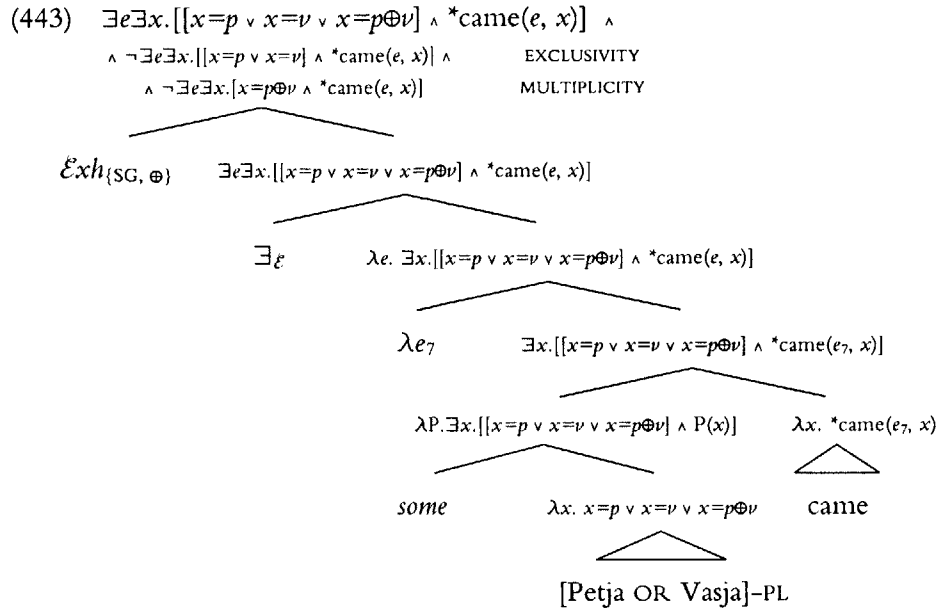
                  [Petja OR Vasja]-PL

Informally, the strengthened meaning is that there is a coming event and the agent of this event is either Petja or Vasja or both but there is no coming event where the agent is one of Petja or Vasja and there is no event with the sum of Petja and Vasja as the agent. This is obviously a contradiction.

Another possibility would be to apply $\mathcal{E}xh$ before existential closure. The denotation on that level is the one of an event predicate:

(444) $\lambda e. \exists x [[x=p \lor x=v \lor x=p \oplus v] \land {}^*came(e, x)]$

The scalar alternatives are the following:

(445) a. $\lambda e. \exists x [[x=p \lor x=v] \land {}^*came(e, x)]$ [SG, OR]

     b. $\lambda e. \exists x [[x=p \oplus v] \land {}^*came(e, x)]$ [PL, $\oplus$]

Again, each of the alternatives is stronger than the prejacent, and so, the exclusivity and multiplicity implicatures are computed at the event predicate level:

(446) $\lambda e.\exists x \, [[x{=}p \vee x{=}v \vee x{=}p{\oplus}v] \wedge {}^*\text{came}(e, x)] \wedge$

$\wedge \neg \exists x \, [[x{=}p \vee x{=}v] \wedge {}^*\text{came}(e, x)] \wedge$

$\wedge \neg \exists x \, [x{=}p{\oplus}v \wedge {}^*\text{came}(e, x)]]$

The strengthened meaning in (446) is, again, obviously contradictory.

In sum, wherever you apply $\mathcal{E}xh$ in cases like (439), the result of implicature computation is contradictory, which I take to be the reason why these cases are ungrammatical.

3.3.2   Downward-entailing environments

Now let's turn our attention to DE environments and see how we can account for the fact that plural disjunctions are licensed in such environments. Consider (447):

(447) Ja ne dumaju, čto   Petja ili Vasja   prišli.
      I not think   that [Petja OR Vasja]-PL   came-PL
      I don't think Petja or Vasja arrived.

Just as in the previous case we looked at, there are several possible sites for the insertion of the exhaustivity operator $\mathcal{E}xh$. Obviously, if we apply $\mathcal{E}xh$ at the event predicate level in the embedded clause, the result of exhaustification will be contradictory,

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just like in (446); if we were to insert $\mathcal{E}xh$ right above the event closure in the embedded clause, we would also get a contradiction, just like in (443).

There is, however, another possibility — to apply $\mathcal{E}xh$ at propositional level, but above negation (448)[30]. In this case the two scalar alternatives will look as in (449):

(448) $\mathcal{E}xh_{\{SG, \oplus\}} (\neg \exists e \exists x.[[x=p \lor x=v \lor x=p\oplus v] \land {}^{*}came(e, x)])$

(449) a. $\neg \exists e \exists x.[[x=p \lor x=v] \land {}^{*}came(e, x)]$　　　　　[SG, OR]

　　　　b. $\neg \exists e \exists x.[[x=p\oplus v] \land {}^{*}came(e, x)]$　　　　　　[PL, $\oplus$]

Since each of the alternatives is weaker than $\mathcal{E}xh$'s prejacent, exhaustification is vacuous:

(450) $\mathcal{E}xh_{\{SG, \oplus\}} (\neg \exists e \exists x.[[x=p \lor x=v \lor x=p\oplus v] \land {}^{*}came(e, x)]) =$
　　　$= \neg \exists e \exists x.[[x=p \lor x=v \lor x=p\oplus v] \land {}^{*}came(e, x)]$

The result is not contradictory, so the plural disjunction is licensed.

The same logic applies to other downward-entailing environments. As soon as you apply $\mathcal{E}xh$ above a DE-environment, the alternatives will be weaker than the prejacent, exhaustification will be vacuous, and so, the plural disjunction will be grammatical.

3.3.3　Quantificational environments

Plural disjunctions are also licensed in environments that involve quantification (see (420)-(423)). Why should it be so? I will argue this is because exhaustification can be applied above the quantifier, yielding a non-contradictory result.

Let's start by examining the case in (420), repeated below as (451):

(451) Ran'še　　vse　turniry　　　　"Bol'šogo šlema"　　vyigryval-i
　　　　earlier　　all　tournaments.ACC　Grand　Slam.GEN　won-PL
　　　　Federer　ili　Nadal'.
　　　　[Federer　OR　Nadal]-PL
　　　　'Earlier, all the Grand Slam tournaments were won by Federer or Nadal.'

Interestingly, the sentence with the plural disjunction in (451) has a dependent plural reading. The sentence says that each Grand Slam tournament was won by either Federer or Nadal (or both, if we are including the doubles) and that if the tournaments are taken

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[30] I will assume for the purposes of exposition that in *Neg*-raising sentences, negation is interpreted below the attitude predicate. I am certainly not aiming here for the correct theory of *Neg*-raising; whichever one adopts, it should be possible to apply $\mathcal{E}xh$ above negation.

together, the winners were Federer and Nadal (not just one of them). We'll be able to capture this reading if we adopt the semantics for the quantifier *vse* ('all') from the previous chapter (section 2.3.2.4), so the denotation of *vse turniry "Bol'šogo šlema"* ('all the Grand Slam tournaments') will be as follows:

(452) [[vse turniry B. š. / all the GS tournaments]] =

= $\lambda P.\ \lambda e.P(e)(\sigma^*\text{GS\_tournament}) \wedge \forall y[(y<\sigma^*\text{GS\_tournament} \wedge \text{atom}(y) \rightarrow$
$\exists e'[e'<e \wedge P(e')(y)]]]$

This is a generalized quantifier of the Kratzerian type $\langle\langle e,st\rangle,st\rangle$. Let's see what we get if we insert *Exh* at the event predicate level, right above this quantifier:

