Plurals, possibilities, and conjunctive disjunction*

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Abstract

Sentences with disjunction in the scope of a possibility modal often convey something stronger than predicted under the standard semantics for modals and disjunction, roughly paraphrasable in terms of a wide scope *con*junction. *You may have beer or wine*, for example, is naturally understood as conveying that you may have beer **and** that you may have wine. This 'puzzle of free choice permission' (Ross, 1941) has spurred a wide array of revisions, often radical, to standard assumptions about disjunction, modality, scalar implicature, or some combination thereof. A deeper puzzle is that, while there is good evidence that the conjunctive effect is due to SCALAR IMPLICATURES, standard and well-motivated assumption about the latter predict precisely that it should **not** arise.

In this paper I observe that plural existential quantifiers – but not singulars – pattern with possibility modals in giving rise to an analogous conjunctive effect, and that identical analytical puzzles arise. These patterns remain mysterious on otherwise plausible revisionist accounts. I explore the possibility that the pattern is in fact entirely revealing: possibility modals behave like plural existentials because they are. I suggest a unified account of the conjunctive effect as due to an 'embedded implicature' triggered by a DISTRIBUTIVE OPERATOR (which distributes over the parts of the plurality introduced by the plural existential/possibility modal). This implicature is a subcase of those generally triggered by universal quantifiers over disjunction.

1   Introduction
1.1   An old puzzle

The information conveyed by a sentence with *or* in the scope of *may*, *might*, *can*/*could*, etc. is often stronger than expected under the standard treatment of such expressions as (equivalent to) $\diamond$-operators of modal logic, and of *or* as (equivalent to) boolean disjunction. For example, (1) naturally conveys that *both* drinking beer and drinking wine are permissible options for the hearer – (1b), but is predicted under the latter assumptions to be true even if only one of them is permissible – (1a).[1,2]

(1)   You may have beer or wine.

    a. $\diamond(B \vee W)$ *n.b.* $=\diamond B \vee \diamond W$
        (1a) is True in w iff $\exists w'$
    b. $\diamond B \wedge \diamond W$

(Throughout the paper we follow the practice of using the first letter of the first contentful word of a disjunct as its translation in the language of propositional modal logic).

The same puzzle crops up across modalities ((2a)-(2c) allow for identical strengthenings), but for historical reasons – it was first noticed in work on deontic logic (Ross, 1941) – it is known to as 'the puzzle of free choice permission'.[3]

(2)   a.   Jenny may/might be a doctor or a lawyer. (*epistemic*)
    b.   Jenny could/might have been a doctor or a lawyer. (*metaphysical?*)
    c.   Jenny can outsmart a doctor or a lawyer. (*ability*)

In each case, rather than (just) $\diamond(D \vee L)$, the logically stronger $\diamond D \wedge \diamond L$ is naturally understood (using the corresponding, appropriate accessibility relation for '$\diamond$'). That the same conjunctive effect is observed across kinds of modalities casts doubt on the possibility that the effect with (1) is due solely to something special about *the act of* granting permission. This point is made

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[1]Since (1a) only requires that there exist a possible world/state of affairs in which the laws/rules (of the actual state of affairs w*) hold, and in which the disjunction holds, i.e. that

(i) $\exists w(wRw^* \wedge$ (*B* is in True in w $\vee$ *W* is true in w)) *where* R *is the relation of deontic accessibility*

[2](1b) does not in fact fully characterize the meaning actually conveyed, a point to which we return, but is sufficient to frame the basic puzzle.

[3]We follow tradition in using deontic examples – though the account developed applies in full generality across modalities – and stick to the somewhat misleading terminology.

more directly by the fact that the conjunctive effects arises equally where the function of (1) is to report permission (*according to this rulebook...*), rather than grant it.

At the same time, there are good reasons to assume that the explanation for the puzzle is not that the standard truth conditions are (drastically) wrong, but rather that the strengthening is pragmatic in nature. In particular, the strengthened meaning bears all of the hallmarks of being due to scalar implictures. Far from explaining away the puzzle, however, this observation deepens it; standard and well-founded assumptions about scalar implicature predict precisely that such a strengthening should be *im*possible. Before turning to an elaboration of the latter two claims in Section 2, we show that the puzzle generalizes beyond possibility modals, arising for plural existential quantification over the domain of individuals and times, and sketch an account that builds crucially on the latter observation.

1.2   A new puzzle

Plural existential quantifiers in both the individual and temporal domain can give rise to conjunctive effects for *or* in their scope, completely parallel to the case of possibility modals. Singular existential quantifiers systematically cannot. The following, for example, are naturally understood as conveying the conjunctive (b) meanings, rather than the expected disjunctive ones ((a)):

(3)   (The air in the train was extremely stuffy...) Some passenger**s** became nauseous or had trouble breathing.
   a. $[\exists X: P(X)] \, (N(X) \vee T(X))$
   b. $[\exists X: P(X)] \, N(X) \wedge [\exists X: P(X)] \, T(X)$
      'Some passengers became nauseous, and some passengers had trouble breathing.'

(4)   (his year at work has been very difficult...) Sometime**s**/at time**s** John broke down into tears or was too tired to continue.
   a. $[\exists T] \, (\text{J-cries at } T \vee \text{J-too-tired at } T)$
   b. $[\exists T] \, \text{J-sick at } T \wedge [\exists T] \, \text{J-too-tired at } T$
      'Sometimes John broke down into tears, and sometimes he was too tired to continue.'

(The variables 'T' and 'X' range over pluralities (which can be thought of as sets of atomic individuals), and the predicate letters in the above should be read

as expressing 'distributive' properties, i.e. properties that hold of a plurality p iff they hold of each (atomic) individual that is part of p (i.e. each member of the set)).

Similar to the case of possibility modals, the (a) meanings are too weak because they are consistent with one of the disjuncts failing to be satisfied be anything in the domain of the quantifier – for example, in the case of (3), with it being the case that no passenger got sick.[4] Similarly, the conjunctive effect is not predicted straightforwardly even under the more realistic assumption (to be adopted later) that the disjoined predicates in (3) and (4) are simple predicates of atomic individuals, with distributivity handled by an intermediary operator (see Schwarzschild (1996) for a summary of motivations for this assumption). For example,

(5) $[\exists X: P(X)] [\forall x: x \text{ is-part-of } X] (N(x) \vee T(x))$

can be witnessed (made true by the existence of) a "homogeneous" plurality of passengers, i.e. one containing only passengers who got nauseous (or only passengers who had trouble breathing).

