

Friends and colleagues: Plurality, coordination, and the structure of DP

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FIRST DRAFT

Abstract

Starting from an analysis for the diverging crosslinguistic grammaticality of DP-internal conjunctions such as *this [man and woman] are in love*, the article develops a theory of the syntax/semantics interface within the DP and a novel proposal for the interpretation of conjunction. The main claims are that plural/mass denotations are built in stages within the DP, by the combined effect of number features and semantic operators associated with functional heads; that languages differ in whether the denotation of nouns is filtered for singular or plural number, and that the word *and* crosslinguistically denotes SET PRODUCT, an operation which, in different contexts, can mimic the behavior of intersection and union.

1 Introduction

This paper presents a little-known set of data concerning conjunction inside the noun phrase, and shows how this domain includes structures with readings which are unexpected under any current theory of the semantics of coordination. Moreover, these readings are shown to vary across languages in an interesting and systematic fashion, and to depend on the choice of determiners outside the conjunction.

Our goal is to account for these facts without having to posit an extra meaning for *and*. The attempt rests on three pillars: a theory of the syntax/semantics interface for Determiner Phrases, based on the idea that the semantic number for a noun phrase is built “in stages” inside the DP, through the combined semantic effect of two independent functional heads; a syntactic parameter which distinguishes English from Romance languages with respect to the realization of Number; a novel semantics for conjunction, which—in different contexts—can mimic either union or intersection. We will try to show that these proposals can be independently motivated, and that, when combined, they converge on the desired cross-linguistic distribution for the DP-conjunction facts under consideration.

To the extent our analysis is successful, it supports the existence of a mapping between syntactically motivated functional heads and semantic functions, and speaks in favor of a tighter integration between syntactic and semantic approaches to language.

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2 The problem

2.1 Distributive and collective conjunction

The background to this study is a well-known puzzle in the semantics of conjunction. If we take the standard semantic view that predicates denote properties—sets of individuals in an extensional Montegovian framework—constituent conjunction of predicates as in (1) can be straightforwardly mapped onto the operation of *set intersection*.

- (1) a. My uncle is [short and fat].
b. My uncle is [a good father and an excellent husband].

The conjunction of two argument noun phrases, however, cannot be mapped onto intersection with the same ease. For instance, the conjunction in (2) does not denote the intersection of the property of being John and that of being Mary, but, pretheoretically, a plurality formed by the two entities which *John* and *Mary* individually denote.

- (2) a. [John and Mary] danced.
b. [John and Mary] met.

Even setting aside the fact that *and* can conjoin many other categories, the difference between (1) and (2) raises issues for the possibility of a unified analysis of the meaning of *and*. There are nevertheless compelling motivations for a unified analysis; first and foremost the observation (made most forcefully in Winter 1996, citing a survey in Payne 1985) that no language seems to have different words for the intersective *and* in (1) and the plurality-forming *and* in (2).

Treating noun phrases as generalized quantifiers (sets of properties) appears to offer a promising solution under the banner of intersection. *And* in (2a) can be rendered as intersection just as in (1): the conjoined noun phrase denotes the intersection of the properties independently possessed by John and Mary. This solution still leaves as a problem the behavior of conjoined noun phrases in sentences with non-distributive—“collective”—predicates (e.g. *meet*, *be together*); since *meet* in (2b) denotes a property which is not independently possessed by either John or Mary, it will not be found in the intersection of the GQs built on *John* and *Mary*; something else therefore needs to be said for these cases. Some authors have responded to this problem by adopting a non-Boolean view of conjunction (e.g. Hoeksema 1983, Krifka 1990); in recent work Winter (1996) pursues instead the strategy of adapting an intersective (or Boolean, Winter 1998,2001) semantics for *and* also to these cases of collective conjunction.

While the debate in the last ten years has been lively and productive, the set of data considered in the semantic literature has always had at its core the cases illustrated in (1)–(2): conjunction of whole noun phrases, in English, functioning as the subjects of a range of distributive and non-distributive predicates. Building on Heycock and Zamparelli 1999 and Heycock and Zamparelli 2000, this paper aims to turn the attention of the linguistic community to the largely uncharted domain of conjunction *inside* the noun phrase, and to the analytic challenges and possibilities opened up by a comparative view that looks beyond English.

2.2 Conjunction within the noun phrase

In extensional Montague semantics, common nouns—just like adjectives—denote properties (type $\langle e,t \rangle$). This denotation combines with the denotation of the determiner to yield an $\langle \langle e,t \rangle, t \rangle$ type denotation (a Generalized Quantifier) or alternatively, an *e*-type denotation if we follow Heim’s (1982) quantifier raising system, or a type-shifting system *à la* Partee 1987, Partee and Rooth 1983. Montague’s semantics for common nouns can easily be mapped onto the more elaborate syntactic structure for noun phrases originating with Abney 1987: the Determiner Phrase (DP) hypothesis. Under this hypothesis, the determiner heads the whole noun phrase, and the noun heads its own internal projection, NP.¹ The semantic

¹The terminology in this area is unfortunately confusing. In the rest of this paper, we follow typical recent practice in using the expression “noun phrase” to mean the extended projection of N, namely the DP, and the acronym NP to refer to the immediate maximal projection of N inside the DP.

distinction between Montague’s “full noun phrases” and “common nouns” can be recast assuming a division of labor between the two projections DP and NP (see Stowell 1983, Higginbotham 1987, Hudson 1989, Longobardi 1994, Chierchia 1998a, 1998b, Longobardi 1999, among others):

- (3) noun phrase = [DP Det [NP (Adjs) Noun]]
- (4) a. DPs can be arguments.
- b. NPs are predicates.

Syntactic work subsequent to Abney 1987 (including at least Valois 1991, Cinque 1990, Crisma 1991, Cinque 1994, Giusti 1992, Bernstein 1993 and Zamparelli 1995, 1998) has added various functional projections (FPs) between D and the NP proper, to host attributive adjectives and other DP-internal modifiers (in particular, numerals). Semantically, this move has pushed upward the boundary of the part of DP which has to be interpreted “predicatively,” from NP to some FP immediately under D. For the time being, we will take the predicate to be NP, but we will partially correct this simplifying assumption in Section 4.

If NPs are predicates, the null hypothesis is that the conjunction of two NPs under a common determiner should behave exactly like the conjunction of two predicative adjectives, as in (1a). Indeed, this prediction seems correct for (5), where each DP refers to a single individual who has both the property of being a friend and the property of being a colleague. Henceforth, we refer to this reading of conjunction-containing DPs as the JOINT reading.²

- (5) a. [DP My [NP friend and colleague]] is writing a paper.
- b. [DP That [NP liar and cheat]] is not to be trusted.

This would be all there is to say on the matter, if we considered only singular count nouns and most languages other than English. In English, however, the following sentences are also grammatical.

- (6) a. [DP This [NP man and woman]] are in love.
- b. [DP This [NP soldier and sailor]] are inseparable.

The DPs in (6) refer to pairs of individuals, as is made clear by the verbal agreement. Despite the singular morphology of the determiner and both Ns, the DPs do *not* each refer to a singular individual with the properties of being both a man and a woman, or a soldier and a sailor. Pretheoretically, it seems that each property in the conjunction applies to a distinct individual: 2 properties lead to 2 individuals. We call this reading of the DP the SPLIT interpretation.

If NPs are properties, i.e. sets of individuals, and *and* denotes set intersection, the existence of a split reading is completely unexpected, as pointed out in Bergmann’s (1982) squib. For one thing, no comparable split interpretation seems to exist for cases of copular predication: *A recent event was sad and unexpected* cannot mean ‘A recent event_i was sad, and a recent event_j, unexpected.’³ Moreover, a cursory crosslinguistic look reveals that English is unusual (though not unique) in allowing a split reading in singular conjunction: in many other languages the direct equivalent of (6) is sharply ungrammatical, as illustrated by the French example in (7).

- (7) *[Ce [marin et soldat]] sont souvent ensemble.
[this [sailor and soldier]] are often together

The restricted crosslinguistic distribution of the split reading was noted in Dowty 1988, and has recently been presented and analyzed in King and Dalrymple 2002 in English, Finnish, Hindi and other languages. We will return to their analysis in Section 6; at this point, however, a brief comment is probably in order concerning a simple direction of analysis which might have occurred some readers. This is the idea that split readings might be reduced to a separate phenomenon: the possibility—in British English—of using plural verb agreement with singular collective nouns:

- (8) That group / couple were eating lunch. *British English*

²Throughout this paper we use the terminology *joint/split reading* pretheoretically. As will become clear, we do not mean to suggest that the existence of these two “readings” implies the existence of a lexical or structural ambiguity.

³See however Section 7.2 for a discussion of somewhat similar cases.

For instance, one could imagine treating (6)a as (9), with a silent noun meaning *pair*:

(9) This man and woman ~~pair~~ were eating lunch.

It is important to point out from the outset that this simple way out is not viable, for a number of reasons. First, all our American informants have confirmed the existence of singular split readings in their varieties of English, while (8) is known to be ruled out in American English. Second, even for British speakers, (8) may also have singular verb agreement, while *this man and woman was eating lunch* is impossible with the 2-people meaning. Third, the conditions in which “silent pair-nouns” may appear remain entirely unspecified. For instance, if (9) exists, what could rule out **this Italian ~~pair~~ love each other*? Fourth, the singular split reading is systematically present in residual forms even in languages, like Italian, that do not allow (6) or (8), as we shall see in Section 3.1. Finally, joint and split readings are also available for plural NPs, where a “silent pair” approach would have no effect. Thus, the most salient (perhaps the only) reading of (10a) has two people, each of whom is both a friend and a colleague; the most salient reading of (10b) is one in which 5 men and 5 women got married.

(10) a. [My two [friends and colleagues]] wrote their paper together. *Joint*
b. [Ten [men and women]] got married today in San Pietro. *Split*

Although plural split cases such as (10b) are perhaps less striking than singular examples like (6) because there is no mismatch between the DP-internal agreement and the agreement on the verb, they are equally unexpected under an intersection analysis.

Remarkably, languages which do not allow singular split cases almost always allow split readings in the plural:⁴

(11) Ces marins et soldats sont souvent ensembles.
these sailors and soldiers are often together
Possible description of a group with no one who is both a soldier and a sailor.

Given these facts, three research issues arise:

- I. What semantics for conjunction can capture the full range of DP-internal cases?
- II. What is the difference between English and languages that do not allow a singular split reading? And why does this difference break down in the plural?
- III. Can a semantics that handles DP-internal conjunction correctly be extended to conjunction of other categories—at the least, conjunction of full DPs?

The rest of the paper offers a detailed answer to the first two of these issues, and some ideas about how the third one might be tackled. Our strategy will be to split the problem in two parts. Focusing on the paradigmatic split case in (12), with the bracketing indicated,

(12) [_{DP} this/a [_{NP} man and woman]] are in love.

we propose that the existence of this reading can be explained if:

- the NP conjunction *man and woman* denotes the property of being a couple (of opposing sex).
- the pluralities present in this NP denotation, i.e. the couples themselves, can be made compatible with a singular determiner such as *this* in languages which allow the singular split reading, and incompatible in those which don't.

We will discuss these points in reverse order. In the next section, we take some time to lay out the data, many aspects of which have never been discussed in the literature in the perspective of the syntax/semantics interface. Next, in Section 4, we concentrate on the second part of the problem; that is, we assume that *man and woman* does indeed denote the property of being a couple, and lay down a theory

⁴The single exception of which we are aware is Greek, discussed in Section 6.1.

of how the denotation of NPs is formally processed within the DP—a theory of the syntax/semantic mapping in a nominal structure with multiple layers. The core idea is that singular-split and non-singular-split languages differ on a parameter that determines whether singular determiners “filter” the content of a plural property or not. This will answer research issue II above.

In Section 5, we go back to research issue I, to give a novel semantics for conjunction which justifies our previous assumption that *man and woman* does in fact denote the property of being a couple. We will show that this semantics interacts with the syntax/semantics interface to yield the full distribution of the split and joint readings both within and across the languages discussed. Section 6 discusses some alternative analyses. Finally, Research Issue III is addressed, far more briefly than it deserves, in Section 7, together with some speculations on open issues.

3 Conjunction within the DP: the data

3.1 Conjunction of singulars

The joint reading of singular DP-internal conjunction is illustrated again in (13).

- (13) a. In front of me, [a friend and colleague] was standing in line.
 b. [That famous linguist and political activist] is always shunned by the popular press.
 c. Anne married [the singer and song-writer] in April 1956.
 d. Bill is [John’s friend and brother-in-law]

For many speakers there is something odd about the joint reading in the presence of a singular definite determiner, except when the context makes available a very clear, unique referent. A survey of the construction in the British National Corpus shows in fact that these constructions are most commonly used as appositions, where the referent is maximally identifiable. The following are typical examples from the BNC:

- (14) a. Included in the parson were General Leopoldo Galtieri, [the former army commander and president], and 38 other officers.
 b. Gordon Dunlop, [the former director and chief financial officer of British Airways], has turned his interest toward . . .

It is important to stress that, out of context, all the DPs in (13) are ambiguous: *a friend and colleague* stereotypically refers to a single person, but it can also refer to two, as it does in *Father Brown married a friend and colleague to each other*. Of course, the context, verbal agreement, or the use of (in)compatible properties can bias the interpretation toward a split or a joint reading to a greater or lesser extent. Thus, the following cases allow only the split interpretation.

- (15) a. [My grandfather and great-grandfather] were both sailors.
 b. [That soldier and sailor] are always in agreement.
 c. [The red card and white card] face each other.

A second point is that the split reading is not an idiomatic peculiarity within English, limited to a small number of potentially lexicalized pairs like *bread and butter*, or to a limited subset of determiners. A search on the BNC reveals many examples of unambiguously split readings of DP-internal conjunction, with at least the following determiners and quantifiers:⁵

- (16) a. *definite determiner*: the actor’s work depends so much on the technical decisions of [the director and editor]
 b. *indefinite determiner*: In today’s preliminary hearings . . . [a 36-year-old farmer and 25-year-old X-ray technician] both claim a right to asylum
 c. *demonstrative*: [This global stance and anthropological imagination] continue to guide him
 d. *“one”*: . . . each item consisted of so many bars of [one tempo and time signature]

⁵It is impossible to quantify exactly the percentage of split readings over the total number of DP-internal coordination, since the context cannot fully disambiguate most of the cases.

- e. *possessive*: [My mouth and throat] went dry

Split conjunction is also possible with *every* and *each*; the examples in (17) are also from the BNC.

- (17) a. *every*: There is a Bastille in [every glen and firth].
 b. *each*: the technical structure of [each step and pose] is known

(17a) seems most plausibly interpreted as quantification over glens and over firths (river-mouths), rather than over glen-firth pairs; quantification over individuals rather than pairs is also clearly possible, and probably also the most plausible interpretation for *each step and pose* in (17b). It is possible to construct examples which make this clearer:

- (18) a. Every man and woman has lived alone at some point.
 b. Each man and woman had to enter the room alone.

Moreover, split readings seem available also for Dutch, particularly with definite determiners, though not as productively for pairs of semantically unrelated nouns (Jack Hoeksema, personal communication).

- (19) a. Deze man en vrouw zijn gescheiden. *Dutch*
 This man and woman are divorced
 This man and woman are divorced (*not necessarily from each other*)
 b. Dit mannetje en vrouwtje staan op de taart.
 this man-DIM and woman-DIM stand on the cake
 c. ?Een man en vrouw stonden te roken.
 A man and woman were smoking

Split readings also occur in Finnish.⁶

- (20) a. Tämä mies ja nainen tässä laulavat kuorossa. *Finnish*
 this-SG man and woman here sing-PL in a choir
 b. Yksi sotilas ja merimies tappelivat kadulla.
 one soldier and sailor were fighting in the street

On the other hand, in most languages we have looked at (Italian, Spanish, French, German)⁷ singular joint readings are possible, but singular split readings, when forced, are strongly ungrammatical even when gender agreement is controlled for.

- (21) a. *Un uomo e bambino mangiano. *Italian*
 a man and child are eating
 b. *Questo uomo e ragazzo sono buoni amici.
 this man and boy are good friends
 c. *Ho visto il padrone e cane insieme
 I have seen the master and dog together

⁶In Finnish bare nouns can appear in the singular, so it is not as straightforward as it is in English to establish that the coordination is within the DP, rather than being between a DP with a determiner and a DP consisting only of a noun. However, the adverbial *tässä* (here) cannot appear with a bare noun like *nainen* (woman) when this is used as a DP; thus it marks the right periphery of the DP commencing with *tämä* (this).

A striking fact about Finnish, for which we currently have no explanation, is that it is also possible for the determiner to show plural rather than singular morphology; the same possibility appears to be true of Russian (Andrew Spencer, personal communication, and King and Dalrymple 2002), as if in these languages determiner agreement followed the pattern of verbal agreement. We will not discuss these facts in the present work.

⁷The judgments on German seem more variable than the other languages; it remains to be determined whether this reflects idiolectal, dialectal, or possibly lexical variation. Some possible split cases, e.g. *Ottos Bruder und Schwester* ‘‘Otto’s brother and sister’’ have been confirmed by speakers from different areas.

Hungarian is also a language in which split readings are available only in the plural. We do not discuss Hungarian in detail here, however, as the overall pattern of number agreement in the noun phrase is different from the other languages under consideration, and merits more detailed analysis than we can provide here.