(453) (see (457))
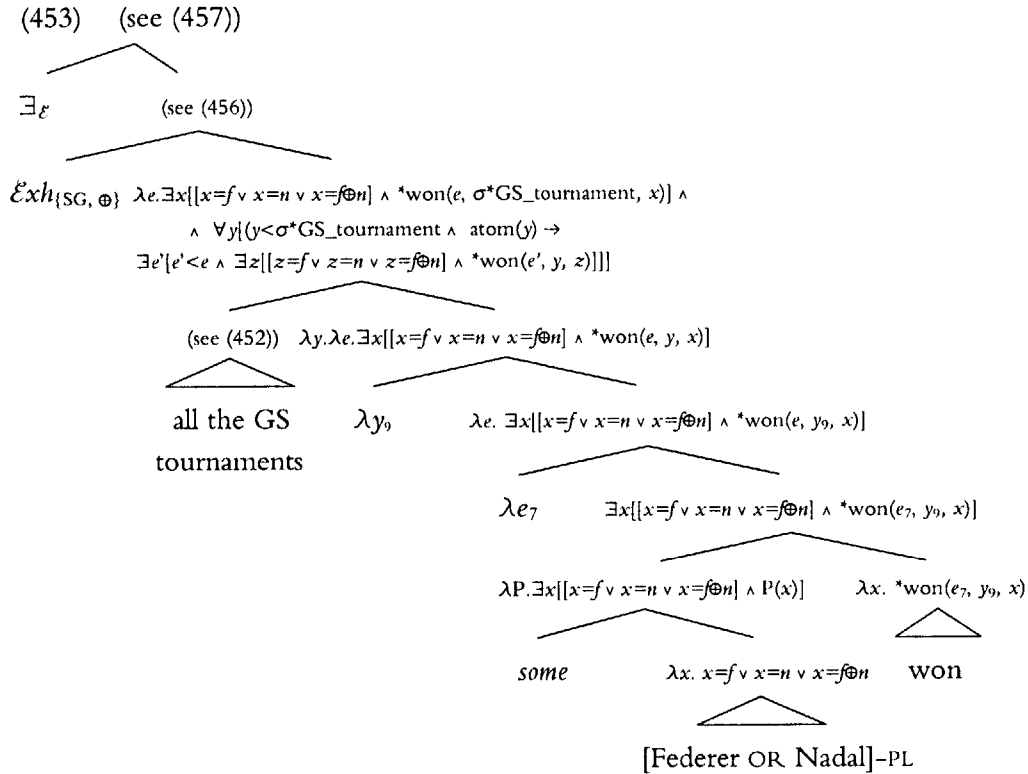
So, the prejacent of *Exh* has the following denotation:

(454) $\lambda e.\exists x[[x=f \vee x=n \vee x=f\oplus n] \wedge {}^*\text{won}(e, \sigma^*\text{GS}, x)] \wedge$
$\wedge \forall y[(y<\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow$
$\rightarrow \exists e'[e'<e \wedge \exists z[[z=f \vee z=n \vee z=f\oplus n] \wedge {}^*\text{won}(e', y, z)]]] =$

= $\lambda e.[{}^*\text{won}(e,\sigma^*\text{GS}, f) \vee {}^*\text{won}(e,\sigma^*\text{GS}, n) \vee {}^*\text{won}(e,\sigma^*\text{GS}, f\oplus n)] \wedge$

$\wedge \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow$

$\rightarrow \exists e'[e'{<}e \wedge [{}^*\text{won}(e', y, f) \vee {}^*\text{won}(e', y, n) \vee {}^*\text{won}(e', y, f{\oplus}n)]]]$

And these are the scalar alternatives:

(455) a. $\lambda e.[{}^*\text{won}(e,\sigma^*\text{GS}, f) \vee {}^*\text{won}(e,\sigma^*\text{GS}, n)] \wedge$

$\wedge \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'{<}e \wedge [{}^*\text{won}(e', y, f) \vee {}^*\text{won}(e', y, n)]]]$

[SG, OR]

b. $\lambda e.{}^*\text{won}(e, \sigma^*\text{GS}, f{\oplus}n) \wedge$

$\wedge \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'{<}e \wedge {}^*\text{won}(e', y, f{\oplus}n)]]$

[PL, $\oplus$]

Each of these alternatives is stronger than the prejacent, so exhaustification will give us the following result:

(456) $\mathcal{E}xh_{\{\text{SG}, \oplus\}}(\lambda e.[{}^*\text{won}(e,\sigma^*\text{GS}, f) \vee {}^*\text{won}(e,\sigma^*\text{GS}, n) \vee {}^*\text{won}(e,\sigma^*\text{GS}, f{\oplus}n)] \wedge$

$\wedge \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'{<}e \wedge [{}^*\text{won}(e', y, f) \vee {}^*\text{won}(e', y, n)$

$\vee {}^*\text{won}(e', y, f{\oplus}n)]]]) =$

$= \lambda e.[{}^*\text{won}(e,\sigma^*\text{GS}, f) \vee {}^*\text{won}(e,\sigma^*\text{GS}, n) \vee {}^*\text{won}(e,\sigma^*\text{GS}, f{\oplus}n)] \wedge$

$\wedge \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'{<}e \wedge [{}^*\text{won}(e', y, f) \vee {}^*\text{won}(e', y, n)$

$\vee {}^*\text{won}(e', y, f{\oplus}n)]]] \wedge$

$\wedge \neg [[{}^*\text{won}(e,\sigma^*\text{GS}, f) \vee {}^*\text{won}(e,\sigma^*\text{GS}, n)] \wedge$

$\wedge \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y){\rightarrow}\exists e'[e'{<}e \wedge [{}^*\text{won}(e', y, f){\vee}{}^*\text{won}(e', y, n)]]]] \wedge$

$\wedge \neg [{}^*\text{won}(e,\sigma^*\text{GS}, f{\oplus}n) \wedge$

$\wedge \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'{<}e \wedge {}^*\text{won}(e', y, f{\oplus}n)]]] =$

$= \lambda e.$

(a) $[{}^*\text{won}(e,\sigma^*\text{GS}, f) \vee {}^*\text{won}(e,\sigma^*\text{GS}, n) \vee {}^*\text{won}(e,\sigma^*\text{GS}, f{\oplus}n)] \wedge$

(b) $\wedge \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'{<}e \wedge [{}^*\text{won}(e', y, f) \vee {}^*\text{won}(e', y, n)$

$\vee {}^*\text{won}(e', y, f{\oplus}n)]]] \wedge$

(c) $\wedge [\underline{\neg [{}^*\text{won}(e,\sigma^*\text{GS}, f) \vee {}^*\text{won}(e,\sigma^*\text{GS}, n)]} \vee$

$\vee \neg \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'{<}e \wedge [{}^*\text{won}(e', y, f) \vee {}^*\text{won}(e', y, n)]]]] \wedge$

(d) $\wedge [\neg [{}^*\text{won}(e,\sigma^*\text{GS}, f{\oplus}n)] \vee$

$\vee \neg \forall y[(y{<}\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'{<}e \wedge {}^*\text{won}(e', y, f{\oplus}n)]]]$

The boldfaced disjunct in (456)c, saying that there were tournaments that were not won by Federer or Nadal, contradicts (456)b: every tournament was won by Federer, Nadal, or both — and must therefore be false. Now, the boldfaced disjunct in (456)d contradicts the conjunction of (456)c (its underlined part) and (456)a, so it must be false, too.