A conjunctive effect is impossible with the singular counterparts of (3) and (4); only the (a) meanings – here, in accordance with expectation – are attested:

(6)   (The air in the train was extremely stuffy...) Some passenger/a passenger became nauseous or had trouble breathing.

    a. $[\exists x: P(x)] (N(x) \vee T(x))$

    b.   *$[\exists x: P(x)] N(x) \wedge [\exists x: P(x)] T(x)$

        'Some passengers became nauseous, and some passenger had trouble breathing.'

(7)   (his year at work has been very difficult...) Once/at at least one time, John broke down into tears or was too tired to continue.

    a. $[\exists t] (J\text{-cries at } t \vee J\text{-too-tired at } t)$

    b.   *$[\exists t] J\text{-sick at } t \wedge [\exists t] J\text{-too-tired at } t$

        'At least once John broke down into tears, and at least once he was too tired to continue.'[5]

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[4]The (b) paraphrases given here are in fact not entirely correct, a point which is later addressed in full, but the difference is irrelevant for present purposes.

[5]I henceforth focus attention on the examples with individual quantifiers, ignoring temporal cases, though the proposal developed applies in full generality to both.

The conjunctive phenomenon observed with plural existentials is on the face of it exactly the same as that observed with possibility modals, and, as we'll see, the analytical problem it poses is identical: the strengthening seems to be due to scalar implicatures, but it (apparently) can't be. Adding to the mystery is the fact that possibility modals do not pattern with singular existentials. We might expect precisely the opposite, since on the standard assumption they have the same semantics, possibility modals being singular existential quantifers over possible worlds. The observation of the asymmetry between plural existentials/possibility modals and singular existentials, previously unobserved or ignored in the literature, turns out to be the key to unravelling the puzzle of free choice permission.

1.3   Towards one solution

Summarizing, we are apparently faced with 3 problems: explaining (i) how the conjunctive strengthenings arise for possibility modals, (ii) how they arise for plural existentials, and (iii) why they don't with singular existentials (outside the modal domain). The goal of this paper is to dissolve them in turn.

   (i) will be assimilated into nothing more than a sub-case of (ii), as we propose that possibility modal *are* in fact plural existential quantifiers, over possible worlds. From this it follows that (iii) isn't a well-defined problem in the first place: there is nothing mysterious a priori about why possibility modals don't behave like singular existentials, since they aren't. The lack of conjunctive strengthenings with singulars itself is shown to be unsurprising, for exactly the reason that there seemed to be a puzzle about possibility modals in the first place: otherwise motivated assumptions about scalar implicature straightforwardly rule them out.

   What is in need of explanation from this perspective is just (ii): what is special about *plurals*. We observe that *overtly* distributive plural existential quantification yields a conjunctive effect, just as found with (3), (4) (as with these, the effect doesn't follow from the semantics: see the discussion under ex. (5)):

(8)   Some of the boys each wrote a poem or novel.
        ↝ Some of the boys wrote a poem, and some of the boys wrote a novel.[6]

The proposal developed here has two parts. The first is that distributivity is a

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[6]'↝' is used here informally for 'conveys', and later in a technical sense for '(all else being equal,) leads to the scalar implicature that'.

necessary condition for the conjunctive effect with *or* in the scope of existentials – modal or non-modal. The second is that it is an implicature calculated based on the distributive operator (overt or covert) and *or* that is responsible – in particular, an *embedded* implicature added within the scope of the existential. To see how the idea works, observe that a sentence like

(9)   Each of them got nauseous or had trouble breathing

implicates that

(10)   At least one of them did each of the things.

It is shown that this can be given simple explanation as due to scalar implicatures, derived by comparison to the simpler, stronger sentences with one disjunct eliminated, *Each of them got nauseous/had trouble breathing*. Now we observe that the nuclear scope of (3) is essentially a sentence like (9), where *them* is bound by the existential *some passengers*. By effectively adding the implicature ((10)) which arises for (9) in general to its *embedded* instance in (3) – and binding its pronoun to the existential – we straightforwardly derive the conjunctive effect. (cf. 'There are some passengers such that: each of them N or T, and at least one of them N and at least one of them T').

The second part of the proposal is of course independent from the first, but is shown in Section 3 to have make some desirable predictions.

I will *not* give a knockdown argument that possibility modals are plurals, offer only considerations of conceptual naturalness, and some preliminary empirical and conceptual arguments (Section 5). I also show that the assumption is very weak (Section 4.1), and hence harmless (but in proportion difficult to prove).

Before developing the proposal in some further detail, we turn to motivating its most basic facet. Why should we want an account of free choice permission (and conjunctive effects with plurals) as due to scalar implicatures, and where do existing (scalar implicature) based accounts go wrong?

2   The Implicature Paradox

As noted by Alonso-Ovalle (2005), the conjunctive effect with *or* under possibility modals has the hallmarks of strengthened meanings due to scalar implicatures: it (very strongly tends to) disappear in downward entailing contexts, and

can be 'cancelled'. We begin with the first point, and return to the latter below; consider:

(11)   You may not have beer or wine.

The overwhelmingly natural 'reading' is exactly the one that is expected under standard assumptions – in light of the independent fact that negation always scopes above deontic modal auxiliaries in English (e.g. von Fintel 2006): $\neg\Diamond(B \lor W)$, $=\neg\Diamond B \land \neg\Diamond W$ (no beer, no wine!). The same point is not as easy to establish with plural existentals – as least with *some* – since they are so-called 'postive polarity items', resisting appearance in DE contexts in which implicatures routinely disappear. It clearly holds for their negative polarity variants, however:

(12)   John doubts that any students drank beer or wine.

    a. $\neq$'John doubts this: some students drank beer, and some students drank wine.'