- (22) a. *En face de moi discussaient un soldat et marin. French
 opposite me were arguing a soldier and sailor
 b. *Ce soldat et marin étaient d'accord.
 this soldier and sailor were in agreement
 c. *Mon grandpère et arrière-grand-père étaient tous les deux charpentiers.
 my grandfather and great-grandfather were both carpenters
- (23) a. *En el bar vi a un soldado y pescador. Spanish
 in the bar I saw ACC a soldier and sailor
 b. *El soldado y pescador estaban luchando.
 the soldier and sailor were fighting
 c. *Ese soldado y pescador se han odiado siempre.
 that soldier and sailor REFL have hated always
- (24) a. ?*Der Bücherbord und Tisch, den/die sie gerade angestrichen hatte, waren noch
 the bookcase and table which[sing/plur] she just painted had were still
 feucht. German
 wet
 The bookcase and table that she had just painted were still wet.
 b. ??Ich sah ein Fahrrad und Auto, das/die draußen liegengelassen worden waren.
 I saw a bicycle and car which[sing/plur] outside left become had.
 I saw a bicycle and car that had been left lying outside.
 c. ?*Die Hündin und Katze, von der/denen ich dir erzählt habe, sind draußen.
 That/those dog and cat about which[sing/plur] I you told have are outside.
 The dog and cat that I was telling you about are outside.
- (25) *A mesa e escrivaninha estao arrumadas. Brazilian Portuguese
 the table and small desk are in order
- (26) *Az orvos es ugyved reszegek voltak. Hungarian
 the doctor and lawyer were drunk.

One important exception in Italian is the case of singular conjuncts introduced by the singular quantifiers *ogni* “every”, *ciascuno* “each”, *qualche* “some_{sing}”, *qualunque*, free-choice “any_{sing}”. These cases range from mildly deviant to completely normal, even though this language does not normally tolerate singular split readings.

- (27) a. ?{Ciascun / qualsiasi / qualche} cucchiaio e coltello va lucidato individualmente.
 {each / any / some} spoon and knife must be polished individually
 b. Ho invitato ogni uomo, donna e bambino ad evacuare l' area.
 I invited every man, woman and child to abandon the area
 c. Parlerò con qualsiasi genitore e insegnante interessato ad ascoltarmi.
 I will speak with any parent and teacher interested to listen to me

Analogous judgments hold for French and Spanish (Corine Astesano, Leonor Moral, personal communication).

Similarly, conjunctions under *nessuno* “no” and *alcuno* negative polarity “any_{plur}” in Italian are only mildly deviant, though they tend to be interpreted as quantifications over *pairs* of objects.⁸

- (28) a. ?Nessun cucchiaio e coltello va pulito con l' aceto
 no spoon and knife must be cleaned with vinegar
 b. Non ho comprato nessuna/alcuna borsa e sciarpa per questo vestito
 (I) not have bought any/any bag and scarf for this dress.

⁸Italian is a negative concord language: hence in negative polarity environments, *nessuno* and *alcuno* are synonymous.

The residual marginality seems to be linked to uncertainty in verbal agreement; plural verbal agreement is indeed a possibility with the (a) cases, but more marginal. Object position, where no agreement has to be overtly realized, improves all cases.⁹

3.2 Conjunction of plurals

While in singular DP-internal conjunction it is usually simple to identify two distinct readings, one joint, the other split, in the plural the situation is more complex. Verbal agreement can no longer be used to disambiguate; on the other hand, numerals can now help to clarify the total number of individuals referred to. In addition, of course, it continues to be possible to pick NPs denoting incompatible properties.

3.2.1 Simple plural definites

Consider first of all cases of simple plural definites:

- (29) a. [His friends and enemies] agreed only on one point.
 b. He talked to [John's sons and nephews].
 c. [Those arrogant American generals and Yugoslavian diplomats] will surely find the peace talks exceedingly irritating.
 d. [The diamonds and rubies you saw at the exhibit] are worth a king's ransom.
- (30) a. [His friends and colleagues] all came to the party.
 b. [The writers, journalists and film critics who crowded the parties] steered the conversation into a dead end.
 c. Robert and Bill, [my countrymen and fellow revolutionaries] have been arrested.

In (29), pragmatics and the use of incompatible properties yield the direct equivalent of a fully split reading for the bracketed DPs: pretheoretically, all the bracketed DPs in (29) refer to a plurality of individuals, each of whom has one and only one of the properties in the conjunction. Moreover, each of the properties must be represented in the plurality, that is to say, [John's sons and nephews] cannot refer to a group made entirely of John's sons, or entirely of John's nephews. The necessity for all the properties to be represented distinguishes these cases from simple cases of disjunction:

- (31) He talked to [John's sons **or** nephews] yesterday.

The DP in (31) might refer to a group of, say, 3 sons and 4 nephews, but it might also cover a case with 7 nephews and no son. The latter possibility is excluded for the *and* case, as further discussed in Section 5.3 and 5.4.

In (30), on the other hand, the use of compatible properties makes possible fully mixed readings, provided all the properties are represented. For instance, *the friends and colleagues* could refer to a group of two friends who are not colleagues, three colleagues who are not friends and five who have both properties. What intuitions show here is that “fully joint” and “fully split” readings are just two extremes

⁹One further exception to the absence of the singular split reading in Italian is the acceptability of what appear to be split readings for the conjunction of abstract mass nouns. Such conjunctions are extremely common in our English data: the following are some examples from the BNC:

- (i) a. their fitness and concentration
 b. much determination and hard work
 c. the fanaticism and sheer ferocity of tabloid prejudice
 d. this optimism, cheerfulness, and absolute lack of self-pity

The existence of such split readings for English is unsurprising; the existence of analogous split cases in Italian is also not unexpected, under the view of mass nouns sketched in Section 4.3.

- (ii) La corruzione e lentezza del tribunale era/erano nota/e a tutti.
 the corruption and slowness of the court was/were known[sg/pl] to everyone

On the other hand similar examples in French do not appear to be acceptable, and concrete mass nouns in Italian also fare worse.

The apparent free variation in verbal agreement is characteristic also of the English examples. The issues raised by the behavior of coordinated mass nouns will be pursued in further research, but is beyond the scope of this paper.

of a range of possible denotations. This fact places an interesting constraint on the type of account we need to look for: any theory which posited a strong binary distinction between fully split and fully joint readings (e.g. attributing them to separate syntactic structure) would simply be inadequate to deal with simple cases like (30).¹⁰

In the previous section we saw that in a number of languages, including Italian, French, German, Spanish, Brazilian Portuguese, and Hungarian, singular DP-internal conjunction can receive only the joint interpretation; the split interpretation is unavailable, as illustrated in (21)–(26). In the plural, however, all but one of the languages we have investigated fully allow split readings in addition to the joint one.¹¹

- (32) Gli amici e nemici di Gianni si trovano d'accordo su un solo punto. *Italian*
the friends and enemies of Gianni were in agreement on a single point
Gianni's friends and enemies were in agreement on a single point.
- (33) Les neveux et petit-neveux de Jean sont venus aux funérailles. *French*
the nephews and great-nephews of Jean are come to the funeral
Jean's nephews and great-nephews came to the funeral.
- (34) Los hermanos y hermanas de Juan se dividieron la herencia. *Spanish*
the nephews and nieces of Juan REFL divided the inheritance
Juan's nephews and nieces split the inheritance.
- (35) Die Bücherborde und Fenster, die sie gerade angestrichen hatte, waren noch feucht. *German*
the bookcases and windows which she just painted had were still wet.
The bookcases and windows that she had just painted were still wet.

As mentioned in Section 2.2, Greek provides a single counterexample to this generalization: split readings are ruled out also for plural definites like (36a), although they are available for plural indefinites like (36b) (King and Dalrymple 2002).

- (36) a. *oi gátes kai kóttēs
the-PL cats and chickens
b. merikés gátes kai kóttēs
several-PLUR cats and chickens

3.2.2 Plurals with numerals

In all the languages we have tested, plural split readings can also be introduced by cardinal numerals and vague adjectival numerals (*many, several, numerous, few, a few, various*), with and without a definite determiner. Split readings with vague determiners are particularly natural.¹² The examples in (37) are from Italian, those in (38) from French.¹³

¹⁰As discussed in Section 6.1, this may be a problem for the analysis in King and Dalrymple 2002.

¹¹The split interpretation is reminiscent of a (semi)partitive structure with *tra* (among/between) found in Italian:

- (i) Venti tra generali e diplomatici discutevano animatamente.
twenty among generals and diplomats discussed animatedly
Twenty of the generals and diplomats were having an animated discussion.

However, the split constructions in this sections cannot in general be considered elliptical versions of the *tra* construction, since *tra*-versions of definite examples like (37a) are clearly ill-formed.

- (ii) *I (numerosi/varì) tra generali e soldati ...
the (numerous/various) among generals and soldiers

¹²The salient reading of these examples is one in which the vague numeral is applying 'collectively' to the group formed by e.g. American generals and Yugoslavian diplomats, not a conjunction between [the numerous American generals] and the bare plural [Yugoslavian soldiers]. Note that this second (irrelevant) parse is unavailable in French and restricted in Italian.

¹³One exception to the possibility of plural split readings in languages which do not allow singular split readings is the significantly reduced acceptability of conjunctions of nouns with modifiers or complements, introduced only by an article. Thus, (i) contrast with (37):

- (37) a. I {numerosi / pochi / venti} generali americani e diplomatici jugoslavi alla
 the {numerous / few / 20} generals American and diplomats Yugoslavian at the
 conferenza concordavano su un solo punto.
 conference agreed on a single point
 The numerous/few/20 American generals and Yugoslavian diplomats at the conference
 agreed on a single point.
- b. {Molti / Vari / Parecchi} amici di Carlo e parenti di Francesca si incontrarono
 {many / various / several} friends of Carlo and relatives of Francesca REFL met
 per la prima volta al matrimonio.
 for the first time at the wedding
 Many/various/several friends of Carlo and relatives of Francesca met for the first time at
 the wedding.
- (38) a. {Les / Ces} nombreux marins américains et soldats britanniques se battaient.
 {the / these} numerous sailors American and soldiers British REFL fought
 The/These numerous American sailors and British soldiers were fighting.
- b. Plusieurs neveux de Jean et cousins de sa femme sont arrivés.
 several nephews of Jean and cousins of his wife are arrived

World knowledge disfavours a joint reading for these examples, but in other cases, e.g. those involving people with multiple roles like (*Quei*) *venti linguisti e filosofi* ((those) twenty linguists and philosophers), the joint reading is clearly available, exactly as in English. However, this reading is lost, in both English and Italian, if the numeral is repeated in each conjunct. For instance, in (39), only the split reading (distinct objects or people) survives.

- (39) a. I tre cavatappi e tre apribottiglie erano già sul tavolo. *total:6*
 the three corkscrews and three bottle-openers were already on the table
- b. I due amici e due colleghi apparvero sulla soglia. *total:4*
 the two friends and two colleagues appeared on my doorstep
- c. Quei venti linguisti e venti filosofi non raggiungeranno mai un accordo. *total:40*
 those 20 linguists and 20 philosophers will never reach an agreement

4 DP structure and plurality

We have now set out the basic data. In the rest of the paper we will argue that the distribution of split and joint readings for DP-internal coordination follows from the interaction of minimally different realizations of the singular/plural distinction in the noun phrase with a language-invariant interpretation for conjunction. In this section we set out a detailed proposal for the realization of number and the internal structure of noun phrases. Our interpretation for conjunction will be given in Section 5.

4.1 Functional projections and their semantics

The structure we will use to account for the data is an extended DP with multiple projections between D and the N proper, based on Abney 1987, Hudson 1989, Cinque 1994, Longobardi 1994, Ritter 1991b, Siloni 1994, Zamparelli 1995, 1998 and others:

- (40) a. [DP *Det* [_{NumP} *Num* [_{PIP} *Pl* [_{NP} (*Modifiers*) *Noun* (*Modifiers*) (*Compl*)]]]]]
 b. [DP *Those* [_{NumP} *few* [_{PIP} *Pl* [_{NP} *linguistic papers*]]]]

- (i) a. ??I [generali americani e diplomatici jugoslavi] alla conferenza ...
 the [generals American and diplomats Yugoslavian] at the conference ...
 b. ??Gli [amici di Carlo e parenti di Francesca] ...
 the [friends of Carlo and relatives of Francesca] ...

Unfortunately, we do not have space to discuss this restriction in the present paper.

Following Zamparelli 1995 and others, we assume that the NP layer hosts the noun plus attributive adjectives (possibly within additional projections, which we disregard), NumP hosts cardinal numerals (and possibly other predicative determiners, see the discussion on the indefinite article *a(n)* below). At spell-out, DP can host “strong” determiners (definite articles, demonstratives, universal quantifiers and *most*), plus *some* and *no*, though as we shall see, in the account that we are going to propose not all of these elements will be generated (merged) in this layer. We will leave open whether the DP layer also hosts cardinals in their specific (“strong,” in Milsark’s sense) reading. Finally, we name *PIP* a projection linked to the generation of plural denotations. We will discuss the crucial role of PI in Section 4.3.¹⁴

Although (40) is not meant to be a complete structure for the noun phrase, we will work under the hypothesis that the layers in (40) constitute the minimal structure necessary to obtain a quantificationally correct denotation for noun phrases.¹⁵

Locating cardinals in NumP means that a noun phrase introduced by a cardinal numeral will be quite different from a “strong” DP such as *those children* (41a). If argumental noun phrases are full DPs (a point to which we will return), *two children* will have the structure in (41b) as an argument, while in predicative position it will be a bare NumP (41c) (Zamparelli 1995).

- (41) a. [DP those [NumP ... [NP children]]]
 b. [DP D^e [NumP two ... [NP children]]]
 c. [NumP two ... [NP children]]

Observe that, for arguments, (41b) follows automatically from the availability of a post-determiner position for numerals (as in *the two children*) which is “adjectival” in nature (Carden 1976, Giusti 1991, Kadmon 1987), and the possibility of determinerless plurals introduced by an adjective (a point made in Hoeksema 1983 and Verkuy1 1981).

We will adopt a “checking” theory of features along the lines of Chomsky 1995, 2000, augmented with a mechanism of *feature underspecification*, similar to the one described in Chomsky (2001) (but also common to unification grammars, see Shieber 1985). Specifically, we assume that lexical heads come with features which may have a value but may also be *unvalued* (*underspecified*, in the terminology of unification grammars). The presence of unvalued feature drives the operation of *agree*: a head with an unvalued feature needs to agree with another head which has the same feature and a value for it. As result of this process, the unvalued feature receives a value. Features without a value crash at Spell-Out. “Agree” may involve visible movement of a constituent, or a mechanism of feature percolation which only moves the formal features of some element. In one important departure from the system set out in Chomsky 2001 we do not assume that features that receive a value in the course of the derivation are deleted before the level of interpretation is reached; on the contrary, we believe that the feature values acquired by a head may have an important role in determining the specific semantic function of that head. This will be exemplified in Section 4.4.

We will make two additional assumptions: first, that the formal features of an element always move together as a bundle, even if only one of the features in the bundle is unvalued; second, that when an unvalued feature agrees with its target, the remaining features in the bundle must be consistent with the corresponding features of the target. For instance, the bundle [PERS=*unvalued*; GENDER=Male] could agree with [PERS=3; GENDER=Male], but not with [PERS=3; GENDER=Female], since even if PERS is driving the agreement the two gender values are incompatible. Finally, as an abbreviatory convention, we will simply write e.g. [GENDER] for [GENDER=*unvalued*].

¹⁴ In what follows, we will be deliberately vague about the specifier or head position of some of these elements, assuming that the semantic variation which may be derived from this syntactic difference (if any) will be orthogonal to our topic. Across constructions, it is not hard to find operators with comparable meaning but a different spec/head status. Examples are *whether* vs. *if* (Kayne 1991); possessor phrases (*John’s*—see Abney 1987, Sections 2.1 and 4.1) vs. possessive pronouns; “complex determiners” such as *more than 3 but less than 5* vs. *4* (Keenan and Stavi 1986). See Zamparelli 1995, Section 6.4, and Heycock and Zamparelli 2002 for discussion.

The structure in (40) corresponds to the one in Zamparelli 1995, 1998, mapping his SDP (‘Strong DP’) onto our DP, PDP (‘Predicative DP’) onto NumP and KIP (‘Kind Phrase’) onto PIP (for some of its functions). We adopt the present terminology because it is more in line with the labels used elsewhere in the literature.

¹⁵For instance, (40) does not have room for *all*, which must be external to DP, (given *all those forty-five boys*), possibly realized as an adjunct, see Sportiche 1988.

In this paper we will be distinguishing between a semantic and a syntactic feature for number. The semantic feature we will call LATT (for “lattice”). It has two possible values: -LATT (semantically singular) or +LATT (semantically plural, i.e. “having a join semilattice structure”—see below). The semantic feature LATT is distinguished from the ϕ -feature for syntactic number, indicated as +PLUR (syntactically plural) and -PLUR (syntactically singular). \pm PLUR belongs to the more general group of *agreement* features. The motivation for this choice of features will be discussed in Section 4.3.

4.2 The syntax/semantics interface of nominals

Turning to the semantics, we assume a basic domain At of atomic objects (entities of type e). For the sake of simplicity we will disregard intensions, and use $\|X\|$ to refer to the extension assigned to the syntactic object X by the interpretation function f in a model M .

What should be the denotation of *singular* and *plural* nominal expressions? Following Link 1984, 1987, Landman 1989, Schwarzschild 1996 and many others, we assume that pluralization can be modeled as an operation that turns the denotation of a noun, a set of singular individuals, into a set composed of all the ways in which these individuals can be grouped together into *pluralities*. We choose to render pluralities as *sets of atomic individuals*, as in Landman 1989 and Schwarzschild 1996, rather than *individual sums*, as in Link’s (1984) formalization.¹⁶ In addition, *singular* individuals will also be mapped onto sets, i.e. the singleton sets containing the relevant atomic individuals (as e.g. in Scha 1981). This choice will give, for instance:

- (42) a. $\|\text{John}\| = \{\text{john}\}$
 b. $\|\text{The boys}\| = \{\text{john, bill, henry}\}$

Singular and plural predicates (whether NP or other syntactic types) will therefore all denote sets of sets, entities of type $\langle\langle e, t \rangle, t \rangle$. Semantically, the only difference between singular and plural is that the extension of singulars will only contain *singletons*.

Given a predicate $P \langle\langle e, t \rangle, t \rangle$, the notation $*P$ stands for the *pluralization* of P , defined as the closure under union:

- (43) $*\|P\| =$ the smallest X such that $\|P\| \subseteq X$ and $\forall Y, Z \in X [Y \cup Z \in X]$

The $*$ -operator does not introduce the empty set into the denotation of a plural, much as in Landman 1989,¹⁷ and preserves singletons in its output, as argued for in Schwarzschild 1996, Lasersohn 1995 (contra Chierchia 1998a).