Thus, after the event closure applies, we'll have the following strengthened meaning:

(457) $\exists e.^*\text{won}(e, \sigma^*\text{GS}, f\oplus n)] \wedge$

$\qquad \wedge \forall y[(y<\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'<e \wedge [^*\text{won}(e', y, f) \vee {}^*\text{won}(e', y, n)$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad \vee {}^*\text{won}(e', y, f\oplus n)]]] \wedge$

$\qquad \wedge \neg\forall y[(y<\sigma^*\text{GS} \wedge \text{atom}(y) \rightarrow \exists e'[e'<e \wedge {}^*\text{won}(e', y, f\oplus n)]]]]$

In prose, there is an event of winning all the Grand Slam tournaments, and Federer and Nadal are the winners in that event; and each of these Grand Slam tournaments was won by Federer or Nadal or both; and it's not true that each of these Grand Slam tournaments was won by both (the sentence in (451) is most likely to be understood as only talking about the singles titles, making the *both*-option not relevant). This is the correct meaning, and since we didn't arrive at a contradiction, the plural disjunction is licensed.

Now let's turn to other quantificational cases.

The case of frequency adverbials like *každyj vtornik* ('every Tuesday') in (421)/(458) can be given exactly the same account.

(458) Každyj vtornik Petja ili Vasja   prixodil-i ko mne na rabotu.
      every   Tuesday [Petja OR Vasja]-PL came-PL   to me on work
      'Every Tuesday Petja or Vasja came to my office.'

The sentence means that each Tuesday it was either Petja or Vasja or both who came to my office while it is not the case that each Tuesday both Petja and Vasja came, although overall both boys must have come.

Apparently, in Russian, frequency adverbials like *každyj vtornik* ('every Tuesday') can have a denotation like the one below (cf. 'on all Tuesdays').

(459) $[\![$ každyj vtornik $]\!]$ = $\lambda P. \lambda e.P(e)(\sigma^*\text{Tuesday}) \wedge$

$\qquad\qquad\qquad\qquad\qquad \wedge \forall t[(t<\sigma^*\text{Tuesday} \wedge \text{atom}(t) \rightarrow \exists e'[e'<e \wedge P(e')(t)]]$

The derivation will be exactly parallel to the one we had before. The strengthened meaning we will arrive to at the end of the day is given in (460).

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(460) $\exists e.^*\text{come}(e, \sigma^*\text{Tu.}, p \oplus v)] \wedge$

$\qquad \wedge \forall t[(t < \sigma^*\text{Tu.} \wedge \text{atom}(t) \rightarrow \exists e'[e' < e \wedge [^*\text{come}(e', t, p) \vee$

$\qquad\qquad\qquad\qquad\qquad \vee\ ^*\text{come}(e', t, v) \vee\ ^*\text{come}(e', t, p \oplus v)]]] \wedge$

$\qquad \wedge \neg\forall t[(t < \sigma^*\text{GS} \wedge \text{atom}(t) \rightarrow \exists e'[e' < e \wedge\ ^*\text{won}(e', t, p \oplus v)]]]]$

The meaning is correct, and since it is not contradictory, the plural disjunction is licensed.

Yet another quantificational environment where plural disjunction is licensed involves modals and bouletic predicates. To get those results right, we will need to modify our assumptions a little bit, similar to what we did in Chapter 2, when we discussed Sauerland's readings, see Appendix for details and derivations.

3.4 Implications for the theory of Scalar Implicatures

In the previous section, we offered an analysis of the agreement facts with disjunction. The generalization we made was the following: plural agreement with a disjunction, both disjuncts of which are singular, is licensed only in DE and quantificational environments. The analysis we proposed to account for such a distribution of the plural disjunction can be summarized in the following way: plural disjunction triggers two implicatures: the multiplicity one (coming from the plural feature) and the exclusivity one (coming from the disjunction). In cases where the combination of the assertion with those two implicatures creates a contradiction, plural disjunction is not licensed and thus the sentence with plural agreement on the verb is ungrammatical. In cases where such a contradiction does not come about, plural disjunction is licensed.

However, the proposed analysis raises a question: why is it the case that the implicature conflict leads to ungrammaticality rather than to implicature cancellation?

It is well known that in general scalar implicatures are not obligatory, i.e. they can be cancelled, as illustrated below:

(461) John ate five cookies. In fact, he ate seven.

If the implicature generated by the numeral "five" ('It's not the case that John ate 6 cookies') was obligatory, we would get a contradictory sequence of sentences, but the common intuition is that these sentences are compatible.

In order for our analysis of the disjunction facts to work, we need to make sure that both implicatures have to be calculated, in other words, neither of them can be cancelled. The question is to understand why this is so.

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In Chapter 2, we argued that certain scalar items are specified as obligatorily activating alternatives, in other words, they should obligatorily be in the scope of the exhaustivity operator, whose restrictor contains the corresponding alternatives. We showed that plural presents one example of such a scalar item. This is exactly what leads to the obligatory multiplicity implicature associated with plurals.

In this section, we will argue that there is also another source of obligatory implicatures. More specifically, we will show that certain constraints on pruning of alternatives can lead to implicatures being obligatorily generated.

Let's come back to the explanation of the ungrammaticality of (462):

(462)   *[Petja OR Vasja]-PL came.

I argued that the ungrammaticality of (462) is due to a conflict between implicatures generated by two scalar items: PL and OR. Let's repeat the set of alternatives for (462):

(463) $\lambda e.$ [*came(e, p) $\vee$ *came(e, v)]   [SG, OR]

(464) $\lambda e.$*came$(e, p \oplus v)$ [PL, $\oplus$]

As we showed in the previous chapter, plural requires that there is an $\mathcal{E}xh$ operator in the structure which c-commands it and that the restrictor of the $\mathcal{E}xh$ operator contains the singular alternative ((463) in this case). However, there is also another alternative, namely, the one in (464) coming from disjunction. We know that the implicature generated by disjunction is usually optional, which means that disjunction does not impose any requirements, unlike plural.

Hence in principle we should have two possible representations for (462): the one where the restrictor of the $\mathcal{E}xh$ operator contains both alternatives (see (465)) and the second one where the restrictor of the $\mathcal{E}xh$ operator only contains the singular alternative, as in (466) (the representation in which the restrictor of $\mathcal{E}xh$ contains only and-alternative is not allowed in this case, as the requirement of the plural would be violated):

(465) $\mathcal{E}xh_{\{SG, \oplus\}}$ ($\lambda e.$ [*came(e, p) $\vee$ *came(e, v) $\vee$ *came(e, p$\oplus$v)])

(466) $\mathcal{E}xh_{\{SG\}}$ ($\lambda e.$ [*came(e, p) $\vee$ *came(e, v) $\vee$ *came(e, p$\oplus$v)])

Note that the LF in (465) is the one that leads to ungrammaticality, as negating both of the alternatives creates a contradiction, as shown below (see Section 3.3.1 for details).

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(467) $\mathcal{E}xh_{\{SG,\, \oplus\}}$ (λe. [*came(e, p) $\vee$ *came(e, v) $\vee$ *came(e, $p\oplus v$)]) = λe. [[*came(e, p) $\vee$ *came(e, v) $\vee$ came(e, $p\oplus v$)] $\wedge \neg$ [*came(e, p) $\vee$ *came(e, v)] $\wedge \neg$*came(e, $p\oplus v$)]

Now, the second derivation is not contradictory and if it was available, we would predict the sentence in (462) to be grammatical. The task is thus to rule out this derivation. This derivation would lead to the meaning in (468):

(468) $\mathcal{E}xh_{\{SG\}}$ (λe. [*came(e, p) $\vee$ *came(e, v) $\vee$ *came(e, $p\oplus v$)]) = λe. [[*came(e, p) $\vee$ *came(e, v) $\vee$ came(e, $p\oplus v$)] $\wedge \neg$ [*came(e, p) $\vee$ *came(e, v)]] = λe. *came(e, $p\oplus v$)

After closing the event argument, we get the following meaning:

(469) $\exists e$ [*came(e, $p\oplus v$)]

Thus, if we were allowed to prune the and-alternative, we would predict that (462) should be grammatical and mean "Both Petja and Vasja came".

Note that the meaning we get in (468) is equivalent to the alternative we pruned. Intuitively, it seems that such a situation should be somehow blocked.