For many people *some* can appear unproblematically in the scope of weakly downward entailing operators, (i.e. non-antiadditive ones) like *at most n people* (Szabolcsi, 2004), allowing the point to be established more directly:

(13)   At most three people sent some friends a card or a letter.

    a. $\neq$'At most three people are such that they sent some friends a card, and some friends a letter.' (i.e. possibly a fourth sent some friends a card, but no friends a letter, or vice versa)

    b.   ='At most three people sent a card or a letter to some friends.' entails: no more than three people sent cards to friends, and no more than three sent letters

There is little hope that the conjunctive effect can be derived in a standard way as scalar implicatures, however. Consider the robust empirical generalization, (14), witnessed by the examples following it:

(14)   For any embedding X (possibly null), if *XA/XB* is logically stronger than *X(A $\lor$ B)*, *X(A $\lor$ B)* has among its implicatures that $\neg KXA$ and $\neg KXB$ (where *K* means 'the speaker knows/is certain that)

(15)   Alex drank beer or wine. $=B(a) \lor W(a)$

    a. $\rightsquigarrow$The speaker isn't certain that Alex drank beer, and isn't certain

that Alex drank wine

(16)   Most students drank beer or wine.   =[Most x: S(x)]: B(x) ∨ W(x)

    a.   ⤳The speaker isn't certain that most students drank beer, and isn't certain that most students drank wine

(17)   Every student drank beer or wine.   =[∀x: S(x)]: B(x) ∨ W(x)

    a.   ⤳The speaker isn't certain that every student drank beer, and isn't certain that every student drank wine

(18)   John must clean his room or take out the trash.   =□(C ∨ T)

    a.   ⤳¬□C, ¬□T   (=◇¬C, ◇¬T)

This generalization has a fairly straightforward explanation in classical Gricean pragmatics as a kind of Quantity/scalar implicature (as well as in neo-Gricean system, e.g. Sauerland 2004). If the speaker knew that XA/XB, saying so would have been more informative (and briefer, no less). So as long as knowing the truth of these more informative statements is relevant to the purposes of the conversation, and the speaker is assumed to be cooperative, a hearer is licensed to infer that the speaker wasn't in a position to assert *XA/XB*, i.e. doesn't know that XA/XB. As is often observed, these implicatures tend, as a matter of empirical fact, to strengthen to K¬XA/XB, where certain conditions are met. So for example (17) typically conveys in addition to its literal content that (the speaker knows that) not every student drank beer (¬[∀x: S(x)] B(x)), and that (the speaker knows that) not every student drank wine (¬[∀x: S(x)] W(x)) – which is to say, that there were both wine drinking and beer drinking students.

Of course possibility modals and plural existentials are precisely embedding operators that fall under the antecedent of the conditional in (14). For example *John may have beer* is logically stronger than *John may have beer or wine*, and *Some passengers got nauseous* than *Some passengers got nauseous or had trouble breathing* – both according to standard semantics assumptions, and as an apparent matter of empirical fact (viz. the fact noted above, that embedding the disjunctive variants under a DE operator (e.g. negation) leads to a *stronger* statement). The problem, then, is that Gricean/neo-Gricean acounts of (14) would seem to be at dire risk of predicting that the conjunctive effect should *not* be possible. Implicatures of ¬KXB/W – e.g. ¬K(John may have beer), ¬K(Some passengers got nauseous) – *directly* contradict it.[7] But paradoxically,

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[7]In the case of plural existentials, the exact predictions of such a theory depend on what the plural means. If the truth conditional contribution of *Some passengers got sick/had trouble breathing* is that *2 or more* passengers did,

at the same time it seems that an account of the conjunctive effect in terms of scalar/Quantity implicatures seems to be on the right track – as witnessed by its disappearance in entailment reversing contexts, and by the fact that it can be canceled:

(19)   Some students drank beer or wine (I can't remember which).

    a.   ⤳The speaker isn't certain that some students drank beer, and the speaker isn't certain that some students drank wine.

(20)   John may drink the beer or the wine (I can't remember which).

    a.   ⤳The speaker isn't certain that John may drink the beer, and the speaker isn't certain that John may drink the wine.

(We note again that singular exisentials are systematically consistent with (14), and thus lead to no special problem.)

(21)   Someone drank the beer or the wine.

    a.   ⤳The speaker isn't certain that someone drank the beer, and the speaker isn't certain the someone drank the wine.

There are many logically possible approaches to resolving this apparent paradox. There have been many proposals about the conjunctive effect with possibility modals that are essentially *semantic* in nature (e.g. Higginbotham (1991); Zimmermann (2000); Geurts (2005)), yet do or can in principle still explain the facts noted here that seem to militate in favor of a pragmatic analysis (in terms of scalar implicatures). I won't discuss these interesting proposals in detail here, only noting that they do not extend to cover the conjunctive effect with plural existentials. Rather I'll focus on more recent pragmatic accounts which attempt to resolve the paradox by proposing essentially the following: disjunction is governed by a weaker kind of pragmatic reasoning than what is available to account for (14) under classical (neo-) Gricean assumptions (e.g. Sauerland (2004)).

The idea is to revise some assumptions about how the pragmatics generates (scalar) implicatures, such that both the Generalization (14) respecting 'reading'

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implicatures of ¬K(Some passengers got sick/had trouble breathing) are consistent with the speaker knowing/it being the case that exactly one student had beer, and exactly one wine. This is the wrong result in general, and in particular does not capture what is expressed by the conjunctively strengthened 'reading' (on which there may be and naturally are many passengers of each type). The problem is even more severe once a more realistic semantics is adopted for plural existentials (Section 4.1).

and the conjunctive effect are available/consistent with the speaker being cooperative (and such that, in general, (14) is attested). An illustrative example is Alonso-Ovalle (2005), who essentially adopts Kratzer & Shimoyama (2002)'s proposal for free choice indefinites in German. The pragmatics of disjunction proposed by Alonso-Ovalle is such that there are two reasons why a cooperative speaker might assert $\Diamond(B \vee W)$: one is that he said exactly as much as he knew with respect to the the permissibility of B and W, i.e. he couldn't make either of the stronger claims $\Diamond B$, $\Diamond W$: $\neg K \Diamond B$, and $\neg K \Diamond W$. The other, in short, is that he couldn't "choose between" these stronger, simpler claims, in the sense that he they have parallel epistemic status: he knows each of B and W to be permissible, or each not to be.[8] If the speaker is in the latter epistemic position, then given that he believes what he literally asserted ($\Diamond(B \vee W)$), he must know that both A and B **are** permissible, i.e. the conjunctive effect follows.[9] Presumably, context will disambiguate which epistemic state the speaker is in (for which of the reasons the speaker opted out of asserting $\Diamond B/W$). A related approach is developed in Fox (2006), where the basic insight of the Kratzer and Shimoyama/Alonso-Ovalle approach is built into a syntactic/grammaticalized (i.e. non-Gricean) system for generating implicatures. A recursively available syntactic operator, akin to *only*, generates implicatures by associating with scalar terms; one instantiation yields the Generalization (14) respecting strengthened meaning, two stacked instantiations yield the conjunctive strengthening.