Formally, a model for the interpretation of count noun phrases will consist of a quadruple $\langle At, f, \subseteq, * \rangle$, where At is the set of atomic objects, f the interpretation function, \subseteq the individual subpart relation, and $*$, the pluralization operation. From At (which will never be used directly) we can define the set S of singular individuals and the set I of individuals (singular and plural).

- (44) a. $S = \{\{x\} : x \in At\}$
 b. $I = \{X : X \neq \emptyset \wedge X \subseteq At\}$

(We use x, y, z, k, p, q, r as variables, other letters as constants; P, Q, R for sets of sets, and other uppercase letters for elements in S or I).

Our general assumption is that each syntactic functional head denotes a function over the denotation of its syntactic complement; the function varies depending on the (overt or covert) content of the head. We will assume that functional layers whose heads do not perform any semantic or syntactic function are

¹⁶As far as we can see, the theory presented in this paper could be recast in lattice-theoretic terms using Link’s (1983) sum operator.

¹⁷From a linguistic standpoint, the choice of whether to include the empty set or not partly depends on assumptions about the denotation for *zero Ns*. If *zero* is treated on a par with other numerals and the empty set has cardinality 0, it is tempting to say that the empty set is introduced by the $*$ -operator, considering that in all languages where it is used, *zero* requires a plural noun (Viviane Deprez, p.c.). The price to pay is that all *zero Ns* become fully coextensional. The solution must be sought, it seems, in an intensional treatment for *zero*, which we will not pursue here.

simply missing: the denotation of their complement is passed up the tree unaltered.¹⁸ To see an example, let us consider the construction of a plural DP.

One crucial feature of our proposal is that the semantic operation of pluralization is moved out of the noun and attributed to the presence of an abstract functional head external to the NP. Thus, we assume that the denotation of all nouns, singular or plural, is a set of singleton elements. The only difference between plural and singular nouns is the value of their PLUR feature.

The task of generating a plurality is given to the *-operator, defined in (43), which is associated with PI*, an abstract head of the PIP projection that takes NP as its complement. When applied to the denotation of the NP proper, the result is a complete join semilattice of individuals, minus \emptyset .

- (45) a. $\|NP\| \subseteq S$
 b. $\|[_{PIP} PI^* NP]\| = * \|NP\|$

For example, with 4 individual tall boys a, b, c, d in the domain, $[_{NP} \text{ tall boys}]$ will denote $\{\{a\}, \{b\}, \{c\}, \{d\}\}$, and PIP will be:

- (46) $\|[_{PIP} \text{ tall boys}]\| = \{\{a, b, c, d\}, \{a, b, c\}, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a\}, \{b\}, \{c\}, \{d\}\}$

At the next level up, NumP behaves as a *filter*. It regulates the cardinality of the PIP denotation, eliminating from it all the pluralities with the wrong number of atoms, much as in Hoeksema 1983:65 and Verkuyl 1981. $|X|$ should read as “the cardinality of P”.

- (47) $\|[_{NumP} n \text{ PIP}]\| = \{X : X \in \|PIP\| \text{ and } |X| = n\}$

For instance, with four tall boys in At and the PIP *tall boy(s)* as in (46), we have:

- (48) a. $\|[_{NumP} 3 [_{PIP} \text{ tall boy(s)}]]\| = \{\{a, b, c\}, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}\}$
 b. $\|[_{NumP} 4 [_{PIP} \text{ tall boy(s)}]]\| = \{\{a, b, c, d\}\}$

The fact that plurals contain singular individuals makes a number of correct predictions. First, the complex determiner *one or more* is interpreted correctly:

- (49) $\|[_{NumP} \text{ one or more } [_{PIP} \text{ boys}]]\| = \|[_{PIP} \text{ boys}]\|$

Second, as noted by many authors, examples like (50) seems to be falsified by a single case.¹⁹

- (50) a. There have never been relatives of mine in the House of Lords.
 b. I have never come across linguists who have met Jakobson.

Third, the English determiner *no* can select for singular as well as plural nouns. But, as pointed out by Schwarzschild (1996) and others, the meaning of singular and plural *no* doesn't seem to be truth-conditionally different. (51) has the same truth conditions as *No boy arrived*: it is false in a situation in which a single boy has arrived.

- (51) No boys arrived.

DPs are the canonical arguments. Semantically, this means that they denote singular or plural individuals (type $\langle e, t \rangle$ in this system), or Generalized Quantifiers (type $\langle \langle e, t \rangle, t \rangle$). Here we adopt the following as a general semantic schema for the D head: D minimally denotes a free variable whose value is chosen from the set denoted by the NumP.

- (52) $\|[_{DP} D \text{ NumP}]\| = X : X \in \|NumP\|, \quad \textit{NumP a property}$

¹⁸It may of course be empirically impossible to distinguish between FPs that are missing and FPs that are present but completely inactive. If the latter route turns out to be preferable on theoretical grounds, we will assume that semantically empty heads denote the identity function as a default.

¹⁹Since *relatives of mine* and *linguists who have met Jakobson* cannot denote kinds, the possibility of deriving a single individual reading from a kind denotation, as in Chierchia 1998b, is precluded.

This skeleton definition can be further specified by the lexical content of D; in particular, overt quantifiers in this position function as binders for the D variable.²⁰

A particularly interesting case is that of *definites*. Following Sharvy 1980, we assume that the definite determiner *the* denotes **Max**, which picks the *supremum* of the denotation of its complement:

$$(53) \quad \mathbf{Max}(P) = \iota Y : Y \in P \text{ and } \forall Z: Z \in P, Z \subseteq Y$$

$$(54) \quad \llbracket [\text{DP the NumP}] \rrbracket = \mathbf{Max}(\llbracket \text{NumP} \rrbracket) \quad \text{NumP a property}$$

If the argument of the definite is a set of singletons (as will be the case for a singular noun), **Max** will be defined only in case this set actually contains a single element. This captures the fact that *the* with a singular noun presupposes (contextual) *uniqueness*; on the other hand, *the* plus a plural noun picks the largest plurality which can be built from the denotation of the noun (Sharvy 1980; Chierchia 1998a), and so presupposes *maximality*.²¹

One immediate consequence is that if a definite applies to a NumP containing a cardinal numeral, it will be well-formed (semantically defined) only when the numeral is chosen to preserve a unique maximal element in the denotation fed to D. For instance, in our model with 4 tall boys, $[\text{NumP } 3 \text{ tall boy(s)}]$ would give the denotation in (48a), which does not contain any unique maximal element. The only possible syntactic argument to a definite determiner would be (48b), which gives $\{\{a \ b \ c \ d\}\}$.²²

4.3 Motivations for two heads and two features

The DP structure introduced above uses two syntactic projections related to the semantic realization of plurality, i.e. NumP and PlP, and two features, LATT and PLUR. It might seem that a more conservative approach should be able to obtain the same result with a single syntactic projection (say, NumP, home of cardinal numbers) and a single ‘Number’ feature. The goal of this section is to show that two independent heads and two features are in fact necessary.

Theories that allow a single number projection in the DP (e.g. Ritter 1991a) usually assume, more or less tacitly, that plural nouns come from the lexicon denoting pluralities, perhaps as a semantic reflex of the application of a morphological suffix. This paper takes the opposite view (originally defended by Verkuyl 1981) that plural nouns such as *boys* do not denote anything different than singular nouns, but are simply merged under an abstract functional head that generates the plural denotation and carries the +LATT value.

Evidence for this idea comes from a constraint on the position of cardinal modifiers: cross-linguistically, numerical modifiers must appear in a very external position in the DP. If plural nouns denoted pluralities to start with, it would be a mystery why these modifiers, in many cases clearly adjectival in nature, never appear in a position *below* PlP, unlike all other adjectives. The distribution of numerals could of course be stipulated at a syntactic level, but this would not capture the fact that cardinal expressions are bad even when embedded in restrictive relative clauses. Contrast (55a) with (55b).

- (55) a. ?The people who lifted the piano came to twelve.
 b. *I need people who come to twelve to lift the piano.

In English, the point is obscured by the fact that cardinal numerals are marginal in predicative position, but Italian, where numeric predicates are perfect, shows the same pattern.

²⁰For example “Most people left” could be rendered as:

$$(i) \quad \exists P, P \in * \llbracket \text{people} \rrbracket \wedge |P| \text{ is greater than a certain proportion of } \llbracket \text{people} \rrbracket \wedge \llbracket \text{left} \rrbracket (P)$$

²¹We leave open here whether *the* also provides an existential quantifier, or just a variable to be bound at sentence level.

²²Notice that if numerals in NumP could have an “at least” reading, the denotation for $[\text{NumP } 3 \text{ tall boy(s)}]$ would be:

$$(i) \quad \llbracket [\text{NumP } 3 \text{ tall boy(s)}] \rrbracket = \{\{a, b, c, d\}, \{a, b, c\}, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}\}$$

which does preserve the supremum. The fact that *the 3 tall boys* is impossible in the context given shows that no “at least” reading is available in this position.

- (56) a. I problemi erano {quattro / molti / troppi}.
 the problems were {4 / many / too many}
- b. ??Devo risolvere problemi che siano {quattro / molti / troppi}
 I must solve problems that are {4 / many / too many}
- c. *Ho comprato libri che hai letto (che erano) quattro.
 (I) have bought books that you have read (that were) 4

(56b) cannot mean: *I must solve n problems*, for some value of *n*, and in (56c) *che erano quattro* is only interpretable as a parenthetic non-restrictive relative.²³ Our approach to this problem is that modifiers that crucially make reference to a plurality can attach only above the point at which a plurality has been formed by the *-operator.

This still leaves open the possibility that a single head, say NumP, could denote the composition of the two semantic operations—the creation of a plurality and its filtering by a cardinal number. But coexistence in a single head strongly predicts that the two operations should be both active or both inactive; in particular, it should be impossible to form a plurality without filtering it. However, we will show that if this possibility is assumed to exist we obtain a natural account of the difference between English and Romance languages. The existence of two distinct projections, though not logically necessary, has more explanatory power.

Turning to the role of the features encoding plurality: in the system we have proposed LATT delivers the semantics of plurality, and PLUR makes sure that syntactic number is consistent across all DP constituents, nouns, determiners and adjectives (in languages where adjectives agree in number), so as to exclude:

- (57) a. *that boys
 b. *those boy

One could argue, as Hoeksema 1983 does for the agreement between nouns and verbs, that this should be a semantic, not a syntactic matter. Semantics alone can in fact exclude many ill-formed combinations, such as **three boy*, under the minimal hypothesis that singular nouns do not contain pluralities. But semantics alone cannot go all the way (see Wechsler and Zlatić 2000, King and Dalrymple 2002 for the same conclusion).

First, the ungrammaticality of **one boys* (contrasted with *one or more boys* in (49)) could not be accounted for semantically, since singularities are present in a plural nominal. Similarly, the contrast in English between *one man and woman* and **two man and woman* (which should both mean “a couple”) is hard to explain without a syntactic clash between *two* and the two singular terms.

Second, even where a syntactically singular noun allows plural verb agreement (as with “collective nouns” in British English), the determiner always follows the syntactic number.

- (58) {This / *These} committee are to meet tomorrow.

Languages like Hungarian and Latin provide clear evidence of a split between syntactic and semantic features. In Hungarian, nouns remain morphologically singular when combined with numerals (59a), while plural morphology is needed when the numeral is absent (59b):

- (59) a. Öt hajót láttam.
 5 ship_{sing} I saw
- b. Hajókat láttam.
 ships_{plur} I saw

Conversely, Latin proper names such as *Athenae*, *Syracusae*, *Pisae* are syntactically plural objects with a singular semantics (thus demonstrating that although in most languages a +PLUR value entails +LATT, this cannot be universal).

²³Notice that *Cerco colleghi che siano in quattro* ‘I am looking for colleagues who are in a group of 4’ is perfect; but the property of belonging in a group is quite different from the property of having a certain cardinality. The less than total ungrammaticality of (56b) with a relative is probably due to this back-up interpretational strategy.

Last but not least, the distinction between semantic plurality (in a broad sense) and singular/plural grammatical number offers a handle on a syntactic/semantic distinction between count and mass nouns. As well known, mass nouns have many similarities with count plurals (in particular, the properties of *cumulative* and *distributed reference*, Quine 1960, and Cheng 1973, cited in Pelletier and Schubert 1989). As far as their internal structure is concerned, mass nouns have restrictions on the position of amount modifiers which are entirely parallel to those seen for plurals (consider **dirty much water*, or in Italian **l' acqua molta* 'the water much'). The same reasoning leads to the conclusion that they, too, are "pluralized" by a PIP projection above NP, and do not come from the lexicon already denoting mereologies (Leonard and Goodman 1940) or lattices (Link 1983).

A different argument with the same conclusion comes from measure phrases. Schwarzschild 2002 observes that measure phrases (MPs) can appear as pseudopartitives with mass nouns (*MP of N*, as in (60a)) only when they are built on a scalar property which covaries with the part-whole relation of the object they measure.

- (60) a. [2 liters] of oil.
b. *[90 degree(s)] of oil.

Thus, subparts of 2 liters of oil must be less than 2 liters, while subparts of oil whose temperature is 90 degrees may well still be 90 degrees, hence the contrast in (60). Interestingly, the opposite is true when measure phrases appear in nominal compounds:

- (61) a. *[2 liter] oil (poured through the hole)
b. [90 degree] oil (poured through the hole)

Here, measure phrases which track the part-whole relation are ill-formed, while measure phrases which do not, such as *90 degree(s)*, make fine compounds. The question is why (61a) is bad. The extension to mass nouns of our *-operator provides an explanatory answer: MPs in nominal compounds appear in a position much closer to N than MPs in pseudopartitives (witness *2 liters of dark 90-degree oil*), a position *below* the layer in which the part-whole structure is generated by *. Therefore, only MPs which do not rely on the existence of a part-whole structure are well-formed at this level.

- (62) [DP ... [PLP Pl* [NP {90 degree / *2 liter(s)} oil]]]

These facts strongly suggests that mass nouns, just like plurals, acquire their final denotation only at some point in the derivation.

Crosslinguistically, mass noun phrases are also similar to plurals in their external distribution. For instance, in Italian and Spanish both bare plural count nominals and singular mass nominals are restricted, roughly, to lexically governed positions, while singular count nominals are impossible in any argumental position (Contreras 1986, Longobardi 1994). Evidently, count plural and singular mass nominals must share a common value for some syntactic feature which plays a role in this distribution. This value cannot be PLUR (a singular count noun is -PLUR just like a singular mass one). The natural alternative is +LATT.

The next important question is which element in the noun phrase provides a value for LATT. A possible answer is: the noun itself. Thus *boy* would be [-LATT,-PLUR], and *water*, [+LATT,-PLUR]. This would mean that nouns are *syntactically* specified from the lexicon as being 'mass' or 'count'. However, Pelletier and Schubert (1989) have argued, convincingly in our opinion, that this position is untenable. Any singular noun can be *used* in a "mass" or in a "count" way, as shown by examples such as:

- (63) a. This is *a good water* for kidney problems. "water" = "type of water"
b. When the grinder was turned off, there was *table* all over the floor. "table" = "table matter"

We propose instead that for a syntactically singular noun "being mass" means being in the scope of the pluralization operator. Specifically, the Pl head denoting the *-operator will be marked as [+LATT], and all nouns will have an *unvalued* LATT feature. Nouns must thus agree with some element that can provide a value for LATT. Once this feature has been acquired, it can be used to determine the noun's denotation as 'count' or 'mass', in ways which will not concern us here. For concreteness, in what

follows we adopt a proposal by Chierchia 1998a (who builds on Gillon 1992), according to which the singular individuals denoted by mass nouns differ from those in the extension of count nouns in that the former are *not individuated* (in the sense that no counting criterion is provided for them).²⁴ It is for this reason that DPs such as *a water* can only be interpreted by virtue of a strategy that coerces the kind of “taxonomic” reading illustrated in (63a). Clearly, this is only the sketch of an account; the central point that we would want any full analysis to preserve is that “mass” denotations, like plural count denotations, are constructed in the syntax, and flagged the same way as plural nouns.

4.4 The role of LATT

We have argued that pluralities are formed at PIP when PI hosts the *-operator, which creates a lattice. What happens when this operator is not active? In this case, the set of singletons that the NP denotes is passed up to higher heads unaltered: the semantic difference between count singular and plural/mass DPs is derived simply by switching the *-operator on and off.

But what is the source of the -LATT value that singular count nouns need to receive? By hypothesis, functional layers which are semantically and phonologically empty are not present in the structure. Even if they were present, allowing a head which is null and completely inactive to set the value of a feature would render the distinction between valued and unvalued features entirely moot: the putative singular counterpart of the PI* operator would be an ad-hoc feature-assigning device with no phonological content, no semantic function and no thematic role. If we stick to the idea that such “radically empty” heads do not exist, N must acquire a value for LATT from some other source. This source—we propose—is the determiner.

This idea sheds some light on an old puzzle in the nominal system of most Germanic and Romance languages, the severe ill-formedness of determinerless singular count nouns (64), contrasting with the broad acceptability of plural count and singular mass nouns (especially in object or predicative position; see Contreras 1986, Longobardi 1994).²⁵

- (64) a. Gianni è *(un) uomo.
 John is *(a) man.
 b. Ho visto *(un) uomo.
 I have seen *(a) man.

In the present approach, this distribution has a simple explanation: some phonologically overt determiner, minimally *a*, must be present as a source of the -LATT value needed by bare singular count nouns. Plural count and singular mass can take +LATT from PI*, singular counts require a special support element within the DP to be fully valued.²⁶

Let’s now examine the role of the second head associated with number: NumP. As we have seen, a cardinal occupying NumP has the semantic effect of filtering the denotation of its complement. We will assume that these cardinals are endowed with a valued LATT feature, specifically *one*_[-LATT] and *two/three/...*_[+LATT]. Now the question is: what is the status of a phonologically empty Num head? Our answer is that, when they are realized, empty Num heads have a LATT feature, but no intrinsic value for it; thus, they must obtain this value by agreeing with a ±LATT-bearing head. PI can normally serve this role.