In order to account for that, we will use the constraint on pruning proposed in Fox and Katzir 2011, which can be stated as in (470):

(470) Contextual pruning cannot prune one of the symmetric[31] alternatives without also pruning the other.

First, let's give some motivation behind such a constraint and then we will show how its application to our case accounts for the unavailability of the LF in (466).

Fox and Katzir's claim is that context cannot break symmetry: it can either keep both of symmetric alternatives or eliminate both of them, but not eliminate one and keep the other one. As Fox and Katzir argue, the principle can be derived from the fact that contextual pruning can only eliminate alternatives which are not relevant from a formally defined set of alternatives and from certain assumptions about relevance, namely that the prejacent of the exhaustivity operator is always relevant and that relevance is closed under negation and conjunction.

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[31] S_1 and S_2 are symmetric alternatives of S if S is equivalent to the disjunction of S_1 and S_2 and S_1 and S_2 contradict each other.

Now we will show that symmetric alternatives always behave similar with respect to relevance, namely they are either both relevant or both irrelevant, thus contextual pruning cannot distinguish between them.

Imagine that we have A and two symmetric alternatives to A, namely B and A & ¬B. If B is relevant, A & ¬B will be relevant as well, due to the relevance postulates. Conversely, if A & B is relevant, B is relevant too, as B=A&¬(A&¬B)). Hence, two symmetric alternatives must both be either relevant or both be irrelevant. Contextual pruning must either eliminate both of them or keep them both. This leads to the principle in (470).

Let's return to our case. We can notice that the two alternatives are symmetric as well: they contradict each other and their disjunction is equal to the prejacent. Hence, if we were to prune one them, we would have to prune the other one as well. Remember that the plural requires that its singular alternative must not be pruned. But if we cannot prune the singular alternative, we have to keep the and-alternative as well, and this rules out the LF in (468). We showed that the only available representation is the one in (467) but it leads to a contradiction.

We should also check what happens at the higher level, namely after the event closure. At that level the sentence denotes (471) and the two alternatives are as shown in (472)-(473):

(471) $\exists e$ [*came(e, p) v *came(e, v)) v *came$(e, p{\oplus}v)$]

(472) $\exists e$ [*came(e, p) v *came(e, v)]   [SG, OR]

(473) $\exists e$ *came $(e, p{\oplus}v)$ [PL, $\oplus$]

Again, the same situation would repeat. We can imagine two possible representations for (471):

(474) $\mathcal{E}xh_{\{SG, \oplus\}}$ $(\exists e$ [*came(e, p) v *came(e, v) v *came$(e, p{\oplus}v)$]$)$

(475) $\mathcal{E}xh_{\{SG\}}$ $(\exists e$ [*came(e, p) v *came(e, v) v *came$(e, p{\oplus}v)$]$)$

The first one would lead to a contradiction, as we discussed in section 3.3.1:

(476) $\mathcal{E}xh_{\{SG, \oplus\}}(\exists e$ [*came(e, p) v *came(e, v) v *came$(e, p{\oplus}v)$]$)$ = $\exists e$ [*came(e, p) v *came(e, v) v *came$(e, p{\oplus}v)$] ∧ ¬$\exists e$ [*came(e, p)v*came(e, v)] ∧ ¬$\exists e$ *came$(e, p{\oplus}v)$

The second one will be ruled out due to the constraint on pruning in (470): again, we are dealing with two symmetric alternatives ($\exists e$ [*came(e, p) $\vee$ *came(e, v)] and $\exists e$ *came(e, $p \oplus v$)), one of which is not allowed to be pruned and so the second one cannot be pruned either, ruling out (475).

As we showed, exhaustifying at both levels leads to contradiction, and in such a way the ungrammaticality of (462) is accounted for.

Now, let's turn to the downward-entailing sentence, repeated below:

(477) Ja ne dumaju, čto Petja ili Vasja prišli.
       I   not think   that [Petja OR Vasja]-PL came-PL
       I don't think Petja or Vasja arrived.

Note that in this case the only possible site for the insertion of the exhaustivity operator is above the negation. Exhaustifying anywhere below would lead to a contradiction, just as we showed above. Is the requirement of the plural satisfied, if we exhaustify above the negation?

It is, as the singular alternative is in the restrictor of the *Exh* operator, but it does not get negated, as it is weaker than the prejacent. Exhaustification is vacuous, but not contradictory, hence (477) is grammatical, and without any pruning needed.

As for the quantificational cases, we showed that there is no contradiction created in such cases either, hence no pruning is required to save them. We should only nore that the only requirement in thise cases is that the singular alternative be in the restrictor of exh. As for the and-alternative, it can either be there (leading to meanings in (456), (460)) or be pruned (as nothing blocks pruning in this case). It seems that we can indeed cancel the and-alternative, unlike the singular one, which is confirmed by the contrast between (478)-(479):

(478) Ran'še   vse turniry   "Bol'šogo šlema"   vyigryval-i
       earlier   all tournaments.ACC   Grand Slam.GEN   won-PL
       Federer ili Nadal'.   Tochnee   oba.
       [Federer OR Nadal]-PL more precisely   both
       'Earlier, all the Grand Slam tournaments were won by Federer or Nadal. More precisely, both.'

(479) * Ran'še   vse turniry   "Bol'šogo šlema"   vyigryval-i
         earlier   all tournaments.ACC   Grand Slam.GEN   won-PL
         Federer ili Nadal'.   Tochnee   odin iz nix.
         [Federer OR Nadal]-PL more precisely   one   of them

'Earlier, all the Grand Slam tournaments were won by Federer or Nadal. More precisely, one of them.'

Based on what we discussed in this section, we can formulate the following generalization describing how grammaticality is related to implicature calculation:

(480)   Ungrammaticality arises in those cases when the implicatures of a sentence lead to a contradiction and there is no possibility of obviating the contradiction by pruning the alternatives which give rise to those implicatures (either because of the requirements of certain scalar items, or because of the constraint on pruning in (470)).

3.5   Plural disjunctions and nibud'-pronouns in Russian

It is quite striking that plural disjunctions in Russian have essentially the same distribution as indefinite pronouns of *nibud'*-series. *Nibud'*-pronouns are licensed only in quantificational (482) and DE-environments (483), and in questions (484) (see Yanovich 2005, Pereltsvaig 2008, Fitzgibbons 2010 for recent discussions).

(481)   * Petja uvidel kogo-nibud'   iz   svoix   odnoklassnic.
          Petja saw   who-NIBUD'   of   his   girl-classmates

(482)   a. Každyj   mal'čik vstretil kogo-nibud'   iz   svoix   odnoklassnic.
            every   boy   met   who-NIBUD'   of   his   girl-classmates
            'Every boy met some of his girl-classmates' ($^\checkmark\forall > \exists$, $^*\exists > \forall$)

        b. Petja často vstrečal kogo-nibud'   iz   svoix   odnoklassnic.
            Petja often met   who-NIBUD'   of   his   girl-classmates
            'Often, Petja met some or other of his girl-classmates' ($^\checkmark often > \exists$, $^*\exists > often$)

        c. Petja xočet vstretit' kogo-nibud'   iz   svoix   odnoklassnic.
            Petja wants to.meet who-NIBUD'   of   his   classmates
            'Petja wants to meet some or other of his girl-classmates'

                                            ($^\checkmark want > \exists$, $^*\exists > want$)
                                            (Yanovich 2005: 314)

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(483) a. */?? Petja govoril mne, čto kto-nibud'   iz ego odnoklassnikov
        Petja told   me   that who-NIBUD' of his   classmates
        byl na mitinge.
        was on rally

     b. Petja ne govoril mne, čto kto-nibud'   iz   ego   odnoklassnikov
        Petja not told   me   that who-NIBUD' of   his   classmates
        byl na mitinge.
        was on rally
        'Petja didn't tell me that any of his classmates was at the rally'

(484) Petja uvidel kogo-nibud'   iz   svoix   odnoklassnic?
      Petja saw   who-NIBUD' of   his   girl-classmates
      'Did Petja see any of his girl-classmates?'