The problem faced by both of these accounts is that, having weakened the pragmatics to allow for conjunctive 'readings' of $\Diamond(A \vee B)$ they end up wrongly predicting that *singular* existentials (as well as plurals) should also give rise to them. This is for the simple reason that possibility modals are semantic analogues of singular existentials. For example, under Alonso-Ovalle's assumptions, one of the two cooperative reasons for asserting *Someone drank beer or wine* is – entirely parallel to the modal case – that the speaker couldn't choose between the (stronger, simpler) non-disjunctive statements *Someone drank beer* and *Someone drank wine* (i.e. knows each to be true, or each to be false). From this a conjunctive effect wrongly follows – if believes what he said, he must know them both to be true. In principle this severe problem might be addressed, at least within Fox's formalization of the basic idea, if a further distinction can be drawn between singular existentials on the one hand, and possibility modals

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[8]The first reason is in fact not discussed by Alonso-Ovalle (or Kratzer and Shimoyama), but it follows from the assumptions he makes that it is a valid one – which is desirable given the cancelability of the conjunctive effect.

[9]Crucially, the speaker could cooperatively opt out of choosing $\Diamond(B \wedge W)$, since this is even stronger than what he ends up conveying.

and plural existentials on the other, in the nature of the alternatives used in pragmatic reasoning.[10] The proposal developed here starts from the opposite direction, and explores whether understanding the singular/plural distinction can pave the way to a general account of conjunctive effects.

3 Distributivity Implicatures

We propose that the key to understanding free choice permission lies in assimilating it to another puzzle, the fact that plural existentials lead to a parallel conjunctive effect. The key to understanding the latter is the observation that *overtly distributive* plural existential quantification also does:

(22)   Some of the students each bought a car or a motorcycle.
        [∃X: Students(X)] [∀x: x is-part-of X] C(x) ∨ M(x)

      a.   ⤳Some of the students (each) bought a car, and some of the students (each) bought a motorcycle.[11]

The conjunctive effect in (22) is every bit as puzzling as it is in the case of plural existentials without overtly realized distributivity; under the generalization (14) we expect implicatures that the speaker doesn't know that the non-disjunctive statements *Some of the students (each) bought a car/motorcycle* are true, but this is precisely the opposite of what is attested.[12] It seems plausible that the effect is somehow tied to distributivity itself, since distributive/universal quantification allows for a similar one, as noted in the previous section:

(23)   Each of the students bought a car or a motorcycle.
        [∀x: x is-one-of-the-students] C(x) ∨ M(x)

      a.   ⤳Some of the students (each) bought a car, and some of the stu-

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[10]Fox for example suggest that a further (scalar) implicature of singular existentials blocks the conjunctive effect – namely a (scalar) implicature that an identical sentence but with a *plural* existential is false. For example, *Some passenger got sick* is claimed to implicate that it's not the case that two did. I'm not sure whether in general singular existentials give rise to such strong implicatures. Although they do seem to give rise to implicatures that the speaker *doesn't know* (or in some cases, care) whether the corresponding plural sentence is true, the systematic existence of the stronger implicature is crucial for Fox's suggestion to be able to save his approach, as far as I can tell.

[11]Parallel examples in the temporal domain cannot be constructed, since we don't find 'floating' *each* in the adverbial domain. Cf. however an inversely linked partitive such as *On each of several (special) occasions I drank beer or wine with dinner*, where (unsurprisingly) we find a conjunctive effect.

[12]Here again the conjunctive effect can be defeated/fail to arise, vis. the possibility of adding the rider '…but I don't know which.'

dents (each) bought a motorcycle.

Given this similarity, it is possible to understand the conjunctive effect of (22) as owing to exactly the kind of implicature found with (23), but calculated at an *embedded* level, within the scope of the plural existential. Looking at the scope of *some of the students* in (22), we have something which is essentially identical to (23): a universal quantifier with disjunctive scope. Adding the implicatures that such a configuration gives rise to when unembedded, but within the scope of the existential, gives exactly the conjunctive strengthening:

(24)   There is a plurality P of students such that: each student in P bought a car or a motorcycle, and some some students in P bought a car, and some students in P bought a motorcycle
        'Some of the students bought a car, and some of the students bought a motorcycle'

Accounting for the relevant implicatures of universals over disjunction is, as noted in the previous section, unproblematic on standard (neo-) Gricean accounts. What needs to be assumed is that, among the relevant ALTERNATIVES to $\forall(A \lor B)$ – its 'scalemates' – are $\forall A$ and $\forall B$. (And of course that the algorithm for computing implicatures allows the hearer to conclude that these are both false.) So, for example, for (23), *each of students bought a car* and *each of the students bought a motorcycle* can be concluded false. It follows from the assertion (23) in conjunction with these implicatures that at least one student bought a car (but not motorcycle), and at least one a motorcycle (but not a car). This isn't exactly the paraphrase we've been using for the conjunctive, which was stated in terms of a *plural* existential – *Some students bought a car, and some students bought a motorcycle*, but it is intuitively the correct one. (23) is fine in the (degenerate) case that there were just two students, one who bought a car, and the other a motorcycle, and is decidedly odd in case all the students bought both. It is shown below that the result is also what is wanted (at the embedded level) for (22).