What is the semantic effect of ±LATT at NumP? A reasonable possibility is that Num_[-LATT] is equivalent to a cardinal with the meaning *one*, and Num_[+LATT] to a cardinal (set) meaning *more than one*. The former preserves only elements of cardinality 1 in the denotation of PIP, the latter removes exactly these elements. Thus, if NumP is present, the ±LATT value will always make Num exclude

²⁴In Chierchia’s account singular mass nouns actually denote singular and plural individuals together, an extension which we reserve for count plural PIPs. Note that this part of Chierchia proposal is completely independent from the notion that ‘mass atoms’ are not individuated, which we accept.

²⁵Many of these languages do allow a restricted subset of nominals (typically profession names or kin terms) to appear without a determiner when in predicate position (see for example Munn and Schmitt 2002); we set these aside for present purposes.

²⁶Note that **John is dark man* is not better than (64b); adjectives contrast with determiners in this respect because they are themselves unvalued for the features LATT, PLUR and GEND; the same adjective can easily accompany mass nouns as well as count noun (*dark water, dark chair*).

either singular or plural individuals from the PIP denotation, regardless of whether NumP is lexically filled or not. Schematically, starting from a situation such as (65a) (NumP present but empty, Num and N unvalued for LATT, PI* valued), the ‘agree’ operation derives (65b). (66) gives a sample denotation at the various layers.

- (65) a. $[\text{NumP Num}_{[\text{LATT}]} [\text{PIP PI}^*_{[+\text{LATT}]} [\text{NP N}_{[\text{LATT}, +\text{PLUR}]}]]]$
 b. $[\text{NumP Num}_{[+\text{LATT}]} [\text{PIP PI}^*_{[+\text{LATT}]} [\text{NP} [\text{NP N}_{[+\text{LATT}, +\text{PLUR}]}]]]]]$
- (66) a. $[\text{NP N}_{[\text{LATT}, +\text{PLUR}]}] = \{\{a\}, \{b\}, \{c\}\}$
 b. $[\text{PIP PI}^*_{[+\text{LATT}]} [\text{NP N}_{[+\text{LATT}, +\text{PLUR}]}]] = \{\{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{b,c\}, \{a,b,c\}\}$
 c. $[\text{NumP Num}_{[+\text{LATT}]} [\text{PIP PI}^*_{[+\text{LATT}]} [\text{NP N}_{[+\text{LATT}, +\text{PLUR}]}]]] = \{\{a,b\}, \{a,c\}, \{b,c\}, \{a,b,c\}\}$

Suppose, on the other hand, that an empty NumP may be absent, much like an empty PIP. In this case the denotation of PIP (whether singular or plural) will not be filtered. This is a very relevant result, since part of the problem of examples like (6), repeated below, is that if *man and woman* denotes a plural individual (a pair), as we have assumed, we do not want this plurality to be filtered out by *this* in English, despite the fact that *this* is syntactically singular.

- (6) This man and woman are in love.

We are now in a position to state the syntactic core of our proposal, and the root of the difference in the availability of a singular split interpretation for coordination in different languages.

(67) **NumP Parameter**

- a. *In English-type languages, NumP is not present under D when empty.*
 b. *In Italian-type languages, NumP is present under D even when empty.*

The effect of this parameter is that in Italian-type languages (that is, languages that do not allow singular split conjunctions), both singulars and plurals are filtered at NumP. In English, on the other hand, singular or plural semantic number may involve the presence or absence of the *-operator and nothing else—unless of course a numeral is overtly present at NumP. Thus, in English a singular number on the noun does not entail that pluralities will be eliminated from its denotation. This is the first step to obtain (6).

4.5 Definite and indefinite articles

Let us now consider the behavior of singular articles and numerals in more detail. Since in English (68) is as acceptable as (6), and by hypothesis *man and woman* denotes a plurality, we want to say, somewhat paradoxically, that even *a* or *one* do not always eliminate pluralities from the denotation they receive.

- (68) A/One [man and woman] were in love.

Our proposal is that in English *a* (and probably *one*, taken as a stressed counterpart of *a*, as in Perlmutter 1971) can be merged as a head of PIP, in complementary distribution with PI*. *A* has no semantic role to play, but is simply inserted to provide a -LATT value. NumP remains empty in this case, so according to our proposed parameter, it may be missing, as in (69a); no filtering is performed. We propose that in Italian, on the other hand, the corresponding indefinite form *uno* must necessarily appear at NumP.

- (69) a. $[\text{DP D}^e [\text{PIP a/one}_{[-\text{LATT}]} [\text{NP soldier and sailor}]]]$
 b. $*[\text{DP D}^e [\text{NumP un}_{[-\text{LATT}]} [\text{PI PI} [\text{NP soldato e marinaio}]]]]]$

Empirical evidence for this difference comes from various well-known uses of the English indefinite article which in Italian would be either unnecessary (70a,b) or impossible (70c), (71) (Munn and Schmitt 2002). In particular, the cases in (71) (which have no literal equivalent in Italian) clearly show that *a* can appear below other determiners or operators.

- (70) a. quella peste di (un) Gianni
 that rascal of *(a) Gianni

- b. Sarebbe pericoloso contare su di lui [come (?un) testimone]
It would be dangerous to rely on him [as *(a) witness]
 - c. [Da (*un) esperto linguista], Gianni sapeva come coltivare un albero sintattico.
[as *(an) expert linguist] Gianni knew how to grow a syntactic tree
- (71) a. many a time
b. too tall a man

This does not imply, of course, that *one* can *never* appear in NumP (in *one or more people*, *one or two things*, the word *one* behaves like all other numerals, and must be higher than the *-operator). The *possibility* of a non-NumP position for *a/one* is sufficient to justify the acceptability of (68).

Turning to the definite article, consider (72).

- (72) a. this coin
b. this change

Change requires a [+LATT], *coin* a [-LATT] value. Evidently, a singular definite article must be able to contribute both -LATT and +LATT, depending on the nature of its complement (in the mass case, +LATT comes from Pl*, but the definite must of course be consistent with this value). Rather than treating this phenomenon as an ambiguity, we prefer to regard this example as an instance of *feature neutralization*, formally similar to the cases discussed in Pullum and Zwicky 1986 (see (73)), and Bayer 1996.

- (73) Either they or you are_{2Pers-Sing/3-Pers-Latt} going to have to do it.

These cases are best described as words that, being identical in the two forms, can simultaneously carry two values for the same feature. As expected, we find that coordination of a mass and a count nominal are possible beneath a singular definite determiner:

- (74) this/the biographical information and photograph

Note that here too we have not only phonological but also semantic identity: the semantics of the definite itself, i.e. the function *Max*, remains the same whatever the LATT value. In analogy with (73), we propose that definites can be endowed with both values for LATT. Note that the same assumption must be adopted for *una o più persone* “one or more people”, where we do not want NumP to filter anything from the NP denotation.²⁷ In addition to being consistent with both values of LATT, the English definite determiners that are not morphologically marked for number can take both plural and singular NumPs as complement, as discussed and analyzed in King and Dalrymple 2002 (who provide naturally-occurring examples).

- (75) a. The stars and sun / sun and stars are an inspiration to bad poetry.
b. My ears and nose / nose and ears were quite frozen.

Such determiners, then, can check not only different values of LATT, but also different values of PLUR, simultaneously.

4.6 Gender and NumP

As stated, the NumP Principle in (67) is not linked to independent facts of language. A suggestive possibility is to try to derive this principle from an independent parameter, the presence in many languages of

²⁷On the other hand, the case of *some people / some water* should probably be treated as an ambiguity, given the semantic difference between (ia) and (ib), and the ungrammaticality of (ic) (compare with (74) above).

- (i) a. In the box there is some coin. *a specific coin*
b. In the box there is some change. *any amount of change*
- (ii) a. I was looking for some photograph.
b. I was looking for some biographical information.
c. *I was looking for some biographical information and photograph.

grammatical *gender agreement*. According to this approach, the fact that Italian *uno* has to appear higher than PIP would be linked to the fact that *uno* and many determiners in this and other non-singular-split languages have overt gender marking. Vice-versa, the fact that English has the possibility of leaving *a* in a low, non-filtering position would follow from the lack of agreement on *a*.

Suppose, for instance, that in Italian NumP carries a GEND feature, which forces any determiner marked for gender to be merged in NumP, or to transit through it on the way to DP. In English, gender is a notional and not a grammatical category (*it* refers to things, *he* to masculine human beings, etc.); NumP and determiners in general are not marked for gender and the latter are therefore under no syntactic obligation to appear in NumP.

One result of this hypothesis is that in Italian two gender-marked determiners would compete for ‘checking’ on the same NumP/GendP, and should thus be impossible. Indeed, in Italian, it is possible to combine definite determiners and cardinal numerals just as in English—but not when the numeral is *uno*, which alone carries gender agreement.²⁸

- (76) a. Ho visto {i/questi} quattro o cinque ragazzi.
 b. I have seen {the/these} four or five boys.
- (77) a. ??Ho visto {l’/quest’} un ragazzo.
 b. I have seen {the/this} one boy.

Starting from the hypothesis that radically empty projections are not present in the structure, the proposal in (67) could then be recast in terms of whether a phonetically empty NumP must be preserved for the purpose of syntactic checking.

- (78) **NumP Parameter (Gender version)** *In Italian-type languages, NumP needs to be present to check Gender agreement whenever a gender-marked determiner is present*

However, when considered in more detail, this approach raises numerous issues. For one thing, it is not clear why determiners couldn’t obtain their gender features directly from N, under agree (which is necessary anyway, because of LATT). Next, the hypothesis that Romance NumP is valued for gender feature raises the question of why no cardinal numerals but *uno* are gender-marked. Typologically, the correlation between singular-split languages and lack of gender in the determiner system is confirmed by Finnish, an English-type language with respect to split readings, which lacks gender agreement, but finds a counterexample in Dutch, which has a Neuter and a “Common” (Masculine/Feminine) gender. For these reasons, pending further studies, we prefer to adopt the more conservative version of the parameter stated in (67).²⁹

4.7 Bare nominals

A last aspect to consider before turning to NP conjunction is the possibility of cases where even in Italian the denotation delivered by PIP would not be filtered. In these cases, Italian should behave just like English with respect to plurality.

The first example comes from *bare plurals*. (79) is entirely parallel to (50), and clearly false in exactly the same conditions.

- (79) a. Non ci sono [parenti di mio padre] in questo governo.
 not there are [relatives of my father] in this government
 There aren’t relatives of my father in this government. (false if one is in)

²⁸Following Crisma 1991, Cinque 1994, Zamparelli 1993 and subsequent work, we take adjectives to head extended projections containing their own agreement phrases. A consequence is that while in (77) the definite and indefinite articles compete for a single agreement position, the plural definite can be followed by adjectives that have the status of numerals, such as *molti/pochi* ‘many/few’ (see Carden 1976, Giusti 1992), because these words are self-sufficient with respect to agreement positions.

²⁹Munn and Schmitt 2002 propose that English and Romance differ in whether a Number Phrase is projected: Number would be always present in English but optionally absent in Romance. This seems to be the exact opposite of our proposal, but in fact Munn and Schmitt’s “Number Phrase” does not correspond to our NumP since it doesn’t appear to host numerals. We will not explore the possibility of integrating the two approaches.

- b. Non ho mai conosciuto [linguisti che avessero incontrato Jakobson].
 not I have ever met [linguists who have met Jakobson].
 I have never met [linguists who have met Jakobson] (false if I met one)

The simplest account for these fact is probably to apply to these cases the proposal in Zimmermann 1993 and Van Geenhoven 1996, according to which the bracketed noun phrases above are property-denoting subparts of full DPs, which undergo semantic incorporation with the verb. Suppose, specifically, that cross-linguistically, these nominals are ‘bare PIPs’; the DP layer is missing, and since D doesn’t select NumP, the NumP layer can be missing as well. PIP, however, cannot be missing, or $N_{[LATT]}$ would remain unvalued. But since the plurality formed by PI^* is not filtered, singletons will be present in the denotation of the plural nominals in any language, Italian included.³⁰

A second case where Italian resembles English is the ‘bare noun coordination’ discussed in Heycock and Zamparelli 2002, where even bare singulars may occur, with a meaning similar to definites:

- (80) Quando apparecchi la tavola, [coltello e forchetta] vanno ai lati opposti del piatto.
 when you set the table, [knife and fork] go at the opposite sides of the plate

Crucially for the argument here, such coordinations have a split interpretation even in Italian.

Heycock and Zamparelli (2002) show that *knife and fork* is a conjunction of NPs (or in the present system, PIPs) which has raised to the Spec of a single DP, acquiring all its feature values in that position.

- (81) $[_{DP} [_{PIP} \text{knife and fork}]_i D^e [_{NumP} \text{Num}^e t_i]]$

Here, we can hypothesize that the $\pm LATT$ value does reach NumP, but the PIP denotation is interpreted directly in the $[_{Spec,DP}]$ position and not fed to Num. As a result, no filtering takes place.

4.8 Singular quantifiers

The third case where Italian behaves like English is in a sense the opposite of the one just discussed. In bare singular conjunctions, the PIPs were interpreted *above* the filtering point. Another possibility is that a PIP denotation may be used as a restriction for a variable at a point *below* the level at which filtering should occur.

We noted in the data section that in Italian the quantifiers *ogni* ‘every’, *qualche* ‘some_{sing}’, *qualunque* ‘any_{sing}’, *ciascuno* ‘each’ and *nessuno* ‘no/no-one’ are acceptable with singular split readings, particularly in object position (82). What these quantifiers have in common is that they are singular and have no plural counterpart. Apart from the last two, which we return to shortly, they have no gender morphology. We shall refer to this class as *singular quantifiers*.

- (82) Non posso lucidare {ogni / qualche / ciascun / qualsiasi / nessun} coltello e cucchiaio in
 I cannot polish {every / some / each / any / no-one} knife and spoon in
 mezzo minuto.
 half a minute

The contrast between these cases and other singular determiners is striking. Our proposal is that like *a/one* in English, these quantifiers are generated as heads of PI, where they provide a $-LATT$ value; from PI, they probably raise to a higher position (DP), leaving a trace which is interpreted as a variable bound by the quantifier and restricted by the denotation of the NP.

- (83) $[_{DP} \text{ogni/qualche}_i [_{NumP} t_i [_{PL} t_i [_{NP} \dots]]]]$

Since these quantifiers are in complementary distribution with PI^* , their argument can never be mass or plural count. Direct evidence for the existence of a ‘low’ determiner position comes from the fact that some quantifiers in this class can appear under an indefinite article.³¹

³⁰Note that we are not saying that the bare-PIP structure is the only possible structure for (79); likewise, we are not claiming that kind-denoting bare plurals are bare PIPs. Both assumptions are unnecessary for the point we are making, and quite possibly false.

³¹A related set of facts, which we will not address here, is the appearance of *quale* ‘which’ and *cui* ‘whose’ after a definite article, in certain types of Italian relative clauses.

- (84) a. un qualche libro
 a some book
 a book of some sort
 b. un qualsiasi libro
 an any book
 a single book, it doesn't matter which one you pick

Here *uno* functions as a normal indefinite article in Num and *qualche/qualsiasi* as a modifier, as indicated by the glosses.

In this case, we suggest that the singular quantifier does not move to DP, and no variable is left in Pl; the denotation of N reaches NumP_[-LATT] as it is normally the case with the indefinite article, and pluralities are filtered out. Under the hypothesis that *coltello e cucchiaio* denotes the property of a plurality, the difference between (85a) (with the structure in (83), and no filtering) and (85b) (with filtering) is predicted.

- (85) a. Posso lucidare ciascun/qualsiasi coltello e cucchiaio. *split possible*
 I can polish each/any knife and spoon
 b. *Posso lucidare un {qualche/qualsiasi} coltello e cucchiaio. *split impossible*
 I can polish a {some/any} knife and spoon

Not all quantifiers have the *in situ* option. For the singular quantifiers *nessuno* “NEG+one”, and *ciascuno* “each+one”, we suggest that the morphemes *ciasc-* (‘each’, cf. French *chaque*) and *ness-* (‘no-’) are merged in Pl, but obligatorily incorporate with *uno* in Num and raise from there to DP. Crucially, even though *uno/a* agrees with N and must thus trigger filtering, the variable bound by *ciasc-/no-* is below the filtering point, NumP, and ranges over the unfiltered denotation of the NP.

- (86) [DP *ciasc-uno/ness-uno* [NumP *t* [PIP *t* [NP N]]]]

The complementary distribution of Pl* and *ness-* explains the absence in Italian of a plural version of *nessuno* “no/no-one” in the paradigm in (87a). Note that the problem here is not in the absence of a plural form for the numeral *uno*: in (86b) *alcuni* contains this plural form, but only with a non-negative meaning which excludes singulars (plural “some”).³²

- (87) a. Non ho visto {nessun ragazzo / *nessuni ragazzi}.
 I haven't seen {no+one_{sing} boy / no+ones_{plur} boys}
 “I haven't seen any boy.”
 b. Non ho visto alcuni ragazzi.
 I haven't seen some+ones boys
 “I haven't seen some boys.”

To sum up: our theory predicts that languages where empty NumP projections are missing should all have singular and plural split readings. Among languages where NumP is normally present, singular split readings may also occur, in three circumstances: when the whole noun phrase is reduced to a bare PIP and no DP/NumP layer is present, when a PIP conjunction is interpreted above NumP, or when the determiner is a quantifier which binds a variable (its trace) below the filtering point (at Pl, we have proposed). *A/one* (and all numerals) do not bind variables in this approach. They are either support elements to provide the -LATT feature, or filters (this second option, only when interpreted at NumP).³³

Since singularities are filtered out of an Italian plural DP, but not out of an English DP, one could

-
- (i) a. il quale ragazzo
 the which boy
 b. il cui padre
 the whose father

³²We suggest that the English *no*, which may be either singular or plural may be realized in a higher position, perhaps D itself.