Since the distribution is so similar, it would be plausible to have the same theory for the two phenomena. As of now, it is, unfortunately, not the case. The most prominent theory of *nibud'*-pronouns of Yanovich 2005 states that they are choice functions. The fact that *nibud'*-items have to be in the scope of quantifiers (Yanovich 2005 doesn't discuss DE-environments[32]) is captured by relativizing the *nibud'*-choice functions to a Skolem argument that has to be obligatorily bound, cf. the denotation for *kto-nibud'* ('who-NIBUD' from the examples above):

(485) [[kto-nibud']] = $\lambda x. f(x, \lambda y.\ \text{human}(y))$,
                    where f is a Skolemized choice function,
                    and x is a Skolem argument of the appropriate type.

(Yanovich 2005: 317)

Could it be that plural disjunctions have essentially the same choice-functional analysis? While I won't be able to get into a lot of details, let me mention just one objection to this possibility. One of the properties of choice functions, as opposed to quantificational indefinites, is that they don't have to undergo QR to take scope, and so they are predicted to be able to take (pseudo-)scope out of syntactic islands (cf. Reinhart 1997, Kratzer

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[32] *Nibud'*-items are not licensed in every DE context, for example, they are bad in the local scope of negation, but they become good if negation is in a different clause. It seems that Yanovich's analysis can't be extended to predict the grammaticality of *nibud'*-pronouns in such cases. If this is indeed so, it can be taken as an argument against his analysis of *nibud'*-pronouns (and also against transferring this analysis to plural disjunctions).

1998). Thus, if Russian plural disjunctions denoted choice functions, they would be able to scope out of islands, and this prediction is not borne out. For example, the following sentence does not have a reading in which the disjunction takes scope out of an *if*-clause:

(486) Každaja iz devoček budet rada, esli k nej prid-ut [Petja ili Vasja].
each of girls will.be glad if to her will.come-PL Petja or Vasja

$^\checkmark\forall$ > if > $\exists_\lor$: 'Each of the girls will be glad, if Petja or Vasja come to her.'

$^*\forall$ > $\exists_\lor$ > if: 'Each girl has a particular boy who is either Petja or Vasja, such that she will be glad if that boy comes to her.'

If choice-functional analysis of plural disjunctions indeed overgenerates, there is yet another possibility to capture the similarity between plural disjunctions and *nibud'*-items, which would be to say that *nibud'*-items are essentially plural disjunctions: they are interpreted as plural disjunctions and trigger the same scalar implicatures. This would be very similar to what Chierchia (2013) claims about NPIs and free-choice indefinites in a number of languages. The details of such an analysis are beyond the scope of this dissertation.

3.6 Plural disjunctions in English and beyond

Number agreement with disjunctions demonstrates a lot of variability cross-linguistically.

For some languages it has been reported that plural agreement is the only possibility, regardless of the environment (e.g. Romanian, Moosally 1998, although not all the relevant cases were considered). From the point of view of the theory developed in this dissertation, such languages wouldn't present either insight or a problem. Languages in which singular and plural agreement are both possible in some but not all environments are of greater interest for our purposes, since precisely in those languages we would expect scalar interaction to take place. In fact, we might be able to predict the limits of variation across languages, as our analysis involves just a few parameters: different points of exhaustification, whether disjunctions are existential GQs, whether implicatures are obligatory (general mechanisms of implicature calculation and constraints on pruning are most probably universal). Unfortunately, as of now, there are too few works on different languages to accurately test these parameters.

One of the better-studied languages with respect to agreement with disjunctions is English (see Morgan 1972, 1984, 1985; Peterson 1986; Eggert 2002). Although reported judgments sometimes seem to be in contradiction, some generalizations could be induced.

First of all, with two singular disjuncts, there is a general preference for singular disjunctions in upward-entailing environments:

(487)   John or Bill is/??are going to win the race.   (Morgan 1985: 72)

In a survey reported in Peterson 1986, 36 out of 42 subjects preferred singular agreement in both (488) and (489):

(488)   A rabbit or a goat has/??have eaten all my lettuces.   (Peterson 1986: 237)

(489)   Either John or Bill is/??are responsible for this mess.   (Peterson 1986: 237)

Under negation, plural agreement becomes preferable, cf. the judgment reported in Morgan 1985:

(490)   I don't think John or Bill are/*is going to win the race.   (Morgan 1985: 72)

It looks like in other downward-entailing environments, plural agreement is available, as can be evidenced by the following examples found online:

(491)   Almost every fund-raising day Obama or Biden **are** on the trail means at least $1 million for 2012 re-election war chest. (http://voices.suntimes.com)

(492)   If President Obama or Senator Reid **are** serious about wanting to help students, they should join the House in acting to reform the student loan program. (http://facebook.com)

(493)   Mr. Netanyahu underscores that Israel must be recognized as a Jewish state — and recalls that the conflict began before the West Bank or Gaza **were** occupied. (http://nytimes.com)

In questions, plural agreement also becomes available:

(494)   Do you think John or Bill is/are going to win the race?   (Morgan 1985: 72)

Peterson (1986) argues that plural agreement is preferred for the *yes/no*-reading of the following question (on the *alternative question* reading, singular agreement is preferred):

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(495) Is/are David or Mark coming with me?   (Peterson 1986: 234)

To sum up, it seems that plural agreement becomes available in those contexts in which scalar implicatures are normally not computed, i.e. DE-environments and questions[33].

In the studies of agreement with disjunctions in English, the intuition that is always pursued is that plural agreement signals inclusive interpretation of disjunction (Morgan 1985, Peterson 1986, Eggert 2002). The implicature-based approach taken here allows predicting what exactly the contexts where such interpretation is possible would be. For one, downward-entailing environments and questions are such contexts, just as it was the case in Russian.

However, English does not pattern with Russian in every respect. For example, most speakers I consulted find examples with quantifiers like the one below unacceptable with plural agreement (cf. the grammatical Russian example).

(496) Every Tuesday John or Bill visits/ ?/*visit Mary at the hospital.

As of now, I am not sure what exactly the reason for this preference is[34]. However, I would like to note that some speakers find plural agreement in (496) more acceptable than in a parallel non-quantificational case:

(497) Today Tuesday John or Bill has/ *have visited Mary at the hospital.

Moreover, there are speakers who accept (497), with the universal quantifier scoping over the plural disjunction ('every girl was kissed by either John or Bill or both'), just as predicted in our theory.

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[33] The availability of singular agreement in some (if not all) of these contexts could be due to the independently available strategy of *closest disjunct agreement*, cf. examples from Morgan 1972:

(xiii)   (Either) Harry or his parents are/*is coming.

(xiv)   (Either) Harry's parents or his wife ?is/*are coming

(xv)   There was (either) a bee or two flies in the room.

(xvi)   There were (either) two flies or a bee in the room. (Morgan 1972: 281)

[34] It might be the case that 'every Tuesday' behaves differently in the two languages. As we pointed out above, in Russian, frequency adverbials like *každyj vtornik* ('every Tuesday') can have a denotation as the one we gave in (459)(which makes it similar to 'all the Tuesdays') and this explains why we do get dependent plural readings. It is plausible to assume that in English such a possibility does not exist and this explains why we do not get dependent plural readings. If this is indeed the case, the ungrammaticality of the plural agreement in (496) is not surprising.

(498) John or Bill have kissed every girl at the party.