To make the proposal for (22) clear, we adopt a notational system which captures the general spirit of the proposal in Chierchia (2001). Chierchia argued that many paradigm cases of non-truth conditional meaning classically treated as (neo-) Gricean quantity/scalar implicatures arise in *embedded* contexts, in ways that preclude the classical analyses. His conclusion and proposal was that such meanings are derived by essentially a *grammaticalization* of the (neo-)

Gricean system, which works in parallel with semantics, rather than posterior to it. For our purposes, it isn't crucial whether embedded implicatures are derived in Chierchia's 'semantic' way, or by positing *syntactic* operators that mimic the effect of (neo-) Gricean implicature computation Fox (2006) (a mixed theory is given Chierchia (2005)). For simplicity we adopt a highly simplified syntactic version. We crucially depart from Chierchia and classical neo-Gricean accounts in taking the competitors/scalar alternative to *X(A ∨ B)* to include not only *X(A ∧ B)*, but also *XA* and *XB*, following Sauerland (2004):

(25)   a.   Let STRONG(X) stand for the neo-Gricean strengthening of X: i.e. X conjoined with the negation of its stronger neo-Gricean scale-mates.

        b.   STRONG($\forall x: Ax \lor Bx$) is thus equivalent to

            (i) $(\forall x: Ax \lor Bx) \land \neg(\forall x: Ax) \land \neg(\forall x: Bx) \land \neg(\forall x: Ax \land Bx)$

            (ii) $=(\forall x: Ax \lor Bx) \land (\exists x: Ax \land \neg Bx) \land (\exists x: Bx \land \neg Ax)$

(22) (repeated) can now have the representation in (26a):

(26)   Some of the students each bought a car or a motorcycle.

        a. $[\exists X: \text{Students}(X)]$ STRONG($[\forall x: x \text{ is-part-of } X] Cx \lor Mx$)

        b. $=[\exists X: \text{Students}(X)] ([\forall x: x \text{ is-part-of } X] Cx \lor Mx) \land \neg([\forall x: x \text{ is-part-of } X] Cx) \land \neg([\forall x: x \text{ is-part-of } X] Mx) \land \neg([\forall x: x \text{ is-part-of } X] Cx \land Mx)$

        c. $=[\exists X: \text{Students}(X)] ([\forall x: x \text{ is-part-of } X] Cx \lor Mx) \land ([\exists x: x \text{ is-part-of } X] Cx \land \neg Mx) \land ([\exists x: x \text{ is-part-of } X] Mx \land \neg Cx)$

        d.   'At least one of the students bought a car (but not a motorcycle), and at least one of the students bought a motorcycle (but not a car).'

As noted above and indicated in the paraphrase (26d), the actual result is not quite equivalent to what we've been assuming as a paraphrase of the conjunctive strengthening. One difference is that the strengthened meaning derived doesn't require that there be multiple motorcycle buyers or multiple car buyers – just one or more of each, in contrast with the paraphrase we've been working with, which used a plural existential: 'Some of the students (each) bought a car, and some of the students (each) bought a motorcycle. This seems to be exactly what

is wanted: if there are three students who made a vehicle purchase, one of a motorcycle, two of a car, there's nothing strange about using (22) – so long as there was no need to be more precise, of course. In the further degenerate case in which there was just one car buyer, and just one motorcycle buyer (among the students), the account predicts (26) to have exactly the status of e.g. *Some students (each) bought a car*, in a context in which the speaker knows (and it is relevant that) exactly two students did, and this seems to be correct. There is a general tendency, it seems, for plural existentials to suggest vagueness in number, or to be odd where the number of witnesses hovers at barely plural (i.e. 2).[13] There is likely a pragmatic explanation for this fact, but all that matters for present purposes is that its existence means that the proposed analysis of the conjunctive effect has no special problem with the 'degenerate' case.

The second difference is that the derived strengthened meaning strictly requires that there be at least one student who bought a motorcycle but *not* a car, and at least one who bought a car but *not* a motorcycle. Again, this is intuitively correct, and the facts are entirely parallel to the pure universal case ((23)) – as predicted the by the account.

The account for (22) extends straightforwardly to plural existential cases like (3), given the assumption that the embedded implicature can be calculated just as well on a distributive operator if it doesn't happen to be pronounced. Evidence that non-overt operators can trigger implictatures like their overt counterparts can be found with existential readings for bare plurals, for example. *Alex saw girls from his section at the dance* implicates, just like *Alex saw some girls from his section at the dance*, that he didn't see every girl from his section.

(27)   Some passengers got nauseous or had trouble breathing.

   a. $[\exists X: P(X)]$ STRONG($[\forall x: x$ is-part-of $X]$ $Nx \vee Tx$)

   b. $=[\exists X: P(X)]$ ($[\forall x: x$ is-part-of $X]$ $Nx \vee Tx$) $\wedge \neg([\forall x: x$ is-part-of $X]$ Nx) $\wedge$
         $\neg([\forall x: x$ is-part-of $X]$ Tx) $\wedge \neg([\forall x: x$ is-part-of $X]$ $Nx \wedge Tx$)

   c. $=[\exists X: P(X)]$ ($[\forall x: x$ is-part-of $X]$ $Nx \vee Tx$) $\wedge$ ($[\exists x: x$ is-part-of $X]$ $Nx \wedge \neg Tx$) $\wedge$ ($[\exists x: x$ is-part-of $X]$ $Tx \wedge \neg Nx$)

   d.   'At least one passenger got nauseous (but had no trouble breathing), and at least one passenger had trouble breathing (but didn't get nauseous).'

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[13]This explains why the the plural paraphrase for the conjunctive effect that we've been using up until now seemed intuitively correct – we continue to use it since it is appropriate in all but exceptional cases.

It should now be clear that under the present proposal, the reason that a conjunctive effect is unavailable for *singular* existentials is simply that no distributive operator is present.

The claim that distributivity is crucial to the conjunctive strengthening of (22) is independent of the particular account just given. Embedded implicature is a purely descriptive term, and as has been shown in other domains (Spector (2003), Sauerland (2004)), sometimes what the existence of embedded implicature shows us is that we didn't understand a particular (neo-) Gricean mechanism sufficiently, rather than that a (radically) non-Gricean approach is needed. Distributivity could be implicated in a number of ways. Do we find independent evidence that it *is* crucially involved?