³³A final point about singular quantifiers is why split readings under *every* seem to allow both cumulative and distributive predicates, while split readings under *no* only allow cumulative ones:

ask why English speakers don't say *the boys* instead of *the boy* in a context with one boy. The most straightforward answer is that having a singular denotation hidden in the plural does not entail using it, provided an alternative with unambiguously singular meaning is available. The use of a plural noun to convey a singular meaning would involve the application of a computationally more expensive operation (the *-operator, versus the identity function), often in exchange for nothing: for if the plural was used in a context where NP denotes a singular property (the appropriate context for a singular definite), *||NP|| would be equal to ||NP||; pluralization has no effect in this case.

5 Conjunction

5.1 DP-internal conjunction as set-product

Having set out our assumptions about the structure of noun phrases and the behavior of the features associated with number within the nominal system, we now return to the interpretation of conjunction.

Recall that our problem, as pointed out already in Cooper 1979, Partee and Rooth 1983, Dowty 1988, was that if conjunction of common nouns were interpreted as the intersection of the sets of individuals denoted by the conjuncts, only the joint reading should be obtained. This gives the correct interpretations for (88a,b) and (89a), but not for (89b).

- (88) a. That man is [friendly and collegial].
 b. My [friend and colleague] was waiting in the bar.
- (89) a. #That individual is [male and female].
 b. That [man and woman] waited for me in the bar

The problem here is clearly that the intersection of ||man|| and ||woman|| is empty. Thus the split reading of (89b) is not captured.

Treating singular split conjunction as set union, rather than intersection, also fails to yield the correct result. If ||man|| is {a, b, c}, and ||woman|| is {d, e, f}, then ||man and woman|| would be {a, b, c, d, e, f}. But under standard accounts of disjunction, this is precisely the interpretation of *man or woman*. Yet, we do not want the denotation of *a man and woman* to be a single individual of either sex, but a pair of individuals. It might be thought that one could keep to set union, but somehow allow the DP to refer to a plurality built from the set of individuals. But this would result in serious overgeneration: there is neither a principled way to then restrict *that man and woman* to refer to exactly two individuals (rather than three or more), nor to ensure that it refers to a pair comprised of one man and one woman, rather than two men or two women.

Our proposal instead is that, cross-linguistically, conjunction be interpreted as an operation which, given two or more sets (the denotations of each conjunct), takes a member from each set, performs set union on the resulting tuple, and then returns the set of all the results (Heycock and Zamparelli 1999, 2000). We will refer to this operation as *set-product*; it can be defined as follows:

- (90) **Set-Product (SP)**
 $SP(S^1, \dots, S^n) =_{def} \{ X : X = A^1 \cup \dots \cup A^n, A^1 \in S^1, \dots, A^n \in S^n \}$

For an example of how this works, consider (91) and (92):

- (91) a. ||NP_i|| = {{a}, {b}}, ||NP_j|| = {{c}, {d}}
 b. ||NP_i and NP_j|| = SP(||NP_i||, ||NP_j||) = {{a,c}{a,d}{b,c}{b,d}}
- (92) a. ||NP_i|| = {{a}, {b}, {c}}, ||NP_j|| = {{c}, {d}}
 b. ||NP_i and NP_j|| = SP(||NP_i||, ||NP_j||) = {{a,c}{a,d}{b,c}{b,d}{c,d}{c}}
-
- (i) a. Every man and woman {had lived alone at some point / were married to each other}
 b. No man and woman {?? had lived alone at some point / were married to each other}

The answer is simply that in (ia), if the distributive predicate truthfully applies to the pair it applies to each member; but this isn't the case with *no*, as the reader can easily verify.

As can be seen from these examples, where two non-empty, non-intersecting, sets of elements are combined by the set product operation (as in (91)), the result will be a set of two-membered sets. Crucially, if the two sets intersect at all (as is the case in (92), where $\{c\}$ is a member of both), for each element contained in both sets, there will be a corresponding element/singleton set in the result.

This operation is clearly more complex than simple set-union or set-intersection. As we shall see, however, it has exactly the properties required for capturing the facts concerning nominal conjunction that were set out in Section 3. For the moment, note that the set of singleton sets in $SP(S^1, \dots, S^n)$ corresponds exactly to the intersection of S^1, \dots, S^n .³⁴

5.2 Singular conjunction

Consider first the conjunction of singular NPs. On the assumption that the sets denoted by the NPs *soldier* and *sailor* are disjoint, as in (93a), we obtain (93b):

- (93) a. $\|\text{soldier}\| = \{\{a\}, \{b\}, \{c\}\}$, $\|\text{sailor}\| = \{\{m\}, \{n\}, \{o\}\}$
 b. $\|\text{soldier and sailor}\| = SP(\|\text{soldier}\|, \|\text{sailor}\|)$
 $= \{\{a,m\}, \{a,n\}, \{a,o\}, \{b,m\}, \{b,n\}, \{b,o\}, \{c,m\}, \{c,n\}, \{c,o\}\}$

That is, the interpretation of the whole conjunction is a set of all possible pairs consisting of one soldier and one sailor. This is exactly as required for the singular split reading.

The joint reading follows equally straightforwardly. This interpretation can only arise in a model where there is overlap—whether partial or total—between the denotations of the two NPs. (94) illustrates total overlap of the two conjuncts, with three people who qualify both as friends and colleagues. (95) illustrates partial overlap.

- (94) a. $\|\text{friend}\| = \{\{a\}, \{b\}, \{c\}\}$, $\|\text{colleague}\| = \{\{a\}, \{b\}, \{c\}\}$
 b. $\|\text{friend and colleague}\| = SP(\|\text{friend}\|, \|\text{colleague}\|)$
 $= \{\{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{b,c\}\}$
 (95) a. $\|\text{friend}\| = \{\{a\}, \{b\}, \{c\}\}$, $\|\text{colleague}\| = \{\{b\}, \{c\}, \{d\}\}$,
 b. $\|\text{friend and colleague}\| = SP(\|\text{friend}\|, \|\text{colleague}\|)$
 $= \{\{b\}, \{c\}, \{a,b\}, \{a,c\}, \{a,d\}, \{b,c\}, \{b,d\}, \{c,d\}\}$

As can be seen from these examples, apart from the limit case where the denotation of each of the conjuncts contains only one individual, the same in each conjunct, NP conjunction always produces these “mixed” readings.

What has been said so far holds for English and Italian-type languages alike. However, differences begin to emerge when these denotations are embedded in more structure. Consider for example a definite DP like *the soldier and sailor*, which would be well-formed in English in a model where there was a (contextually relevant) single soldier and a single (distinct) sailor, given that *the* extracts the supremum

³⁴If the denotation of one conjunct is empty our semantics in (90) returns the SP of the remaining conjuncts. This means that (ia) should be equivalent to (ib) and true if men exist but unicorns don't.

- (i) a. A man and unicorn could exist.
 b. A man could exist.

One solution is to redefine SP, enforcing a restriction against vacuous conjuncts.

- (ii) **Set-Product** (presuppositional version)
 $SP(S^1, \dots, S^n) =_{def} \{X : X = A^1 \cup \dots \cup A^n, A^i \in S^1, \dots, A^n \in S^n\}$ if $S^1 \neq \emptyset \wedge \dots \wedge S^n \neq \emptyset$,
undefined otherwise

Another solution is to impute the problems of (ia) to a pragmatic condition which rules out vacuous uses of conjunction. We feel that this is probably to be preferred, since such a constraint is necessary in any case for ill-formed conjunctions like (iii), which no purely logical condition can possibly exclude. See Section 5.4 for similar cases.

- (iii) *This man and man was / were tall.

of its complement (which is not defined for a set containing no single maximal superset). Recall that NumP is absent from English where it is not lexically filled, and that the “semantically singular” PIP is always missing.

- (96) a. $\| [_{NP} \text{soldier}] \| = \{ \{a\} \}$, $\| [_{NP} \text{sailor}] \| = \{ \{m\} \}$
 b. $\| [_{NP} \text{soldier and sailor}] \| = SP(\| [_{NP} \text{soldier}] \|, \| [_{NP} \text{sailor}] \|) = \{ \{a,m\} \}$
 c. $\| [_{DP} \text{the } [_{NP} \text{soldier and sailor}]] \| = \mathbf{Max}(\| [_{NP} \text{soldier and sailor}] \|) = \{a,m\}$

Now consider what happens in Italian when this conjunction is embedded in a DP. The initial conjunction will proceed in exactly the same way, and yield the same interpretation:

- (97) a. $\| [_{NP} \text{soldato}] \| = \{ \{a\} \}$, $\| [_{NP} \text{soldato}] \| = \{ \{m\} \}$
 b. $\| [_{NP} \text{soldato e marinaio}] \| = SP(\| [_{NP} \text{soldato}] \|, \| [_{NP} \text{marinaio}] \|) = \{ \{a,m\} \}$

Crucially, though, in this language NumP is present. Moreover, some overt determiner must be present, to deliver the -LATT value. In the example, Num receives the -LATT feature from *il*, and filters the PIP denotation: only elements in the set which contain a single atom are preserved. In the case of split conjunction $\|PIP\|$ contains one or more two-membered sets: these will be removed.

- (98) a. $\| [_{NP} \text{soldato e marinaio}] \| = \{ \{a,m\} \}$
 b. $\| [_{NumP} \text{Num}_{[-LATT]} [_{PIP} [_{NP} \text{soldato e marinaio}]]] \| = \emptyset$
 c. $\| [_{DP} \text{il}_{[-LATT]} [_{NumP} \text{Num}_{[-LATT]} [_{NP} \text{soldato e marinaio}]]] \| = \mathbf{Max}(\| [_{NumP} \text{soldato e marinaio}] \|) = \mathbf{Max}(\emptyset) = \textit{undefined}$

Since two-membered sets are removed from $\|PIP\|$, the only elements that will ever remain in the case of conjoined singulars are singletons, i.e. singular individuals. If any such are present, the joint reading results. If the two sets are entirely disjoint, however, as in the example above, the restriction will be empty and the result undefined.

Our account crucially assumes that in cases like **il soldato e marinaio*, coordination takes place below the level of NumP; if this was not the case, filtering would affect the two conjuncts independently, and the following derivation could be used to derive the split reading also in Italian:

- (99) a. $\| [_{NP} \text{soldato}] \| = \| [_{NumP} \text{soldato}] \| = \{ \{a\} \}$,
 $\| [_{NP} \text{marinaio}] \| = \| [_{NumP} \text{marinaio}] \| = \{ \{m\} \}$
 b. $\| [_{NumP} \text{Num}_{[-LATT]} \text{soldato e marinaio}] \|$
 $= SP(\| [_{NumP} \text{Num}_{[-LATT]} \text{soldato}] \|, \| [_{NumP} \text{Num}_{[-LATT]} \text{marinaio}] \|)$
 $= SP(\{ \{a\} \}, \{ \{m\} \}) = \{ \{a,m\} \}$ *Coordination of NumPs!*
 c. $\| [_{DP} \text{il } [_{NumP} \text{soldato e marinaio}]] \| = \mathbf{Max}(\| [_{NumP} \text{soldato e marinaio}] \|)$
 $= \mathbf{Max}(\{ \{a,m\} \}) = \{a,m\}$

We can derive this assumption from a more general principle of economy:

- (100) **Economy of coordinate structure**
 Avoid duplication of identical structure within coordination.

That is, if a NumP layer is present in two conjuncts, with the same feature values and no overt content, only the structure in (101b) is allowed.

- (101) a. $[_{DP} \text{il } [[_{NumP} \text{Num } [_{NP} \text{soldato}]] \& [_{NumP} \text{Num } [_{NP} \text{marinaio}]]]]$
 b. $[_{DP} \text{il } [_{NumP} \text{Num } [[_{NP} \text{soldato}]] \& [_{NP} \text{marinaio}]]]]$

If on the other hand the two noun phrases contain multiple overt numerals the structure in (101a) becomes possible, and indeed necessary.

5.3 Plural conjunction

So far we have considered only singular conjunction. We have demonstrated how the the properties of Num interact with the proposed interpretation of conjunction to yield the observed pattern: crosslinguistic

availability of the joint reading; a split reading limited to cases where filtering is not applied to the conjoined NP denotation. We now turn to the interpretation of plural conjunctions.

Assuming a model with two soldiers and two (distinct) sailors, we have:

- (102) a. $\| [_{NP} \text{ soldiers}] \| = \{ \{a\}, \{b\} \}$, $\| [_{NP} \text{ sailors}] \| = \{ \{m\}, \{n\} \}$
 b. $\| [_{NP} \text{ sailors and soldiers}] \| = SP(\| [_{NP} \text{ soldiers}] \|, \| [_{NP} \text{ sailors}] \|)$
 $= \{ \{a,m\}, \{a,n\}, \{b,m\}, \{b,n\} \}$

Up to this point, there is no difference between $\| \text{soldier and sailor} \|$ and $\| \text{soldiers and sailors} \|$. However, since the latter occurs as the complement of $PI^*_{[+LATT]}$, pluralization is triggered and the interpretation of singular and plural conjunctions diverge.

- (103) $\| [_{PIP} PI^*_{[+LATT]} [_{NP} \text{ sailors and soldiers}]] \| = * \| [_{NP} \text{ sailors and soldiers}] \|$
 $= * \{ \{a,m\}, \{a,n\}, \{b,m\}, \{b,n\} \}$
 $= \{ \{a,m\}, \{a,n\}, \{b,m\}, \{b,n\}, \{a,m,n\}, \{a,b,m\}, \{a,b,n\}, \{b,m,n\}, \{a,b,m,n\} \}$

As can be seen, $\| [_{PIP} \text{ sailors and soldiers}] \|$ is a set containing all the possible sets composed by at least one soldier and at least one sailor. This corresponds well to linguistic intuitions about the meaning of the conjunction, as opposed to the disjunction *soldiers or sailors*, as observed in Section 3.2.1. On the other hand, this account of conjunction correctly predicts the existence of “mixed” readings. Consider now the case in which PIP is the complement of an overt cardinal in NumP, e.g. *three*. According to our account, the denotation of the NumP will contain all the sets in the PIP denotation that have three atoms:

- (104) $\| [_{NumP} \text{ three soldiers and sailors}] \| = \{ \{a,m,n\}, \{a,b,m\}, \{a,b,n\}, \{b,m,n\} \}$

Again, the interpretation of the Italian equivalent *tre soldati e marinai* would be identical.³⁵

It is noticeable that split readings under cardinal numerals tend to be better with larger numbers; in particular, the cardinals *two* and (to a lesser extent) *three* are deviant both in Italian-type and English-type languages. There is no comparable effect with the joint reading.

- (105) a. (I) $\{ * \text{due} / \text{??tre} / \text{?quattro} / \text{dodici} \}$ coltelli e cucchiai sono accanto al piatto.
 (the) $\{ 2 / 3 / 4 / 12 \}$ knives and spoons are beside to the plate
 (The) two/three/four/twelve knives and spoons are beside the plate.
 b. (Quei) venti generali americani e diplomatici jugoslavi non raggiungeranno mai
 (those) 20 generals American and diplomats Yugoslavian not will reach ever
 un accordo.
 an agreement
 Those twenty American generals and Yugoslavian diplomats will never reach an agreement.

With small numbers, it is sometimes difficult to tell whether judgments correspond to the predictions of our analysis, which generates all the following examples, in both types of language:

- (106) a. twenty men and women
 b. four men and women
 c. three men and women
 d. two men and women

The (a) and (b) example tend to be accepted by all native speakers, although already the higher number is felt to be more natural; there is considerable variation in the acceptability reported for (c), and all

³⁵An exception is evidently that when there is total or partial overlap between the sets of individuals contributed by the two conjuncts (as for example would be possible in the case of *friends and colleagues*), the singletons arising from the overlap would be preserved in English, but not in Italian-type languages. Thus in the limit case of total overlap, (i) in English could refer to a single individual:

(i) $[_{DP} \text{ my } [_{PIP} [_{NP} \text{ friends and colleagues}]]]$

The oddness of this case can be accounted for in the same way as the oddness of *the boys* in the context of one boy, discussed in Section 4.8.

speakers agree that (d) is unacceptable or infelicitous. We will argue that in this and other cases pragmatic considerations constrain the actual acceptability of the conjunction.

5.4 Pragmatic issues in conjunction

Observe that in our system the denotation of the DP *twenty men and women* will necessarily include sets containing nineteen men and a single woman and vice versa (in both language types), as well as those containing ten men and ten women, etc. We take this to be the correct result: our judgment is that (107) would be falsified if there was one door guarded only by twenty sailors, but not if one was guarded by nineteen sailors and one soldier:

(107) Every door was guarded by (some combination of) twenty soldiers and sailors.

If this interpretation is indeed possible, there seems no straightforward semantic way to exclude the DP in (106c), even though this seems significantly less acceptable. We take the main reason for this effect to be pragmatic in nature. According to our analysis, there are only two possible ways for the group denoted by *three men and women* to be constituted: two men and one woman, or two women and one man. Given Grice's maxim of Quantity, any speaker who knows that there is in fact only one man or one woman in the group should refer to it with the more informative *one woman/man and two men/women*. Further, given this small a number it is hard to imagine a context in which the speaker does not know whether there is only one man or only one woman, but *does* know that there is at least one (since if not, *three men or women* would be the appropriate description). This also explains why relatively small numbers (where it is likely that the speaker would have been able to notice the relative cardinality of the groups) are felt to be less natural in general than large ones.³⁶

Equally, under our analysis as it currently stands (106d) is syntactically and semantically well-formed. The marginality of this example is harder to explain by Gricean principles. There is only one possible interpretation for this phrase: a group of one man and one woman. There are of course alternative ways to express this meaning:

- (108) a. one man and woman
b. one man and one woman

But it is not clear what Gricean principle would lead these to be preferred. Instead we hypothesize that there may be a general principle that leads to avoidance of the (computationally expensive) plural when possible (see Section 4.8).³⁷

Although (106d) is universally judged to be deviant, it is also perceived to have a quite different status from the syntactically deviant (109):

(109) *two man and woman

Under our assumptions, (109) is ruled out by the mismatch between the syntactic -PLUR features that must be instantiated on the nouns (given the morphology) and the +PLUR specification of the numeral. (110) will be ruled out in exactly the same way:

(110) *those children and adult

³⁶The pattern in (105) is replicated in the Italian (semi)partitive structure with *tra* (among) mentioned in footnote 11:

- (i) { ??due/ ?tre/ venti } tra ragazzi e ragazze...
two three twenty among boys and girls

Since the syntax and the compositional semantics of the *tra* construction are distinct from the DP-internal coordination that we have been looking at, the replication of the judgments supports our view that the effect is essentially pragmatic.