Cases of plural disjunctions in quantificational contexts can also be found online:

(499) Every rung on the political ladder Obama climbed, Ayers or his father Tom **were** there to help him along and work the Chicago machine. (http://newsmax.com)

(500) Either Nadal or Federer **have** featured in every Grand Slam final since the 2005 Australian Open, except the 2008 Australian tournament. (http://perfect-tennis.co.uk)

Aside from English, agreement with disjunctions has been studied in some detail in Greek (Flouraki and Kazana 2009, Kazana 2011), and looks like in Greek plural disjunctions are licensed at least in generic sentences and under modals.

3.7   Conclusions

In this Chapter, we looked at the puzzling agreement behavior of disjunctions, namely the fact that in DE contexts and quantificational environments plural agreement with a disjunction, both disjuncts of which are singular, is possible. We argued that plural agreement comes from the plural feature on disjunction, which is treated as predicate. The plural feature obligatorily triggers a multiplicity implicature. The mechanism for deriving this implicature was offered in Chapter 1. When this implicature is in conflict with the exclusivity implicature generated by the scalar item *or*, the plural feature is not licensed, hence the sentence with plural agreement is ungrammatical. In environments where such conflict can be obviated (these are exactly DE and quantificational environments), plural agreement is possible.

Also, a generalization regarding when implicatures can lead to ungrammaticality was offered, namely ungrammaticality arises when implicature of a sentence lead to a contradiction and there is no way of obviating the contradiction by pruning the alternatives that give rise to those implucatures.

Appendix: Plural disjunctions with modals and maximized events

As we saw, plural disjunctions in Russian are licensed under modals and bouletic predicates. In order to get the licensing right, we will need to modify our assumptions about event semantics a little bit[35]. Specifically, event closure will have to not only existentially bind the event argument, but also ensure that the event is maximal. We will check if this new mechanism makes any new predictions for the licensing of plural disjunctions in other environments as well.

A1   Plural disjunctions with modals and bouletics

Consider an example with a universal modal (same as (423) above):

(501) Dolžn-y   prijti   Petja ili Vasja.
       must-PL   come   [Petja OR Vasja]-PL
       'Petja or Vasja must come.'

What licenses plural disjunction in this case? In the quantificational environments we have looked at in section 3.3, quantifiers crucially introduced their own event arguments, and we were able to distinguish big events and their subparts. Modals don't seem to work that way.

And what reading do we get for (501)? As was noted in Chapter 2, dependent plural readings are not available with modals. Here, too, we don't seem to have a dependent plural reading: the sentence is false if it must be the case that only one person, who is Petja or Vasja, is supposed to come. What we have instead is more of a "Sauerland's reading" discussed in Section 2.4.4: in every accessible world there is (at least) one person, Petja or Vasja, who is supposed to come and it is not the case that in every accessible world it is only one person. It should be possible that both come.

Trying to derive the correct result with our current assumptions proves to be impossible. Let's look at different sites where exhaustification could apply (it would need to apply somewhere, since the plural feature needs to be in the scope of *Exh*). Potentially,

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[35] As we already pointed out in Chapter 2, this analysis has a major problem. As we can't offer any other analysis at the moment, we will use it for the purposes of demonstration of what results we would like to get in the end. The task of future research is thus to figure out how to get those results without treating event maximization as being a part of the semantics of event closure.

it could apply at the event predicate level, at the propositional level below the modal, and above the modal:

(502)   (see (508))

$\{\mathcal{E}xh_{\{SG, \oplus\}}\}$ $\forall w'Rw \; \exists e\exists x[[x=p \lor x=v \lor x=p\oplus v] \land {}^*come(e, x, w')]$

               MUST   {contradiction!}

        $\{\mathcal{E}xh_{\{SG, \oplus\}}\}$ $\exists e. \; \exists x[[x=p \lor x=v \lor x=p\oplus v] \land {}^*come(e, x)]$

            $\exists_{\mathcal{E}}$ {contradiction!}

           $\{\mathcal{E}xh_{\{SG, \oplus\}}\}$ $\lambda e. \; \exists x[[x=p \lor x=v \lor x=p\oplus v] \land {}^*come(e, x)]$

                [*some* [Petja OR Vasja]-PL] come
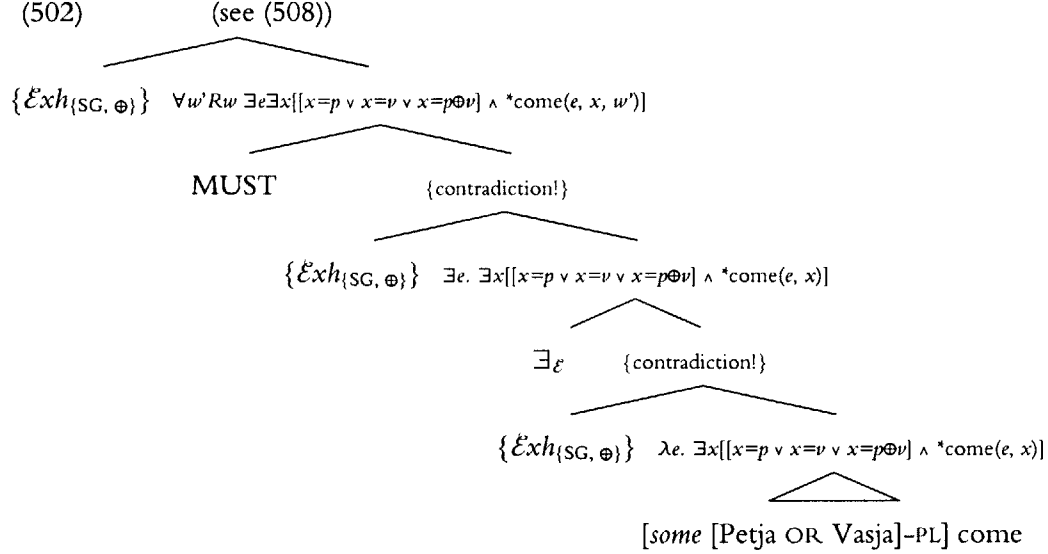
Applying $\mathcal{E}xh$ at the event predicate level or right above the event closure yields a contradiction, as we saw in 3.3.1. We could try to apply it above the modal. The alternatives would be as in (503). Given our assumption that exhausification is blind to non-logical information (here: the fact that *come* is a distributive predicate), both alternatives will count as stronger that the prejacent of $\mathcal{E}xh$. The result of exhaustification is in (504).

(503)   a. $\forall w'Rw \; \exists e\exists x[[x=p \lor x=v] \land {}^*come(e, x, w')] =$

       $= \forall w'Rw \; \exists e[{}^*come(e, p, w') \lor {}^*come(e, v, w')]$ [SG, OR]

    b. $\forall w'Rw \; \exists e\exists x[x=p\oplus v \land {}^*come(e, x, w')] =$

       $= \forall w'Rw \; \exists e[{}^*come(e, p\oplus v, w')]$ [PL, $\oplus$]

(504) $\mathcal{E}xh_{\{SG, \oplus\}} (\forall w'Rw \; \exists e\exists x[[x=p \lor x=v \lor x=p\oplus v] \land {}^*come(e, x, w')]) =$

    $= \mathcal{E}xh_{\{SG, \oplus\}} (\forall w'Rw \; \exists e[{}^*come(e, p, w') \lor {}^*come(e, v, w') \lor {}^*come(e, p\oplus v, w')])$

    $=$

(a) $\forall w'Rw \; \exists e[{}^*come(e, p, w') \lor {}^*come(e, v, w') \lor {}^*come(e, p\oplus v, w')] \land$

(b) $\land \neg\forall w'Rw \; \exists e[{}^*come(e, p, w') \lor {}^*come(e, v, w')] \land$

(c) $\land \neg\forall w'Rw \; \exists e[{}^*come(e, p\oplus v, w')]$

The result is again a contradiction. Specifically the conjunct in (a) contradicts the conjunct in (b). If in every world w' accessible from the actual world w there is an event in which Petja or Vasja or both come, it would have to be the case that in every world w' accessible from the actual world w there is an event in which Petja or Vasja come.