An obvious question is whether we find the conjunctive effect with disjunctions of *collective* predicates. Naively one might expect that our proposal predicts that the answer should be no. Matters are complicated, however, since it is well known that there are 'intermediate' distributive readings – cases in which collective predicates are applied distributively to parts of a plurality, obviously non-atomic ones ('sub-pluralities') (Schwarzschild, 1996):

(28)   The boys gathered in the hall
        →can be true if the totality of boys did not (all) gather (together), but rather gathered into groups

It does seem to be the case the no conjunctive effect arises where the nuclear scope is a disjunction of collective predicates which themselves don't allow for any kind of distributive reading – compare (29) and (30). (The following context may be useful: a student, or group of students, asks what he/they should do for his art project...)

(29)   (Some students wrote a poem or composed a song.
        a.   ⤳'Some students wrote a poem, and some students composed a song.'

(30)   Some students wrote this poem or composed this song.
        a.   #'Some students wrote this poem, and some students composed this song.'

A predicate like *write this poem* or *compose this song* allows for no kind of distributive reading – if it applies to any plurality at all, it applies to exactly one and to none of its parts, whether atomic or plural (i.e. sub-pluralities). Still,

given the existence of intermediate distributive readings, it might seem puzzling from the perspective of our proposal that the conjunctive effect is absent in (30). A plurality of students composed of one group who wrote the poem, and one the song, would satisfy the proposed strong meaning if distributed down into just those groups. There are two possibilities. One could take these facts to show that the introduction of an (intermediate) distributive operator is not entirely free, but rather hinges on the properties of the predicate. If this is correct we have an argument that distributivity is crucial to the conjunctive effect. Although these considerations are inconclusive, there turn out to be stronger – but much more involved and indirect – ways of establishing the claim that distributivity is crucial; see Klinedinst (2006).

A further obvious question is whether there is independent evidence for an account in terms of embedded implicature of a genuinely non-Gricean variety, i.e. of a purely formal/grammatical one. The answer depends in large part on what properties are conceptually necessary to the latter type of account. It does seem that there is an intuition that the conjunctive effect enters as part of the content *asserted*, rather than as an inference (as reported in Simons 2005, who backs up the intuition with empirical evidence that is behaves differently that other types of Gricean inferences). If this is correct, it provides at least weak support for the type of account proposed here – since embedded implicatures per definition figure into the level of asserted content.[14]

4   Pluralities and Possibilities

Taking possibility modals to express plural existential quantification over possible worlds, an account of free choice permission can be given which is entirely parallel to that developed in the last section. The only further assumption required is one that is already completely standard: intensions are taken to be functions from *atomic* entities (possible worlds) to extensions. Distribution is therefore necessary in the scope of possibility modals, since these quantify over

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[14]The matter is in actuality a bit more complicated. For reasons that will become clear when Chierchia's system is discussed, any theory of embedded implicature must have the ability to 'factor out', at the global level, implicatures added in embedded contexts. This means that the intuition that embedded implicatures are part of asserted content doesn't strictly come for free. In addition, in a theory like Chierchia's all scalar implicatures – even ones for which there is no such intuition – are generated by the same mechanism, and so it has to draw some further distinction. Thus it cannot even be stipulated that intuitions of asserted content track directly the output of this mechanism. I think that there is a principled way to draw the needed distinction, however, and in any case there remains point in favor against a global Gricean account: whatever its derivation of the conjunctive effect, it will be external to semantic content by definition.

pluralities, and so a simple modal statement like *John may have beer or wine* will translate as follows:

(31) $[\exists W: \text{Acc}_D(W)] [\forall w: w \text{ is-part-of } W] Bw \vee Ww$

'Acc_D' is to be understood distributively, i.e. as holding of pluralities of worlds each of which are deontically accessible.[15] (31) is exactly parallel in structure to the non-modal cases analyzed in the previous section, and the account applies in turn. Calculating an (embedded) distributivity implicature derives the crucial facts of free choice permission:

(32)   a. $[\exists W: \text{Acc}_D(W)] \text{STRONG}([\forall w: w \text{ is-part-of } W] Bw \vee Ww)$

      b. $=[\exists W: \text{Acc}_D(W)] ([\forall w: w \text{ is-part-of } W] Bw \vee Ww) \wedge \neg([\forall w: w \text{ is-part-of } W] Bw) \wedge \neg([\forall w: w \text{ is-part-of } W] Ww) \wedge \neg([\forall w: w \text{ is-part-of } W] Bw \wedge Ww)$

      c. $=[\exists W: \text{Acc}_D(W)] ([\forall w: w \text{ is-part-of } W] Bw \vee Ww) \wedge ([\exists w: w \text{ is-part-of } W] Bw \wedge \neg Ww) \wedge ([\exists w: w \text{ is-part-of } W] Bw \wedge \neg Ww)$

      d.   'There is a plurality of worlds consistent with the rules which includes at least one world in which John drinks beer but not wine, and at least one world in which he drinks wine but not beer'

A more colloquial paraphrase: (1) John's options include the following: drinking beer (without drinking wine), and (2) drinking wine (without drinking beer). Notice that this means that John is not **required** to drink either – which seems to be empirically correct. There is however a further implicature that *John may have beer or wine* often carries, which is not yet derived: that John is not allowed to have both ($\neg\Diamond(B \wedge W)$).

    $\Diamond(B \wedge W)$ fails to entail (32a); so the question arises how the negation of the former is to derived, given the working the assumptions adopted here, which effectively make the latter the actual semantic content of *John may have beer or wine* (on a given occasion of use). What needs to be assumed is that embedded implicatures are effectively ignored for the purposes of implicature calculation at higher levels; in this case the alternative $\Diamond(B \wedge W)$ needs to be compared to *John may have beer or wine* on its 'normal' meaning, $[\exists W: \text{Acc}_D(W)] [\forall w: w$

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[15]Lurking behind this terminological point is an important question. Given the use of pluralities of possible worlds, and distribution over them, we can fairly ask whether there are natural language expressions/structures which express *collective* properties of pluralities of worlds (and what exactly this would mean). This interesting question is largely independent of the proposal, as long as the disjunctive complements of possibility modals that allow for conjunctive strengthening *can* have as meanings functions defined on atomic worlds. We have no reason to think that they can't.

is-part-of W] B(w) ∨ W(w), rather than (32a), where the local implicature has been added. The syntactic framework adopted here for expositional purposes would need to to be enriched to derive this result. Importantly, though, this is an independently crucial property of any theory of embedded implicature.