³⁷There is an alternative possible account for the oddness of *three men and women* and the even more severe oddness of *two men and women*, and that is the hypothesis that a hearer expects a plural noun to contribute more than one entity. This expectation is necessarily violated by one of the nouns in *three men and women*, and by both in *two men and women*.

In such examples, there is conflict between the PLUR features instantiated on the second noun and the feature on the determiner.³⁸

In cases like *the stars and sun* discussed earlier, the principle of Economy of Coordinate Structure given in (100) favors an NP coordination as in (111a), but this structure leads to problems as the +LATT feature is instantiated on only a single conjunct so that the feature on the other conjunct remains unvalued (we cannot assume that Pl can value different values of LATT simultaneously, since different values of LATT have different semantic consequences). The minimal structure that avoids these violations is therefore (111b), where each conjunct projects as far as PIP, and *sun* receives its -LATT feature from *the*, as discussed above.

- (111) a. *[_{DP} the [_{PIP} Pl_{+LATT} [[_{NP} stars_{+LATT}] and [_{NP} sun_{-LATT}]]]]]
 b. [_{DP} the [[_{PIP} Pl_{+LATT} [_{NP} stars_{+LATT}] and [_{PIP} Pl [_{NP} sun_{-LATT}]]]]]

Note that if there is more than one individual in the denotation of the singular conjunct (e.g. using *planet* rather than *sun*) the coordination in (111b) will not yield a set with a maximal element, hence *the stars and planet* will be deviant in the same contexts as *the planet*.

A final point regarding plural coordination concerns the observation in Section 3.2.2 that cases with the same numeral in each conjunct strongly resist a joint reading:

- (112) My four friends and four colleagues appeared on my doorstep. *total: 8*

It turns out that this effect is shared by non-numeral modifiers, whether in the singular or plural:

- (113) My Italian friend and Italian colleague {*was / were} on my doorstep.

The natural way to obtain a joint reading is to unify the numeral or adjective and coordinate at NP:

- (114) My {four / Italian} friends and colleagues were at my doorstep.

Since *four* is present twice in the numeration for (112) two separate NumP must be projected. We propose that the lack of joint reading is once again derived pragmatically. The task of the DP in (114) is that of fixing the reference: it must be informative enough to let the hearer know which objects the predicate should apply to. Given Grice's Maxim of Quantity, any element it contains should provide useful information to this effect. Now, if the joint reading was intended, the second instance of *four* or of an intersective adjective like *Italian* would be redundant. If on the other hand the intended reading is split, *four* and *Italian* are informative, since in this reading numbers and properties can vary independently in each conjunct.³⁹

Evidently the issue of a possible joint reading doesn't arise in the case of different numbers (e.g. *the [two friends and four colleagues]*) since such a reading would have a single variable restricted with the property of being a group of four and a group of two individuals. But restriction, just like predication, cannot apply to a subpart of its argument, possibly because this would violate (some version of) the principle of Full Interpretation.

- (115) a. *Those four people are two students. The other two are professors.
 b. *"A", "B" and "e" are two vowels and two capital letters.

³⁸Gender conflict in languages with grammatical gender gives quite variable results, a discussion of which is beyond the scope of this article.

³⁹This effect is much weaker in predicative nominals like (i), which seem to have reasonably accessible joint readings; similar facts hold for Italian.

- (i) a. John and Mary are [my [two best friends] and [two oldest colleagues]].
 b. I consider John and Mary [two excellent philosophers] but [two lousy parents]
 c. The new job turned John and Mary into [two frustrated linguists] and [two experts on academic politics]

We have at the moment no explanation for this difference.

6 Previous and alternative accounts

As indicated in the introduction, there are to the best of our knowledge no accounts of the pattern of data described in the last section because the full pattern has not been described to date. There have however been analyses dealing with subsets of the data; in this section we will give at least an overview of these accounts. We will show that each has various problems.

In our view, the shortcoming of the analysis in King and Dalrymple 2002 (the only account to give a detailed crosslinguistic paradigm) is that it does not address the first issue that we asked on page 4:

- I. What semantics for conjunction can capture the full range of DP-internal cases?

Our main reason for rejecting the other accounts is that we do not see any principled way to extend them so that they can answer the second issue:

- II. What is the difference between English and languages that do not allow a singular split reading? Why does this difference break down in the plural?

6.1 Concord and agreement

There are two crucial aspects to the proposal made in King and Dalrymple 2002. The first is a distinction between two types of agreement features: CONCORD features and INDEX features. The first generally control agreement within the DP and are primarily syntactic; the second control agreement between the DP and bound pronouns (and often the verb) and have more semantic content, although the actual semantics of plural and singular specification for the INDEX feature is not spelled out. The second crucial aspect of the proposal is an ambiguity for *and* (and its counterparts in other languages). One *and* has the standard Boolean semantics and contributes no agreement features of its own; what is required is that the INDEX NUM of the coordinate structure be the same as one of the conjunct phrases (which in turn are assumed to have to match each other for semantic reasons). The other *and* has a “group forming” interpretation, the semantics of which is not specified. This second *and* itself requires that the coordinate NP as a whole have a plural specification for INDEX NUM.

The way these parts of the proposal interact to account for the behaviors of English and Italian (other possible systems are also discussed and analyzed) is as follows: both languages have both types of *and*. English determiners such as *that/those* specify a particular CONCORD value for the coordinate phrase, but they do not determine an INDEX value. Thus the two features may have different values within a single English noun phrase, as they do in the case of the singular split reading (*this boy and girl*), where the INDEX agreement feature is plural (required by the collective *and*, and reflected in verbal agreement), while the CONCORD feature is singular (inherited from the individual conjuncts).

Italian determiners such as *questo/questi*, on the other hand, specify both a particular CONCORD value and the identical INDEX value. If two singulars are coordinated with Boolean *and*, both CONCORD and INDEX features for the coordination will be singular, so there is no conflict. If two singulars are coordinated with the “group-forming” *and*, the CONCORD feature will again be singular, but the INDEX feature will be plural, as we have seen. But since in this language determiners specify both types of agreement feature, this conflict between the singular INDEX feature required by the singular determiner and the plural INDEX feature contributed by collective *and* will result in ungrammaticality. Hence the lack of singular split cases in Italian. In the plural, however, both types of *and* will be able to occur, since there will never be any conflict between the plural INDEX feature of collective *and* and the plural INDEX feature of the plural determiner.

As should be clear, we are in agreement with King and Dalrymple 2002 that the facts require two different types of agreement feature: our PLUR is a purely syntactic feature (and therefore corresponds largely to CONCORD), while LATT signals semantic plurality, in a broad sense (and therefore corresponds, even more roughly, to INDEX—one important difference being that in our proposal this feature captures the well-known similarities between plurals and mass nouns). There is thus considerable overlap in the two accounts. Setting aside various differences of greater or lesser degrees of detail, there are however two important, closely related differences between our approach and that of King and Dalrymple.

First, we are able to maintain the assumption that there is a single lexical item *and*; King and Dalrymple instead have to posit the existence in every language of two distinct homophonous items, with distinct semantics, one of which (the group-forming *and*) must in addition have a number specification of its own.

Second, we have attempted to set out explicitly the semantics both of conjunction and of plurality that are relevant to the types of conjunction at issue. Since King and Dalrymple do not specify either, it is hard to tell at some points what their proposal entails. Most importantly, it is unclear what the semantics could be for their proposed “group-forming” *and*, and exactly what a plural INDEX value entails. For example, as discussed earlier, we predict that *three boys and girls* is well-formed; also that *twenty friends and colleagues* means a group composed of twenty people, each one of which is either a friend or a colleague or both, and which contains at least one friend and one colleague. With respect to the first example, we think that it would probably be excluded in the King and Dalrymple system, though this is actually difficult to determine. Similarly, for King and Dalrymple the second example is ambiguous between a reading with Boolean *and* and one with “group-forming” *and*, but it is again hard to tell whether or not the second interpretation rules out a “mixed” reading of partial overlap (or whether it allows an interpretation with, for example, one friend and nineteen colleagues).

Finally, we should at least briefly answer the two problems that King and Dalrymple raise for our account.⁴⁰ First, they point out that our account predicts that a plural like *my friends and colleagues* could, in a particular model, refer to a single individual. This is, however, a direct consequence of our choice to follow Lasersohn 1995 and Schwarzschild 1996 in allowing (uncoordinated) bare plurals to include singletons in their denotation, for the reasons (completely independent of coordination) discussed in Section 4.2 and in the cited literature. Nothing in our proposal would change if we made the other choice, except that we would face the problems discussed in that section; King and Dalrymple do not say how these problems should be better resolved.

Second, King and Dalrymple point out that our account does not extend to Greek, a language in which split readings are impossible for definite noun phrases even in the plural, as was illustrated in (36), repeated here as (116).

- (116) a. *oi gátes kai kóttēs
 the-PL cats and chickens
 b. merikés gátes kai kóttēs
 several-PL cats and chickens

We do indeed have no account at present for the absence of a split reading for plural examples like (116a). However, as far as we are able to determine this is also true for King and Dalrymple. Greek does not figure in the typology of languages that falls out from the different ways of specifying INDEX and CONCORD features because none of the combinations would rule out (116a). Given the grammaticality of the split reading in (116b), presumably King and Dalrymple would not want to claim that Greek lacks the “group-forming” *and* (a possibility that their system does however predict). The only solution that we see available to them but not to us is that of making the plural definite determiner require not only a plural INDEX feature, but also a conjunction containing the Boolean *and*, while excluding those containing “group-forming” *and*. While this is presumably technically feasible, it would be the only case we have ever come across of this kind of selection. We therefore consider that the lack of a split reading in Greek examples like (116a) is an unsolved problem under all analyses.

6.2 Split conjunction and type-raising

The first analysis of singular split conjunction that we have found in the literature is a brief discussion in Dowty 1988:173–176. This analysis is based on the analysis of split plural conjunction given in Partee and Rooth 1983 (who cite Cooper 1979), taken together with the account of agreement in Hoeksema 1983. The central idea of this analysis is that split conjunction is the result of type-raising the denotations of the common nouns so that they become functions over the translation of the determiner. The effect

⁴⁰King and Dalrymple raise a third issue, that of mixed singular plural coordinations like *the cat and dogs*. They are correct that these cases were not discussed in our earlier papers; they are however addressed here in Section 4.5.

of this is to allow the determiner to distribute over the conjuncts. Dowty 1988:175 gives the following translation for the conjunction *this man and woman*, where \cap stands for the conjunction operator, and \mathcal{D} is a variable of the type that determiners translate into:

- (117) man $\Rightarrow \lambda\mathcal{D}\mathcal{D}(\text{man}')$
 woman $\Rightarrow \lambda\mathcal{D}\mathcal{D}(\text{woman}')$
 man and woman $\Rightarrow \lambda\mathcal{D}\mathcal{D}(\text{man}') \cap \lambda\mathcal{D}\mathcal{D}(\text{woman}')$
 $= \lambda\mathcal{D}[\mathcal{D}(\text{man}') \cap \mathcal{D}(\text{woman}')]$
 this man and woman $\Rightarrow \lambda\mathcal{D}[\mathcal{D}(\text{man}') \cap \mathcal{D}(\text{woman}')](\text{this}')$
 $= [\text{this}'(\text{man}') \cap \text{this}'(\text{woman}')]$

As Dowty notes, the meaning obtained is the same as for the full DP conjunction *this man and this woman*.

In fact Dowty's ultimate analysis is slightly different, as he argues that it is necessary to use Hoeksema's (1983) collective conjunction (essentially the same point is made in Krifka 1990: 165–166). Since this in turn cannot be generalized across categories, a non-compositional rule specifically for split conjunction has to be stipulated (Dowty 1988:176). In the syntactic system that Dowty is using, adapted from Ades and Steedman 1982, Steedman 1985, $\text{NP}\backslash\text{Det}$ is the syntactic type of a type-raised common noun. Thus (118a) translates into (118b), where $\&_c$ is the “collective conjunction” of Hoeksema 1983.

- (118) a. $[\text{NP}\backslash\text{Det} \text{ NP}\backslash\text{Det} \text{ and } \text{NP}\backslash\text{Det}]$
 b. $\lambda\mathcal{P}[\text{NP}\backslash\text{Det}'(\mathcal{P}) \ \&_c \ \text{NP}\backslash\text{Det}'(\mathcal{P})]$

Dowty makes a virtue of this specific definition, pointing out (the earliest place that we have found this observation in the literature) that “even a language as closely related to English as French does not have the collective interpretation of conjoined common nouns,” and that the same is true of Italian and Spanish (Dowty 1988:176): that is, that these languages have only the intersective (what we have been calling the *joint*) reading of DP-internal conjunction.

As we have seen, however, while Italian-type languages do indeed lack singular split conjunction, they allow split conjunction in the plural. Hence, rather than stipulating a particular interpretation for *and* in a single language (English) that allows the conjunction of two type-raised common nouns, it appears instead that it would be necessary to make this interpretation available for all plural DP-internal conjunctions in both English-type and Italian-type languages, but exclude it in the singular for the latter group of languages only.

We believe that this stipulation is enough to motivate looking elsewhere for an account of split coordination. However, it should perhaps be pointed out that there are some problems for this analysis even if we remain within English. These problems concern the interpretation of numerals and adjectives. Since adjectives can occur in conjunctions with the split interpretation, they too will have to made type-ambiguous in order to account for the grammaticality of examples like (119), on the (preferred) interpretation where the adjective modifies both nouns:

- (119) the unripe peaches and pears

From this example, where the adjective is a predicate over individuals, it appears that it would be necessary in fact to provide another type-raised interpretation for common nouns, in order to make it possible for them to take the adjective as an argument which can then be applied to each noun. However, this is not the only possibility, given the acceptability of examples where the adjective is a collective predicate:

- (120) a. that ill-matched man and woman (\neq that ill-matched man and ill-matched woman)
 b. that mutually incompatible man and woman (\neq that mutually incompatible man and mutually incompatible woman).

This problem is perhaps most striking when numerals are considered. In accordance with Hoeksema 1983, we assume that numerals are not in the same syntactic class as definites, for various reasons including their possible cooccurrence with *the/these/those*. As shown in Section 3.2.2, numerals are perfectly acceptable in split conjunctions, but (except for English *one*), they do not apply to each of the

conjuncts in turn, as shown by the contrast between the split conjunction in (121a), on the one hand, and (121b–c) on the other.

- | | | |
|-------|--|------------------------|
| (121) | a. those five men and women | <i>Total=5 people</i> |
| | b. those five men and five women | <i>Total=10 people</i> |
| | c. those five men and those five women | <i>Total=10 people</i> |

In a compositional semantics, we do not see any way under the type-raising approach to get the determiner in (121a) to apply to each of the conjuncts while the numeral gives the number of atoms in the group denoted by the conjunction as a whole.

6.3 The ellipsis analysis

Given the synonymy of a split conjunction like (122a) with the full DP conjunction in (122b), an obvious line of analysis is to propose that these two constructions are in fact syntactically (and semantically) identical; the only difference between them is in the phonological spell-out.

- (122) a. My mother and father live in the South.
 b. My mother and my father live in the South.

That is to say, the split reading arises from ellipsis of (at least) the determiner in the second conjunct:

- (123) My mother and ~~my~~ father live in the South.

We have not found a developed version of this kind of account in the literature, but we mention it here as it has been suggested to us on more than one occasion as a possible alternative (see also Winter 1998, who raises—but like us ultimately rejects—an ellipsis account for split conjunction).

Although this analysis has some initial plausibility, questions arise immediately. For example, consider the contrast in acceptability between (124a) on the one hand and (124b,c) on the other:

- (124) a. ??His stupidly attacking the speaker and general attitude made a bad impression.
 b. His stupidly attacking the speaker and his general attitude made a bad impression.
 c. His stupid attack on the speaker and (his) general attitude made a bad impression.

Under an ellipsis account, the marginality of (124a) is surprising, given that it is, by hypothesis, simply a phonological variant of (124b). Further, the fact that it also contrasts with (124c) suggests that it is precisely an incompatibility between the verbal features within the gerund in (124a) and the purely nominal second conjunct that gives rise to the reduced acceptability, suggesting that the conjunction is indeed of some DP-internal projection.

Gerunds are however, notoriously difficult to analyse; if this was the only problem for the ellipsis account we might be justified in discounting the data in (124). However, the ellipsis analysis has at least the problems that we have already identified for the type-raising analysis. First and foremost, again this type of account offers no insight into the crosslinguistic pattern of distribution of the split reading that we have documented, and its availability in the plural in these languages. There is no independent motivation that we are aware of for proposing that plural determiners in these languages have phonological or morphological properties that would make them more susceptible to ellipsis than their singular counterparts. As with the type-raising account, we consider that this failing is enough to make us want to pursue other possible approaches.

Further, an ellipsis account suffers from the same drawbacks as the type-raising account when it comes to collective modifiers like *ill-matched* or *mutually incompatible*. These are fully acceptable in split conjunctions, as we have seen in (120) above; but this is of course in sharp contrast to the corresponding full DP conjunctions which, on this account, only differ in being fully pronounced:

- (125) a. that ill-matched man and ~~that ill-matched~~ woman
 b. *that ill-matched man and that ill-matched woman

And again, just like the type-raising account, an ellipsis account makes two false predictions about the interpretation of plural split conjunctions containing numerals. Under this approach, the (a) and (c) examples in (121) differ only in pronunciation

- (126) a. those five men and ~~those five~~ women *Total=5 people*
 b. those five men and those five women *Total=10 people*

Thus this analysis not only predicts an interpretation for the split conjunction in (126a) that it does not have, it offers no account of the reading that it does have.⁴¹

Note further that the examples in (127) show that numerals cannot undergo ellipsis even when they occur between an ellipsed determiner and an ellipsed adjective:

- (127) a. My five maternal aunts and uncles were all Methodists (on my father's side they were Anabaptists). *Total=5 maternal relatives*
 b. My five maternal aunts and my five maternal uncles were all Methodists *Total=10 maternal relatives*

6.4 Wide scope conjunction and the Strongest Meaning Hypothesis

Winter 1998 (ch. 7,8) addresses the problem of split and joint readings in the context of a Boolean approach to the semantics of *and* (Keenan and Faltz 1985). His discussion is centered on joint/split readings of plural and reciprocal sentential predicates and on the split reading of *every* with singular nominals.