To get a better result, we can modify our assumptions about existential closure of events. Existential closure will now not only close the event variable, but also assert that the event is maximal:

(505)　$[\![\ \exists \mathcal{E}_{MAX}\ ]\!]_{\langle\langle s,t\rangle,t\rangle} = \lambda P_{\langle s,t\rangle}.\ \exists e_s\ [P(e) \wedge \forall e'[\ P(e') \to e' \le e]]$

If we applied the existential closure in (79), applied the modal and exhaustified above, the prejacent of $\mathcal{E}xh$ would be as in (506), and its stronger scalar alternatives as in (507).

(506)　$\forall w' Rw\ \exists e \exists x[[x=p \vee x=v \vee x=p \oplus v] \wedge {}^*\mathrm{come}(e, x, w') \wedge$
$\wedge \forall e'[\exists y[[y=p \vee y=v \vee y=p \oplus v] \wedge {}^*\mathrm{come}(e', y, w')] \to e' \le e]] =$
$=\ \forall w' Rw\ \exists e[[{}^*\mathrm{come}(e,p,w') \vee {}^*\mathrm{come}(e,v,w') \vee {}^*\mathrm{come}(e,p \oplus v,w')] \wedge$
$\wedge \forall e'[[{}^*\mathrm{come}(e',p,w') \vee {}^*\mathrm{come}(e',v,w') \vee {}^*\mathrm{come}(e',p \oplus v,w')] \to e' \le e]]$

(507)　a. $\forall w' Rw\ \exists e \exists x[[x=p \vee x=v] \wedge {}^*\mathrm{come}(e, x, w') \wedge$
$\wedge \forall e'[\exists y[[y=p \vee y=v] \wedge {}^*\mathrm{come}(e', y, w')] \to e' \le e]] =$
$=\ \forall w' Rw\ \exists e[[{}^*\mathrm{come}(e,p,w') \vee {}^*\mathrm{come}(e,v,w')] \wedge$
$\wedge \forall e'[[{}^*\mathrm{come}(e',p,w') \vee {}^*\mathrm{come}(e',v,w')] \to e' \le e]]$　　[SG, OR]

　　b. $\forall w' Rw\ \exists e \exists x[x=p \oplus v \wedge {}^*\mathrm{come}(e, x, w')$
$\wedge \forall e'[\exists y[y=p \oplus v \wedge {}^*\mathrm{come}(e', y, w')] \to e' \le e]] =$
$=\ \forall w' Rw\ \exists e[{}^*\mathrm{come}(e,p \oplus v,w') \wedge \forall e'[{}^*\mathrm{come}(e',p \oplus v,w') \to e' \le e]]$　　[PL, $\oplus$]

Exhaustification will lead to the following strengthened meaning:

(508)　$\mathcal{E}xh_{\{SG, \oplus\}}\ (\forall w' Rw\ \exists e[[{}^*\mathrm{come}(e,p,w') \vee {}^*\mathrm{come}(e,v,w') \vee {}^*\mathrm{come}(e,p \oplus v,w')] \wedge$
$\wedge \forall e'[[{}^*\mathrm{come}(e',p,w') \vee {}^*\mathrm{come}(e',v,w') \vee {}^*\mathrm{come}(e',p \oplus v,w')] \to e' \le e]])$

$=$

$\forall w' Rw\ \exists e[[{}^*\mathrm{come}(e,p,w') \vee {}^*\mathrm{come}(e,v,w') \vee {}^*\mathrm{come}(e,p \oplus v,w')] \wedge$
$\wedge \forall e'[[{}^*\mathrm{come}(e',p,w') \vee {}^*\mathrm{come}(e',v,w') \vee {}^*\mathrm{come}(e',p \oplus v,w')] \to e' \le e]] \wedge$

$\wedge \neg \forall w' Rw\ \exists e[[{}^*\mathrm{come}(e,p,w') \vee {}^*\mathrm{come}(e,v,w')] \wedge$
$\wedge \forall e'[[{}^*\mathrm{come}(e',p,w') \vee {}^*\mathrm{come}(e',v,w')] \to e' \le e]] \wedge$

$\wedge \neg \forall w' Rw\ \exists e[{}^*\mathrm{come}(e,p \oplus v,w') \wedge \forall e'[{}^*\mathrm{come}(e',p \oplus v,w') \to e' \le e]]$

The meaning in (508) is not contradictory. It says that in every world w' accessible from the actual world there is a maximal event in which either Petja or Vasja or both come, and not in every world there is an event in which *only one* of the boys, Petja or Vasja, comes, and not in every world there is an event in which *both* boys, Petja and Vasja, come. In other words, it must be the case that Petja or Vasja (or both) come, and it is possible that both come.

This is the right meaning, and since it is not contradictory, the plural disjunction is licensed. Bouletic predicates should work in the same manner.

Event maximization is thus a rather powerful tool. We will have to check if we can maintain our analysis of plural disjunctions in other environments, given this new requirement.

A2 Non-quantificational, non-DE environments

Consider the ungrammatical example in (509)((439) in section 3.3.1).

(509) * [Petja ili Vasja]   prišl-i.
        [Petja OR Vasja]-PL   came-PL
        'Petja or Vasja came.'

Below I prove that exhaustification with event maximization still yields a contradiction in this case.

1) If *Exh* applies at the event predicate level, where the event is not maximized yet, the result is exactly the same as the result we got before (see (446)), i.e. a contradiction.

2) If *Exh* applies at the propositional level, its prejacent is as in (510), and its alternatives are as in (511).

(510) $\exists e[[{}^*come(e, p) \lor {}^*come(e, v) \lor {}^*come(e, p \oplus v)] \land$
        $\land \forall e'[[{}^*come(e', p) \lor {}^*come(e', v) \lor {}^*come(e', p \oplus v)] \to e' \le e]]$

(511) a. $\exists e[[{}^*come(e, p) \lor {}^*come(e, v)] \land$
            $\land \forall e'[[{}^*come(e', p) \lor {}^*come(e', v)] \to e' \le e]]$ [SG, OR]
        b. $\exists e[{}^*come(e, p \oplus v) \land \forall e'[{}^*come(e', p \oplus v) \to e' \le e]]$ [PL, $\oplus$]

(512) $Exh(\exists e[[{}^*come(e, p) \lor {}^*come(e, v) \lor {}^*come(e, p \oplus v)] \land$
        $\land \forall e'[[{}^*come(e', p) \lor {}^*come(e', v) \lor {}^*come(e', p \oplus v)] \to e' \le e]])$

    =

(a) $\exists e[[{}^*come(e, p) \lor {}^*come(e, v) \lor {}^*come(e, p \oplus v)] \land$

$\wedge \forall e'[[^*\text{come}(e', p) \vee {}^*\text{come}(e', v) \vee {}^*\text{come}(e', p\oplus v)] \rightarrow e'\leq e]] \wedge$

(b) $\wedge \neg \exists e[[^*\text{come}(e, p) \vee {}^*\text{come}(e, v)] \wedge \forall e'[[^*\text{come}(e', p) \vee {}^*\text{come}(e', v)] \rightarrow e'\leq e]]$

(c) $\wedge \neg \exists e[^*\text{come}(e, p\oplus v) \wedge \forall e'[^*\text{come}(e', p\oplus v) \rightarrow e'\leq e]]$

This is again a contradiction: the conjunction of implicatures in (b) and (c) contradicts (a).

In sum, just as it was the case with non-maximized events, there is no way to apply obligatory *Éxh* without yielding a contradiction, so the plural disjunction is not licensed.