The (non-syntactic) system of implicature calculation in Chierchia (2001), for example, crucially works in this way. Chierchia is able to derive the correct implicatures for multiple disjunctions *(A ∨ (B ∨ C))*, namely that exactly one of A, B, C is the case. The way the system works is to calculate an implicaure for *B ∨ C* at the embedded level (in the scope of the higher disjunction), and add it to the normal meaning of *B ∨ C*, but effectively *remember* the latter, to be accessed in the computation of implicatures at higher levels. In effect, the rules encode that the overall implicature-strengthened meaning of *A ∨ (B ∨ C)* is obtained by adding the exclusivity implicature for *B ∨ C* locally *((B ∨C) ∧ ¬(B ∧ C), =B ∨$_{excl}$ C)*, passing this through the computation to obtain *A ∨ (B ∨$_{excl}$ C)*, and then computing and adding to it a 'global' implicature yielding an exclusive interpretation for the higher disjunction, but based on the normal meaning of *B ∨ C*: ¬(A ∧ (B ∨ C)). The resulting conjunction *(A ∨ (B ∨$_{excl}$ C)) ∧ ¬(A ∧ (B ∨ C))* is exactly the desired strong meaning – it is true iff exactly one of A, B, and C holds. What is crucial is that the wrong result would have been obtained by calculating implicatures for the higher disjunction taking into account the strengthened meaning of *B ∨ C* itself: *(A ∨ (B ∨$_{excl}$ C)) ∧ ¬(A ∧ (B ∨$_{excl}$ C))* is emphatically not strong enough, since it is consistent with each of A, B, and C obtaining. This 'memory' property of Chierchia's system is what distinguishes it from a theory that posits systematic ambiguity in scalar terms – which notoriously fails for multiple disjunctions – and is thus one that any theory of embedded implicature has to possess, one way or another

The desired total strengthened meaning for *John may have beer or wine*, under the plural analysis proposed here, can be derived in a modification of his system that imports the crucial feature of the analysis: that implicatures can be computed and added at the level of the embedded distributivity operator, based on comparison to the meanings of the distributivity operator applied to each of the disjuncts separately. Chierchia's algorithm, as shown by the example of multiple disjunction, provides for the possibility that this local distributivity implicature be ignored for the purposes of computing further implicatures. The derivation in our case is entirely parallel: the local distributivity implicature is calculated and added to the content (yielding free choice permission), but then ignored at the global level, where a further implicature to ¬◇(A ∧ B) is

calculated by *or-and* comparison, based on the normal meaning of *John may have beer or wine* (i.e. its meaning without the embedded implicature added).[16] See Klinedinst (2006) for a full formal implementation.

4.1   Negation and Plurality

A desirable feature of the standard semantics for possibility modals is that it captures the logical equivalence of $\neg\diamond P$ and $\square\neg P$: you may not have beer if and only if you must not have beer. Interestingly, this equivalence is exactly what is expected on the assumption that possibility modals are in fact plural existentials, despite a possible impression to the contrary. (Doesn't 'there is not a plurality of worlds in which P' just mean that there are less than two – and not necessarily that there are none (that in all worlds not P)?) The crucial observation is that plurals behave systematically like singulars in downward entailing contexts (in the scope of decreasing functions):

(33)   Alex doesn't have any friends (in Berlin).

      a. $\neq$Alex doesn't have two or more friends (in Berlin).

      b. $\approx$'There isn't anyone in Berlin who is a friend of Alex.'

(34)   No students came to the party.

      a. $\neq$No group of two or more students came to the party.

      b. $\approx$'No student came to the party.'

In recent work by Spector (2005) and Anderson et al. (2005), it is argued on the basis of such facts that the plural has a weak semantics, such that plural variables range over entities which must simply contain at least one atomic part. The 'true' plurality conveyed in non-DE contexts – the fact that *Some passengers got sick* 'means that' at least two did – is argued to be derived as a pragmatic effect of competition with singular forms. Under both theories, the effect is predicted to disappear in DE contexts, so that (33), for example, conveys just its (desired) literal meaning – namely, that there is no group of one or more individuals which are friends of Alex.

    Adopting this assumption, *John may not have beer* is represented as follows, where 'X' ranges over objects consisting of one or more atomic individuals, and we now understand the relation 'is-part-of' as extending to hold between

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[16]Chierchia explicitly supposes that implicatures can be calculated based on a given scalar item only once (so not both globally and locally). Crucially, in our case two implicatures must be calculated based on the *or-and* scale: one locally, one globally. Mechanically, Chierchia's system *does* in fact allow for this possibility, as far as I can tell.

an atomic individual and the 'degenerate' plurality consisting of just that individual[17]

(35) $\neg[\exists W: \text{Acc}_D(W)]$ ([$\forall$w: w is-part-of W] B(w)

    a.   'There is no group of one or more accessible worlds, such that each world in it is a world in which John drinks beer (i.e. there neither one nor more than one accessible B world).'

Having adopted these more realistic assumptions about plurality, (35) is equivalent to $\Box\neg B$, as desired. I assume that, unlike the case of plurals in the individual domain, there is no inference to 'true' plurality based on competition/comparison: but the existence of a more than one accessible world, if there is any, will follow automatically from the vastness of the space of possibilities.[18]

    A crucial observation we began with is that conjunctive strengthenings strongly tend to disappear in DE contexts: embed *John may have beer or wine* under negation, and the overwhelmingly natural reading is the negation of its standardly predicted meaning, not the negation of the free choice permission reading. This will remain a result of the present account, since any theory that generates embedded implicature has to derive in one way or another that they cannot be retained in DE contexts; cf.