Consider the plural/reciprocal predicates first. There is an important difference in the interpretation of the (a) and (b) cases below.

- (128) a. The girls know each other.
 b. The girls are standing on each other.
 (129) a. The ducks are swimming and quacking.
 b. The ducks are swimming and flying.

Given what we know about the relation of “knowing”, (128a) is judged false in a situation in which not every girl knows every other girl. (128b), on the other hand, cannot require each girl to stand on each other girl, since the lexical semantics of *standing on* plus world knowledge tells us that the bottom girl is not standing on anybody.

On the basis of this contrast, Dalrymple, Kanazawa, Mchombo, and Peters 1994, 1998 propose that the strength of a reciprocal may be weakened to the strongest meaning which is still compatible with the semantics of the predicates involved (the “Strongest Meaning Hypothesis”). Winter extends this idea to coordinated predicates like (129). Here, world knowledge tells us that *swimming* and *flying* are incompatible at any given moment, while *swimming* and *quacking* are not. As a result, (129a,b) are again interpreted differently:

- (130) a. Each duck is simultaneously swimming and quacking.
 b. Some of the ducks are swimming, the others are flying.

Winter's formulation of the SMH generalizes it to non-reciprocal predicates:

- (131) **Extended Strongest Meaning Hypothesis (SMH)**
A plural predicate whose meaning is derived from one or more singular predicates is interpreted using the logically strongest truth conditions that are generated from one basic meaning and that are not contradicted by known properties of the singular predicate(s). (Winter, 1998,323)

⁴¹Even in a theory of ellipsis in which it might be possible to explain how only one of the two “copies” of the numeral would be interpreted at LF, it remains entirely unclear how it would be possible to guarantee that the set whose cardinality is being restricted contain at least one member from each conjunct (Alan Munn, personal communication).

In (129a), the SMH can afford the strongest possible distributive meaning, (132); in (129b) it must apply the different predicates to subparts of the whole set of ducks, (132b).

- (132) a. $\forall x \in \text{duck} \forall P \in \{\text{swim, fly}\} [P(x)]$
 b. $\exists X, Y, Z [\text{ducks}(X) \wedge Y \cup Z = X \wedge \forall k [[k \in Y \rightarrow \text{swimming}(k)] \wedge [k \in Z \rightarrow \text{flying}(k)]]]$

An additional condition states that meanings can never be weakened to the point of making one of the properties in the conjunction inapplicable. In other words, neither Y nor Z in (132b) can be empty.

Winter does not explicitly discuss DP-internal plural predicates, but intuitively the SMH can be extended to these cases, mapping the weakened interpretation to the split reading with incompatible properties, e.g. (133a), and the joint reading to the purely logical, Boolean meaning which may surface in (133b) because this time the predicates are compatible.

- (133) a. The cats and dogs were licensed.
 b. My friends and colleagues were at the party.

As formulated, the SMH does not extend to split singular cases like (134), which are treated via a completely different mechanism.

- (134) Every cat and dog was licensed.

Winter proposes that the required meaning is obtained by giving the conjunction wide scope:

- (135) **every(cat) \cap every(dog)(is licensed)**

To this effect, he proposes that the word *and* and its cognates in other languages are actually meaningless and that the conjunctive meaning (the *meet* operation in a Boolean semantics) is available at any level. More precisely, two or more conjuncts can be collected into a tuple; a predicate applying to the tuple can be applied pointwise to each element in it. At any point, the free application of *meet* can apply to a tuple to generate a single element.

- (136) a. $\|\text{cat and dog}\| = \langle \text{cat, dog} \rangle$
 b. $\|\text{every cat and dog}\| = \text{every} \langle \text{cat, dog} \rangle \Rightarrow \langle \text{every}(\text{cat}), \text{every}(\text{dog}) \rangle$ *pointwise application of “every”*
 c. **every(cat) \cap every(dog)** *application of “meet” to the pair*

The possibility of applying the *meet* operation at any point is argued to be a general property of language, linked to its ‘default’ status (in contrast, for instance, to the *join* operation associated with disjunction). Since *meet* can apply at any level, the pointwise technique must of course be capable of distributing sentential predicates and other material, giving conjunction the widest possible scope.

- (137) $\langle \text{every}(\text{cat}), \text{every}(\text{dog}) \rangle (\text{is licensed}) \Rightarrow \langle \text{every}(\text{cat})(\text{is licensed}), \text{every}(\text{dog})(\text{is licensed}) \rangle$
 $\Rightarrow \text{every}(\text{cat})(\text{is licensed}) \cap \text{every}(\text{dog})(\text{is licensed})$ *by “meet”*

When applied to the problem of DP-internal conjunction, Winter’s approach avoids some of the pitfalls of previous analysis, but tends to overgenerate. Most importantly, like the others it offers no prospect of a principled account of the crosslinguistic differences.

The first issue is the very existence of two separate—but in fact overlapping—accounts for plural and singular split readings. If singular split readings like (138a) result from wide-scoping conjunction (a universal possibility in this system), this operation should also generate plural split cases like (138b).

- (138) a. My cat and dog were waiting for me.
 b. My cats and dogs were waiting for me.

But as seen above, (138b) would also have an analysis under the Strongest Meaning Hypothesis. Prima facie, this derivational ambiguity might seem an advantage, because the SMH wrongly predicts an unambiguously “joint” interpretation for examples like (139), since *friends* and *colleagues* are compatible properties:

(139) My friends and colleagues were waiting for me.

(139) can describe a situation where less than all—even zero—people share the two properties.⁴² The SMH does not admit such drastic weakening in the case of a fully distributive predicate like *know* in (128), so the source of the “weak” joint reading above must be sought elsewhere. The only candidate seems to be the alternative derivation via wide scoping of conjunction.

But this solution creates other problems. Recall the interpretation of examples with numerals, like (121a), repeated here:

(140) those five men and women *Total=5 people*

A derivation appealing to the SMH can give the correct reading. But the alternative derivation involving wide scope conjunction and pointwise application will yield the unavailable interpretation (a group of 5 men and 5 women).

A further weakness that this account shares with the ellipsis and type-raising accounts is that it does not explain the cooccurrence of collective predicates and split conjunction (*this incompatible man and woman*). More generally, an approach to split readings in terms of the scope of the conjunction seems to allow a reading for (141a) which is equivalent to (141b):

- (141) a. Every knife and fork matches in style.
b. Every knife matches in style and every fork matches in style.

It seems to us, however, that (141a) would be judged false in a situation in which forks matched forks and knives matched knives, but forks did not match with knives; (141b) would of course be true in this scenario.

Finally, the nature of the two operations proposed to account for split readings seems so general that it is hard to explain why in languages like Italian these should be productive in the plural, but possible in the singular only with the singular quantifiers at the end of Section 3.1. Thus this analysis also fails to offer any hope of addressing our original question II.

7 Other cases of conjunction

In the semantic literature, the idea that conjunction must have multiple meanings has been based primarily on analyses of the cases in (142), which appear to call for an ‘intersection’ and a ‘union’ or ‘group forming’ semantics respectively.

- (142) a. John is big and burly
b. John and Mary met.

After reading the previous sections, the reader might wonder if we are adding yet another meaning for *and* to this ambiguity, a meaning to be found only in the highly specialized (and relatively rare) context of DP-internal coordinations. This could be seen a step toward empirical coverage, but hardly toward explanatory adequacy, since questions of learnability and of parsing complexity would immediately arise.

This is however not what we intend. We are proposing set-product as a candidate for a fully unified, cross-linguistic semantics of *and*, at any categorial level. At the same time, we are convinced that this semantics can work only in conjunction with additional principles, some tied to syntactic parameters, others pragmatic in nature, yet others due perhaps to more general cognitive factors. The enterprise will be successful if we are able to show in each case that the interaction between coordination and these factors (one example of which is the plural forming strategies seen in the previous sections) yields the desired semantics.

⁴²In fact fully joint readings are typically dispreferred, even when strongly favoured by context:

- (i) We want people for this job who can do both linguistics and philosophy. So we we plan to give this job to the best qualified linguist and philosopher.

It should be evident that proving a claim of this sort involves a close inspection of the behavior of coordination at all levels, a task which cannot possibly be taken up in the present article. In this final section, however, we want at least to give a bird-eye view of what it would mean to apply set-product at some other levels: what results conjunction would produce, and what general assumptions would be needed to supplement it.

7.1 Coordinations of predicates

If John is tall and John is fat, then we want (143) to come out true:

(143) John is tall and fat.

The simplest view of the semantics of singular adjectives is that they denote sets of singletons. Set-product will apply union to each possible pair of individuals in the denotation of the two predicates, forming two-membered sets if the two individuals differ, singletons if they are the same. Thus, if the singleton {john} is present in each predicate, it will be present in the denotation of *tall and fat*. Further, the set-product approach also predicts an inference from (a) to (b) in cases such as (144)–(146).

- (144) a. Last night, John played and Mary danced at the Jimmie bar.
 b. Last night, John and Mary played and danced at the Jimmie bar.
- (145) a. John is a linguist and Mary is a philosopher.
 b. {John and Mary / These two people} are a linguist and a philosopher.
- (146) a. Some of my guests are on the balcony, the others in the bedroom.
 b. My guests are on the balcony and in the bedroom.

This pattern seems to be acceptable, even in the absence of *respectively*, and it is not captured by a union or intersection approach without further assumptions (see the discussion on the Strongest Meaning Hypothesis in Section 6.4 above). However, using other predicates we have sentences that have the flavor of a contradiction.

- (147) a. ??My grandparents were taller than me and much shorter than me.
 b. #My grandparents died in Normandy and drowned in the Pacific.
 c. ??My friends know German and don't know any European language.

Evidently, pragmatics (and the Strongest Meaning Hypothesis) should favour a distributive reading over the plurality, yet this reading is not readily available. In yet other cases, the sentences become worse with certain choices of subjects. Consider, in particular, the case of coordinate subjects at least one of which is a quantifier.

- (148) a. (At the conference,) John was a linguist and each Italian was a philosopher.
 b. *John and each Italian were a linguist and a philosopher.
- (149) a. Most Scots must be linguists and some Italians must be philosophers.
 b. ??Most Scots and some Italians must be linguists and philosophers (in the “mixed” reading)
- (150) a. More than two women are linguists and more than three men are philosophers.
 b. ??More than two women and more than three men are linguists and philosophers. (in the “mixed” reading)

Thus, in this area our semantics must be constrained by additional principles, if examples (148)–(150) are to be excluded, and the marginal nature of (147) accounted for, but we will not attempt to work these out here (however, see the next section for comments on (148)–(150))

7.2 DP coordination

The two leading proposals for the semantics of noun phrases take them to denote either individuals (sets of atoms, in our approach), or generalized quantifiers (sets of properties, i.e. sets of sets of sets of atoms in our proposal). A popular view since Partee and Rooth 1983, Partee 1987 is that type-shifting between these two denotation is also possible, subject to various constraints.

Consider the first possibility, that full DPs denote individuals. An immediate problem is that the application of SP to sets which do not contain other sets is undefined.

$$(151) \quad \|\text{John and Mary}\| = \text{SP}(\{j\}, \{m\}) \quad \text{undefined!}$$

One solution is to apply a covert operator, call it **Q** for “Quine”, which shifts individuals into singular properties. Now SP can apply:

$$(152) \quad \|\text{John and Mary}\| = \text{SP}(\{j\}, \{m\}) \Rightarrow \mathbf{Q}_{\text{type-shift}} \\ \text{SP}(\{\{j\}, \{m\}\}) = \{\{j, m\}\}$$

Here, set-product mimics union or group formation, yielding a plural individual (or perhaps, if further type-shifting applies, a GQ built on it) which is a suitable denotation for cumulative predicates such as *meet*. Note that the **Q** might be independently needed to interpret *equatives*:

$$(153) \quad \text{Mark Twain is (probably) Samuel Clements}$$

Now let’s consider the second possibility: DPs denote generalized quantifiers (GQ). Thus, *John* denotes the set of properties which are true of John, i.e. $\lambda P[P(\{j\})]$, and the same for *Mary*. What happens if we apply set-product to these denotations?

$$(154) \quad \|\text{John and Mary}\| = \text{SP}(\lambda P[P(\{j\})], \lambda Q[Q(\{m\})])$$

Given the definition of SP, the result will be a set containing the result of the union of each property John has with each property Mary has. Say the two properties involved in the union are P and Q. If $P = Q$ (i.e. if John and Mary share a property), then $\cup(P, Q) = P = Q$. This means that the set of all properties which are common to John and Mary, i.e. the intersection between the two GQs, will still be represented in the output of SP. What happens with non-identical properties? If Mary has property P and John has property Q, and $P \subset Q$, then $\cup(P, Q) = Q$, i.e. only the most general property is preserved in the conjunction. This is as it should be: if John is from England and Mary is from the South of England it is fair to conclude that John and Mary are from England, nothing more. Finally, if Mary has property P and John doesn’t have any property R such that $R \subset P$, then P will not be present in the conjunction of the GQs *John* and *Mary*, since for every Q John does have, $\cup(P, Q) \supset P$. Thus in this case, set product mimics intersection. Interestingly, the same reasoning holds for the conjunction of more complex GQ such as (155), as the reader can verify.

$$(155) \quad \|\text{John and at most 3 women}\| = \text{SP}(\lambda P[P(\{j\})], \lambda Q[\forall X \in (\text{women} \cap Q) |X| \leq 3])$$

Two additional issues need to be taken into account. One concerns the relation between GQs and the conjunction of predicates. As things stand, (156c) doesn’t follow from (156a) or (156b):

- (156) a. Every boy was tall and every boy was fat
b. No boy was tall and no boy was fat.
c. Every/No boy was tall and fat.

This is because even when both *tall* and *fat* are present in the standard generalized quantifier for, e.g., *every boy* i.e. $\lambda Q[\forall X \text{boy}(X) \rightarrow Q(X)]$, their set product is not, being equal neither to the intersection nor to the union of *tall* and *fat*.

There are, it seems, three potential ways out of this problem. A first solution might be a device which obtains the intersection of the conjoined predicates. In the present system, we could for instance assume that a singular filter **SING** is applied to the output of the set product of the two singular predicates, as shown in (157). This operation extracts all the individuals who are at once *tall* and *fat*. If *every* and *no*

are closed under intersection (namely, if they contain the intersection of all the properties they contain), this property will be present in the GQ.

- (157) $\| \text{every boy was tall and fat} \| = \text{SING}(\text{SP}(\| \text{tall} \|, \| \text{fat} \|)) \in \| \text{every boy} \|$
where $\text{SING}(A) = \lambda X[X \in A \wedge |X|=1]$

But the problem is more general, since our account predicts that a conjunction of predicates should have the ‘split’ reading seen in (144)–(146), a reading which distributes over subparts of a plural subject. Consider for instance (158) and (159), said in the context of a Hollywood party.

- (158) a. Most guests will be actors and most guests will be film-makers.
 b. Most guests will be actors and film-makers.
- (159) a. More than 4 guests will be actors and more than 4 guests will be film-makers.
 b. More than 4 guests will be actors and film-makers.

In these cases, extracting the intersection between actors and film-makers will surely not help to deduce (b) from (a). Yet, a reading of (158)b and (159)b which is synonymous with the (a) cases doesn’t seem to be out of question. This is the reading that one would get by wide-scoping *and* over the whole sentence, much as in:

- (160) In ancient times, some farmer must have tilled the fields here and the ones over the mountain.
not necessarily the same farmer

Whatever the facts turn out to be concerning the availability of these readings and the desirability of a wide-scope mechanism for *and* (see the discussion of Winter’s proposal in Section 6.4), there are yet other cases which would not be captured either by giving *and* wide-scope, or by extracting the intersection of the conjoined predicates. Consider for instance the following scenario. Suppose you have 8 guests, 3 on the balcony, 3 in the bedroom and 2 in the kitchen, as shown in (161). In this situation, (162a) is clearly false (assuming that 3 guests don’t count as “many”). Yet, (162b) and (162c) seem to have a true reading (admittedly, less natural in (162c)).

- (161) $\| \text{on the balcony} \| = \{a, b, c\}$ $\| \text{in the bedroom} \| = \{d, e, f\}$ $\| \text{in the kitchen} \| = \{g, h\}$
- (162) a. At present, {most / exactly 6 / more than 5 / many} guests are on the balcony and {most / exactly 6 / more than 5} guests must be in the bedroom.
 b. At present, there are {exactly 6 / more than 5 / many} guests on the balcony and in the bedroom, (the others are in the kitchen).
 c. At present, {most / exactly 6 / more than 5 / many} guests are on the balcony and in the bedroom (only a few are still in the kitchen).

Note that (162b,c) would be false if 6 guests were amassed in the bedroom but nobody was on the balcony—a situation in which the same sentence with *and* replaced by *or* would be judged true. Thus, we cannot account for the true readings in (162) using the singular filter or wide-scoping *and*.

A natural option at this point is to propose that GQs are closed under set-product, that is, that they contain the set product of all the properties they contain. If this route is taken, cases like (156), (158)b, (159)b and (162)b,c are covered, though of course the fact that this reading is harder to get in some cases than others remains to be accounted for.