A3   Quantificational environments

Consider the familiar sentence in (513) ((451) in section 3.3.3):

(513) Ran'še   vse   turniry   "Bol'šogo šlema"   vyigryval-i
       earlier   all   tournaments.ACC   Grand Slam.GEN   won-PL
       Federer ili   Nadal'.
       [Federer OR   Nadal]-PL
       'Earlier, all the Grand Slam tournaments were won by Federer or Nadal.'

There are, again, several sites where *Éxh* could apply:

(514)

1) If *Éxh* applies at the lower event predicate level, below the universal quantifier, the result is exactly the same as in (446), i.e. a contradiction.

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2) If *Exh* applies at the higher event predicate level, above the universal quantifier, the result will be different. Recall the denotation of the universal quantifier we assumed before (452):

(515) $[\![$ vse turniry B. š. / all the GS tournaments $]\!]$ =

$= \lambda P. \lambda e. P(e)(\sigma^*GS) \wedge \forall y[(y \leq \sigma^*GS \wedge atom(y) \rightarrow \exists e'[e' \leq e \wedge P(e')(y)]]$

Crucially, this Kratzerian quantifier does event closure itself. It would be plausible to assume that the event that is existentially bound in this case is also maximized. The denotation is given in (516):

(516) $[\![$ vse turniry B. š. / all the GS tournaments $]\!]$ =

$= \lambda P. \lambda e. P(e)(\sigma^*GS) \wedge \forall y[(y \leq \sigma^*GS \wedge atom(y) \rightarrow \exists_{MAX} e'[e' \leq e \wedge P(e')(y)]]$,

where $\exists_{MAX}$ is a shorthand defined as follows:
$\exists_{MAX} e[P(e)] = \exists e[P(e) \wedge \forall e'[P(e') \rightarrow e' \leq e]$

The prejacent of *Exh* will thus be the following:

(517) $[\![$ all the GS $]\!]$ ($\lambda y. \lambda e. \exists x[[x = f \vee x = n \vee x = f \oplus n] \wedge {}^*won(e, y, x)]$) =

$= \lambda e. \exists x[[x = f \vee x = n \vee x = f \oplus n] \wedge {}^*won(e, \sigma^*GS, x)] \wedge$

$\wedge \forall y[(y \leq \sigma^*GS \wedge atom(y) \rightarrow$

$\rightarrow \exists_{MAX} e'[e' \leq e \wedge \exists z[[z = f \vee z = n \vee z = f \oplus n] \wedge {}^*won(e', y, z)]]] =$

$= \lambda e. [{}^*won(e, f, \sigma^*GS) \vee {}^*won(e, n, \sigma^*GS) \vee {}^*won(e, f \oplus n, \sigma^*GS)] \wedge$

$\wedge \forall y[(y \leq \sigma^*GS \wedge atom(y) \rightarrow$

$\rightarrow \exists_{MAX} e'[e' \leq e \wedge [{}^*won(e', f, y) \vee {}^*won(e', n, y) \vee {}^*won(e', f \oplus n, y)]]]$

Here are the scalar alternatives:

(518) a. $\lambda e. [{}^*won(e, f, \sigma^*GS) \vee {}^*won(e, n, \sigma^*GS)] \wedge$

$\wedge \forall y[(y \leq \sigma^*GS \wedge atom(y) \rightarrow$

$\rightarrow \exists_{MAX} e'[e' \leq e \wedge [{}^*won(e', f, y) \vee {}^*won(e', n, y)]]]$ [SG, OR]

b. $\lambda e. {}^*won(e, f \oplus n, \sigma^*GS) \wedge$

$\wedge \forall y[(y \leq \sigma^*GS \wedge atom(y) \rightarrow \exists_{MAX} e'[e' \leq e \wedge {}^*won(e', f \oplus n, y)]]$ [PL, $\oplus$]

Each of the alternatives is stronger than the prejacent of *Exh*, so exhaustification won't be vacuous:

(519) Exh ($\lambda e.[\ast\text{won}(e, f, \sigma^\ast\text{GS}) \vee \ast\text{won}(e, n, \sigma^\ast\text{GS}) \vee \ast\text{won}(e, f\oplus n, \sigma^\ast\text{GS})]$ ∧

         ∧ $\forall y[(y\leq\sigma^\ast\text{GS} \wedge \text{atom}(y) \rightarrow$

                $\rightarrow\exists_{\text{MAX}}e'[e'\leq e \wedge [\ast\text{won}(e', f, y) \vee \ast\text{won}(e', n, y) \vee \ast\text{won}(e', f\oplus n, y)]]])$ =

= $\lambda e.$

(A) $[\ast\text{won}(e, f, \sigma^\ast\text{GS}) \vee \ast\text{won}(e, n, \sigma^\ast\text{GS}) \vee \ast\text{won}(e, f\oplus n, \sigma^\ast\text{GS})]$ ∧

(B)   ∧ $\forall y[(y\leq\sigma^\ast\text{GS} \wedge \text{atom}(y) \rightarrow$

          $\rightarrow\exists_{\text{MAX}}e'[e'\leq e \wedge [\ast\text{won}(e', f, y) \vee \ast\text{won}(e', n, y) \vee \ast\text{won}(e', f\oplus n, y)]]]$ ∧

     ∧ ¬[

(C) $[\ast\text{won}(e, f, \sigma^\ast\text{GS}) \vee \ast\text{won}(e, n, \sigma^\ast\text{GS})]$ ∧

(D)   ∧ $\forall y[(y\leq\sigma^\ast\text{GS} \wedge \text{atom}(y) \rightarrow \exists_{\text{MAX}}e'[e'\leq e \wedge [\ast\text{won}(e', f, y) \vee \ast\text{won}(e', n, y)]]]$

      ]

    ∧ ¬[

(E) $\ast\text{won}(e, f\oplus n, \sigma^\ast\text{GS})$ ∧

(F)   ∧ $\forall y[(y\leq\sigma^\ast\text{GS} \wedge \text{atom}(y) \rightarrow\exists_{\text{MAX}}e'[e'\leq e \wedge \ast\text{won}(e', f\oplus n, y)]]$

      ]

After event closure applies, we'll have the following strengthened meaning:

(520) $\exists_{\text{MAX}}e[A_e \wedge B_e \wedge \neg[C_e \wedge D_e] \wedge \neg[E_e \wedge F_e]]$

Note that now B is equivalent to A (if every Grand Slam tournament was won by either Federer or Nadal or both, then it's true that Nadal or Federer or both were the winners in the big event, and vice versa); C entails D (if in the big event of winning all the tournaments either Federer or Nadal (and not both!) was the winner, then it must be the case that each tournament was won by one or the other (and not by both)); and F entails E (if each tournament was won by both Federer and Nadal, then it must be the case that overall both Nadal and Federer were the winners). So, the expression in (520) is equivalent to the one below:

(521) $\exists_{\text{MAX}}e[A_e \wedge \neg C_e \wedge \neg F_e]$

Since the conjunction $A_e \wedge \neg C_e$ is equivalent to E,

(522) $\exists_{\text{MAX}}e[A_e \wedge \neg C_e \wedge \neg F_e] = \exists_{\text{MAX}}e[E_e \wedge \neg F_e] =$

= $\exists_{\text{MAX}}e[\ast\text{won}(e, f\oplus n, \sigma^\ast\text{GS})$ ∧

         ∧ $\neg\forall y[(y\leq\sigma^\ast\text{GS} \wedge \text{atom}(y) \rightarrow \exists_{\text{MAX}}e'[e'\leq e \wedge \ast\text{won}(e', f\oplus n, y)]]$

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There is a maximal event of winning all the Grand Slam tournaments, in which Federer and Nadal are the winners, and it is not the case that in each of the tournaments both Federer and Nadal were the winners. As we argued in 3.3.3, this is the correct meaning of the sentence.

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