(36)   John didn't invite Bill or Mary or Susan

    a. $=\neg(A \vee (B \vee C))$
    b. $\neq\neg((A \vee (B \vee_{excl} C)) \wedge \neg(A \wedge (B \vee C))$
        'It's not the case that exactly one of A, B, and C is true'

Since the distributivity implicature is calculated in an upward entailing context, the (immediate) scope of an existential, embedding this entire constellation in a DE context would then force the implicature to be calculated in a DE context, precisely the phenomenon which must independently be blocked. Taking the syntactic proposal entertained here seriously, this could possibly be derived as a distributional restriction on the implicature operator STRONG. In the system

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[17]If the domain of plural objects is taken to be constructed by an operation of sum formation, such that plural objects are elements of join-semilattices, this amounts to saying that the individual John is part of the individual John. If it is taken to be sets, it just amounts to saying that John is a member of the set containing John. Neither claim is objectionable.

[18]Of course, in the case of free choice permission, the calculation of distributivity implicatures 'forces' there to be more than one world in the plurality quantified over, but this fact alone is uninteresting – the work done is to force there to be worlds of both both types (i.e. permissible beer drinking worlds and permissible wine drinking worlds, in the case of *John may have beer or wine*).

in Chierchia (2001), it is simply a built in property of the recursive semantic rules which calculate strengthened meanings. In sum, the proposal introduces no new complications to the theory of embedded implicature.

5   Conclusion

Given the considerations about plural meaning in the last section, the claim that possibility modals are plurals doesn't amount to anything radical – in fact it yields a semantics which is equivalent to the old one, once distributivity is taken into account.[19] But it is far from a vacuous refinement, as the present proposal shows: a unified account of two puzzles, an old one about modals, and a new one about plurals, becomes available within an existing general framework for calculating implicatures – something which has the core properties of the system in Chierchia (2001).

The core of the proposal is that **distributivity** is at base responsible for conjunctive strengthenings of existentials with disjunctive nuclear scopes – in both the modal and non-modal domains. Importantly, this proposal may remain intact and interesting even under a more sophisticated global approach to implicature. What would ensure that it will be is the existence of independent evidence that possibility modals are plural. There are some interesting considerations.

First we have some basic considerations of plausibility (to be clear: not an argument). *Any* (useful) statement involving existential quantification over possible worlds will by practical necessity have a (huge) plurality of witnesses to it, a simple consequence of the vastness of the space of possibilities. An absurd situation would obtain have to obtain for things to be otherwise. Suppose for example that there is **exactly one world** which is witness to (37) on a deontic or epistemic interpretation for the modal:

(37)   Jenny may smoke

    a. $\diamond S$ ($[\exists w: Acc(w)]\ S(w)]$)

It would follow that:

(38) $\forall P(\square(S \Rightarrow P) \vee \square(S \Rightarrow \neg P))$

Which is to say that the law, or what is known, would completely determine the

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[19]Again, in principle there could be different predictions if there are the equivalent of collective readings in the modal domain.

conditions under which S (under which Jenny smokes). In the epistemic case this means that discovering that Jenny smokes – suppose she actually does – is the one thing in the way of the speaker and total omniscience. In the deontic case it amounts to the law specifying in impossibly fine detail the conditions under which Jenny can smoke – do her toes have to be crossed or uncrossed? Can her mother have recently gotten an anchor tatoo? On which forearm?, etc. The reason is the elementary fact that for any single world, e.g. one compatible with what is known or required, a proposition is either true of/in it, or not. Adding a Kratzer style ordering source doesn't change this point: (38) would still follow from (37) if there were exactly one S world among the 'best' accessible worlds. Neither would using situations instead of worlds change anything. Any situation which can reasonably count as one in which Jenny smokes, no matter how 'minimal', will include an infinite number of details (the way her lips are pursed, for example) irrelevant to what the law says about Jenny smoking, and potentially underdetermined by our knowing that she does.

Stronger considerations come from the domain of cross-sentential anaphora, where we find that possibility modals pattern with true plural existentials, and against synonymous morphologically singular existentials, in their possibilities for anteceding pronouns. (We assume without argument here that 'would' (39) is anaphoric to the witness world(s) to the preceding existential modal statement (see e.g. Stone 1999)).

(39)   (Don't smoke.) My sister might come in.
    a.   She **would** (probably/definitely) kill us.
    b.   . . . '(It is probable/certain) given that my sister comes in, she kills us.'

(40)   At least one musician will come in. . .
    a.   . . . He/#They will be female.
    b.   . . . #Most/all of them will be female.

(41)   One or more musicians will come in.
    a.   . . . They/#he will be female.
    b.   . . . Most/all of them will be female.

The generalization seems to be that plural indefinites require plural pronouns for cross sentential anaphora, while morphologically singular indefinites require singular pronouns. Given that 'at least one musician' and 'one or more musicians' are synonymous for all relevant purposes, and (crucially) that they don't

have different, relevant implicatures, the pattern they exhibit must be purely 'grammatical'. When anaphoric *would* restricts a modal adverb like *definitely* or *probably* as in (39a), it seems plausible that it must have plural reference (Stone (1999)) – at pain of collapsing the truth conditions in the two cases. Thus, it effectively follows from the generalization that emerges from (40)-(41) that possibility modals – e.g. *might* in (39)-(39a) – are plural. If *would* must have plural reference, and there is a purely grammatical requirement on antecedence, then *might* cannot be singular: either both *would* and *might* are unmarked, or both plural. But the two possibilities are essentially equivalent given the weak meaning we've assumed for plurals.

There is a final argument of a slightly more conceptual nature. Given that modals express generalized quantification over possible worlds, the question arises of why we only find modal (auxiliaries) with *existential* and *universal* force – in contrast, for example, with what is found in the individual domain. This contrast doesn't follow in general from a simple difference in the nature of the domains of modal and individual quantification, since there are ways of expressing non-universal and non-existential quantifications over worlds, periphrastically (e.g. *it is not the case that you may...*, compare *no* in the individual domain) and/or with expressions that aren't modal in the lexical-syntactic sense (e.g., *it is impossible that*, arguably *it is (50%) likely that*). Taking possibility modals as plurals raises the possibility to bridge the explanatory gap: for example, plurality can be taken to be an underlying feature of all modals, with a truly binary lexical distinction between indefinite (possibility) and definite (necessity) replacing the (more) stipulative existential/universal distinction.

It is my hope that these preliminary arguments can be fleshed out in further detail, to bolster the intuitive plausibility of the claim that possibility modals are plurals. I leave this for future research.

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