A second issue is whether, when applied to GQs, the set-product operation ends up introducing undesirable properties, i.e. properties that neither conjunct independently have. There are two main cases to take into account. Consider first GQs which are monotonically increasing in their second argument, like proper names, or numerals like *three or more*. In this case it can be shown that no extra property is added. Suppose, for instance, that the following holds:

- (163) a. John is fat (and he is not tall)
 b. Mary is tall (and she is not fat)

By weakening, the following must also be true; the disjunction is simply validated by its first member.

- (164) a. John is fat or tall.
b. Mary is tall or fat.

If disjunction takes narrow scope, the property $R = \|\text{fat or tall}\|$ must be in $\lambda P[P(\{j\})]$ and in $\lambda Q[Q(\{m\})]$ (i.e., these GQs are closed under disjunction). But R is precisely one of the elements in the set returned by applying SP to the GQs *John* and *Mary*.

$$(165) \quad \cup(\|\text{fat}\|, \|\text{tall}\|) = \|\text{fat or tall}\|$$

Thus, SP isn't adding any property which isn't already common to the GQ conjuncts.

It is worth noting at this point that bad 'mixed conjunctions' like (166), repeated from (148), can now be distinguished from the acceptable mixed coordinations in (144) and (145). The difference is that the former cases must be conjunctions of GQs, since one of the conjuncts is a GQ. But now, the property of *being a linguist and a philosopher* (the set-product of $\|\text{linguist}\|$ and $\|\text{philosopher}\|$) will be present in $\|\text{John and each Italian}\|$ only if it is independently present in each conjunct, i.e. only if (167) is true. But of course, (166a) does not validate (167).

- (166) a. (At the conference,) John was a linguist and each Italian was a philosopher.
b. *John and each Italian were a linguist and a philosopher.

(167) John was a linguist and a philosopher and each Italian was a linguist and a philosopher.

On the other hand, (144) *John and Mary played and danced (respectively)* will be true because *John and Mary* can be interpreted as a conjunction of individuals and yields a plural individual which may be present in the set product of *played* and *danced*.

The conjunction of GQs is more problematic in the case of GQs which are not monotone increasing in their second argument (e.g. *no, exactly 2, less than 20*). If (168a) is true, it doesn't follow that (168b) is true.

- (168) a. Exactly 2 people are children.
b. Exactly 2 people are human beings.

When applied to the GQs built with these determiners, set-product validates the incorrect inference from (a) and (b) to (c) in (169) and (170).⁴³

- (169) a. [Exactly two children in the group] were males.
b. [Exactly two adults in the group] were females.
c. [Exactly two children] and [exactly two adults] in the group were people.
- (170) a. [No children in the group] were males.
b. [No adults in the group] were females.
c. [No children] and [no adults] in the group were people.

However, it is worth noting that the class of GQs where the problem appears has received alternative analysis for reasons quite independent of coordination. For instance, a popular approach for *no* in (170) and other negative quantifiers, has been to factor *no* into an external negative operator that combines with a (singular) indefinite (171), which *is* monotone increasing (see Ladusaw 1992).

(171) NEG ... [_{DP} D^e [[_{PIP} *a* children] and [_{PIP} *a* adults]]] were people. = (170)c

As for the case of 'exact numerals', Krifka 1999 points out that treatment of these elements in terms of standard Generalized Quantifiers makes false predictions in various domains (see also Landman 2000). One alternative is to see *exactly* as a sentential adverbial which applies to the 'normal' interpretation for cardinal numerals (an existential quantifier with a cardinal filter, see Section 4.2), and blocks certain scalar implicatures normally associated with numerals. Spelling this out would again go beyond the purpose of this overview, but there is one aspect of this approach which might immediately appear

⁴³This is assuming that *people = males + females*. Note that the system sketched above would *not* validate the inference to *exactly two children and exactly two adults in the group were male and female*.

counterintuitive, and which can be easily defused. *Exactly* can be associated with only one conjunct, as in:

(172) John and exactly one woman met.

Regarding *exactly* not as a determiner but as an operator with scope wider than the conjunction appears to run against well-known scope island effects attributed to coordination. Consider however (173):

(173) I interviewed [10 men but only 3 women]

There is widespread agreement that *only* is not a determiner (since it doesn't respect Conservativity), but rather an operator over comparison classes which are built using the predicate. Despite this, *only* has no problem appearing within a single conjunct. Whatever the proper analysis of these cases, it seems likely that the same method could be applied to *exactly* in (172).

7.3 Coordination at higher levels

As might be expected, the level which is less susceptible to an approach along the lines of the one presented here is the coordination of sentences, and in particular truth-value bearing declaratives. The problem here is not so much to understand what kinds of *sets* would be conjoined by set-product in coordinations such as (174) (candidates that come to mind are (sets of) events, sets of answers, sets of worlds where the imperatives have been obeyed), but whether the tuples of elements predicted by the application of set product actually play a role in the interpretation of these coordinations and, if not, how they can be filtered away.

- (174) a. John left and Mary returned.
b. When did John arrive and how did he get in?
c. Go and get lost!

One possible avenue to explore relies on events (cf. Lasersohn 1995); if two sentences denote two distinct events e^1 and e^2 their set-product conjunction $\{\{e^1, e^2\}\}$, obtained as in (152) above could be the base on which event ordering is defined. Unfortunately, at these stage we must leave these speculations entirely unexplored.

8 Conclusion

There is a long history of using conjunction as a tool to probe the syntax of non-coordinated structures (often with controversial results: see for example Steedman 2000). In this paper we have attempted simultaneously to use conjunction in a new way as a tool for exploring the syntax and semantics of nominal projections, and to develop a semantics for conjunction that covers this case but which holds out the possibility of being extensible beyond it.

Conjunction, so simple in appearance, does not give up its mysteries easily; we hope at least to have shown that there are additional readings that any fully adequate account for conjunction will have to give an account of, and that anchoring these readings to syntactic projections can lead to important and potentially far-reaching insights.

References

- Abney, S. P. (1987). *The English Noun Phrase in its Sentential Aspect*. Ph. D. thesis, MIT, Cambridge Mass.
- Ades, A. and M. Steedman (1982). On the order of words. *Linguistics and Philosophy* 4, 517–558. Cited in dowty88.
- Bayer, S. (1996). The coordination of unlike categories. *Language* 72(3), 579–616.
- Bergmann, M. (1982). Cross-categorial semantics. *Linguistics and Philosophy* 5, 299–401.

- Bernstein, J. (1993). *Topics in the Syntax of Nominal Structure across Romance*. Ph. D. thesis, CUNY.
- Carden, G. (1976). *English Quantifiers: logical structure and linguistic variation*. London: Academic Press.
- Cheng, C.-Y. (1973). Response to Moravcsik. In J. Hintikka, J. Moravcsik, and P. Suppes (Eds.), *Approaches to Natural Language*, pp. 286–288. Dordrecht: D.Reidel.
- Chierchia, G. (1998a). Plurality of mass nouns and the notion of “semantic parameter”. In S. Rothstein (Ed.), *Events and Grammar*, pp. 53–104. Dordrecht: Kluwer.
- Chierchia, G. (1998b). Reference to kinds across languages. *Natural Language Semantics* 6, 339–405.
- Chomsky, N. (1995). *The Minimalist Program*. Cambridge, Mass.: MIT Press.
- Chomsky, N. (2000). Minimalist inquiries: The framework. In R. Martin, D. Michaels, and J. Uriagereka (Eds.), *Step by Step*. Cambridge, Mass.: MIT Press.
- Chomsky, N. (2001). Derivation by phase. In M. Kenstowicz (Ed.), *Ken Hale: a life in language*. MIT Press.
- Cinque, G. (1990). *Types of \bar{A} dependencies*. Cambridge, Mass: MIT Press.
- Cinque, G. (1994). Partial N-movement in the Romance DP. In G. Cinque et al. (Eds.), *Paths Towards Universal Grammar*, pp. 85–110. Washington, D.C.: Georgetown University Press.
- Contreras, H. (1986). Spanish bare NPs and the ECP. In I. Bordelouis, H. Contreras, and K. Zagona (Eds.), *Generative Studies in Spanish Syntax*. Dordrecht: Foris.
- Cooper, R. (1979). Model theory for a fragment of English syntax. Draft chapter of a projected book. Madison, Wisconsin.
- Crisma, P. (1991). Functional categories inside the noun phrase: A study on the distribution of nominal modifiers. “Tesi di Laurea”, University of Venice.
- Dalrymple, M., M. Kanazawa, Y. Kim, S. Mchombo, and S. Peters (1998). Reciprocal expressions and the concept of reciprocity. *Linguistics and Philosophy* 21, 159–210.
- Dalrymple, M., M. Kanazawa, S. Mchombo, and S. Peters (1994). What do reciprocals mean? In M. Harvey and L. Santelmann (Eds.), *Proceedings of Semantics and Linguistics Theory (SALT IV)*, Ithaca, pp. 61–78. Cornell University.
- Dowty, D. (1988). Type raising, functional composition, and non-constituent conjunction. In *Categorical Grammars and Natural Language Structures*. Dordrecht: Reidel.
- Gillon, B. (1992). Towards a common semantics for English count and mass nouns. *Linguistics and Philosophy* 13, 597–640.
- Giusti, G. (1991). The categorial status of quantified nominals. *Linguistische Berichte* 136, 438–452.
- Giusti, G. (1992). *La Sintassi dei Sintagmi Nominali Quantificati: uno studio comparativo*. Ph. D. thesis, University of Venice.
- Heim, I. (1982). *The Semantics of Definite and Indefinite Noun Phrases*. Ph. D. thesis, University of Massachusetts at Amherst.
- Heycock, C. and R. Zamparelli (1999). Toward a unified analysis of DP conjunction. In P. Dekker (Ed.), *Proceedings of the Twelfth Amsterdam Colloquium*, pp. 127–132. Universiteit van Amsterdam.
- Heycock, C. and R. Zamparelli (2000). Plurality and NP-coordination. In *Proceedings of NELS-30*.
- Heycock, C. and R. Zamparelli (2002). Coordinated bare definites. Ms., University of Edinburgh, Università di Bergamo. To appear in *Linguistic Inquiry*.
- Higginbotham, J. (1987). Indefiniteness and predication. In E. Reuland and A. ter Meulen (Eds.), *The Representation of (In)Definiteness*, Chapter 3, pp. 43–70. Cambridge, Mass.: MIT Press.
- Hoeksema, J. (1983). Plurality and conjunction. In A. ter Meulen (Ed.), *Studies in Modeltheoretic Semantics*, GRASS, pp. 63–84. Dordrecht: Foris.

- Hudson, W. (1989). Functional categories and the saturation of noun phrases. In *Proceedings of NELS-19*, pp. 207–222.
- Kadmon, N. (1987). *On Unique and Non-Unique Reference and Asymmetrical Quantification*. Ph. D. thesis, University of Massachusetts, Amherst.
- Kayne, R. (1991). Romance clitics, verb movement, and PRO. *Linguistic Inquiry* 22, 647–686.
- Keenan, E. L. and L. M. Faltz (1985). *Boolean Semantics for Natural Languages*. Hingham, Mass: Kluwer.
- Keenan, E. L. and J. Stavi (1986). A semantic characterization of natural language determiners. *Linguistics and Philosophy* 9, 253–326.
- King, T. H. and M. Dalrymple (2002, October). Determiner agreement and noun conjunction. Ms., Palo Alto Research Center.
- Krifka, M. (1990). Boolean and Non-Boolean ‘and’. In L. Kálmán and L. Pólos (Eds.), *Papers from the Second Symposium on Logic and Language*, Budapest. Akadémiai Kiadó.
- Krifka, M. (1999). At least some determiners aren’t determiners. In K. Turner (Ed.), *The Semantics/Pragmatics interface from different points of view*, Volume 1, Chapter 10, pp. 257–291. Elsevier.
- Ladusaw, W. (1992). Expressing negation. In *Proceedings of SALT 2*, pp. 236–259.
- Landman, F. (1989). Groups, I. *Linguistics and Philosophy* 12, 559–605.
- Landman, F. (2000, February). Predicate-argument mismatches and the adjectival theory of indefinites. to appear in the proceedings of the Antwerpen Conference on NP-DP.
- Lasnik, P. (1995). *Plurality, conjunction and events*, Volume 55 of *Studies in linguistics and philosophy*. Dordrecht London: Kluwer.
- Leonard, H. and N. Goodman (1940). The calculus of individuals and its uses. *Journal of symbolic logic* 5, 45–55.
- Link, G. (1983). The logical analysis of plurals and mass terms: A lattice- theoretical approach. In R. Bäuerle, C. Schwarze, and A. von Stechow (Eds.), *Meaning, Use and Interpretation of Language*, pp. 302–323. Berlin: Walter de Gruyter.
- Link, G. (1984). Hydras: On the logic of relative clause constructions with multiple heads. In F. Landman and F. Veltman (Eds.), *Varieties of Formal Semantics*. Dordrecht: Foris.
- Link, G. (1987). Generalized quantifiers and plurals. In P. Gaerdenfors (Ed.), *Generalized Quantifiers*, pp. 151–180. Reidel.
- Longobardi, G. (1994). Proper names and the theory of N-movement in syntax and logical form. *Linguistic Inquiry* 25, 609–665.
- Longobardi, G. (1999). How comparative is semantics? A unified parametric theory of bare nouns and proper names. Università di Trieste.
- Munn, A. and C. Schmitt (2002). Number and indefinites. Ms., Michigan State University. To appear in *Lingua*.
- Partee, B. and M. Rooth (1983). Generalized conjunction and type ambiguity. In R. Bäuerle, C. Schwarze, and A. von Stechow (Eds.), *Meaning, Use, and Interpretation of Language*, pp. 361–383. Berlin: Walter de Gruyter.
- Partee, B. H. (1987). Noun phrase interpretation and type-shifting principles. In J. A. G. G. at alii (Ed.), *Studies in discourse representation theory and the theory of generalized quantifiers*, pp. 115–143. Dordrecht: Foris.
- Payne, J. (1985). Complex phrases and complex sentences. In T. Shopen (Ed.), *Language Typology and Syntactic Description*, Volume 2, Complex Constructions. Cambridge: Cambridge University Press.

- Pelletier, F. J. and L. K. Schubert (1989). Mass expressions. In D. Gabbay and F. Guentner (Eds.), *Handbook of Philosophical Logic*, Volume 4, pp. 327–407. Dordrecht: Kluwer.
- Perlmutter, D. (1971). On the article in English. In M. Bierwisch and K. F. Heidolph (Eds.), *Recent Developments in Linguistics*. The Hague: Mouton and Co.
- Pullum, G. and A. Zwicky (1986). Phonological resolution of syntactic feature conflict. *Language* 62, 751–773.
- Quine, W. (1960). *Word and Object*. Cambridge, Mass: MIT Press.
- Ritter, E. (1991a). Evidence for number as a nominal head. In *GLOW Newsletter*. Paper presented at GLOW-14.
- Ritter, E. (1991b). Two functional categories in noun phrases: evidence from Modern Hebrew. In S. Rothstein (Ed.), *Syntax and Semantics*, Volume 25, pp. 37–62. University of Quebec.
- Scha, R. (1981). Distributive, collective and cumulative quantification. In T. M. V. J. A. G. Groenendijk and M. B. J. Stokhof (Eds.), *Formal methods in the study of language*, pp. 483–512. Amsterdam, The Netherlands: Mathematisch Centrum.
- Schwarzschild, R. (2002). The grammar of measurement. In B. Jackson (Ed.), *Proceedings of Semantics and Linguistic Theory (SALT)*, Volume XII, Ithaca. Cornell University: CLC Publications.
- Schwarzschild, R. S. (1996). *Pluralities*, Volume 61 of *Studies in linguistics and philosophy*. Dordrecht London: Kluwer.
- Sharvy, R. (1980). A more general theory of definite descriptions. *The philosophical review* 89, 607–624.
- Shieber, S. (1985, July). An introduction to unification-based approaches to grammar. Presented as a Tutorial Session of the ACL, Chicago.
- Siloni, T. (1994). *Noun Phrases and Nominalizations*. Ph. D. thesis, University of Geneva.
- Sportiche, D. (1988). A theory of floating quantifiers and its corollaries for constituent structure. *Linguistic Inquiry* 19, 425–449.
- Steedman, M. (1985). Dependency and coordination in the grammar of Dutch and English. *Language* 6, 523–568.
- Steedman, M. (2000). *The Syntactic Process*. A Bradford Book. MIT Press.
- Stowell, T. (1983). Subjects across categories. *The Linguistic Review* 2, 285–312.
- Valois, D. (1991). *Internal Syntax of DP*. Ph. D. thesis, University of California, Los Angeles.
- Van Geenhoven, V. (1996). *Semantic Incorporation and Indefinite Descriptions*. Ph. D. thesis, University of Tübingen.
- Verkuyl, H. J. (1981). Numerals and quantifiers in X-bar syntax and their semantic interpretation. In J. A. G. Groenendijk, T. M. V. Janssen, and M. J. B. Stokhof (Eds.), *Formal Methods in the Study of Language*, pp. 567–599. Amsterdam: MCT.
- Wechsler, S. and L. Zlatić (2000). A theory of agreement and its application to Serbo-Croatian. *Language* 76(4), 799–832.
- Winter, Y. (1996). A unified semantic treatment of singular NP coordination. *Linguistics and Philosophy* 19, 337–391.
- Winter, Y. (1998). *Flexible Boolean Semantics*. Ph. D. thesis, Universiteit Utrecht.
- Winter, Y. (2001). *Flexible Principles in Boolean Semantics*. The MIT Press.
- Zamparelli, R. (1993). Pre-nominal modifiers, degree phrases, and the structure of AP. Technical report, University of Venice. Working Papers in Linguistics.
- Zamparelli, R. (1995). *Layers in the Determiner Phrase*. Ph. D. thesis, University of Rochester. (Published by Garland, 2000).

- Zamparelli, R. (1998). A theory of Kinds, Partitives and OF/Z Possessives. In A. Alexiadou and C. Wilder (Eds.), *Possessors, Predicates and Movement in the Determiner Phrase*, pp. 259–301. Amsterdam: John Benjamins.
- Zimmermann, T. E. (1993). On the proper treatment of opacity in certain verbs. *Natural Language Semantics 1*, 149–179.