Universal Free Choice and Innocent Inclusion

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Universal Free Choice and Innocent Inclusion*

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Abstract The goal of this paper is to provide a global account of universal Free Choice (FC) inferences (argued to be needed in Chemla 2009b). We propose a stronger exhaustivity operator than proposed in Fox (2007), one that doesn't only negate all the Innocently Excludable (IE) alternatives but also asserts all the "Innocently Includable" (II) ones, and subsequently can derive universal FC inferences globally. We further show that Innocent Inclusion is independently motivated by considerations that come from the semantics of *only* (data from Alxatib 2014). Finally, the distinction between Innocent Exclusion and Innocent Inclusion allows us to capture differences between FC inferences and other scalar implicatures.

Keywords: Free Choice, Exhaustification, Innocent Exclusion, Innocent Inclusion

1 The problem of Universal Free Choice

1.1 Free Choice as an implicature

As is well known, a sentence like (1) where an existential modal takes scope above *or* gives rise to the Free Choice (FC) inferences (1a)-(1b) (Kamp 1974). It is also well known that those inferences don't follow from standard assumptions about the semantics of *allowed* and *or*: $\Diamond(a \vee b)$ is equivalent to $\Diamond a \vee \Diamond b$ rather than the observed FC inference $\Diamond a \wedge \Diamond b$.

(1) Mary is allowed to eat ice cream or cake. $\Diamond(a \vee b) \Leftrightarrow (\Diamond a \vee \Diamond b)$

a. $\rightsquigarrow$ Mary is allowed to eat ice cream. $\Diamond a$

b. $\rightsquigarrow$ Mary is allowed to eat cake. $\Diamond b$

Alonso-Ovalle (2005), following Kratzer & Shimoyama (2002), argues further that the Free Choice inference from (1) to (1a)-(1b) should be treated as a scalar implicature, due to its disappearance under negation, as in (2).[1]

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1 For reasons of space we do not provide here further arguments in favor of an implicature-based account of Free Choice, but simply assume that such an account is needed. We argue elsewhere

(2) John isn't allowed to eat ice cream or cake $\neg\Diamond(a \vee b)$

a. $\not\approx$ It's not the case that John is both allowed to eat ice cream *and* allowed to eat cake (but maybe he's allowed one of them). $\neg(\Diamond a \wedge \Diamond b)$

b. $\approx$ It's not the case that John is allowed to eat ice cream and it's not the case that he is allowed to eat cake. $\neg\Diamond(a \vee b)$

Implicature-based accounts of FC (Fox 2007; Chemla 2009a; Franke 2011) maintain that *allowed* and *or* have a standard semantics, such that the basic meaning of (1) can be stated as $\Diamond(a \vee b)$ using a standard modal logic. The FC inferences are derived by enriching the meaning to derive the FC inference $\Diamond a \wedge \Diamond b$ using mechanisms that are independently needed in order to derive scalar implicatures.

1.2 Universal Free Choice: An argument for embedded implicatures?

Our main focus in this paper is universal FC inferences, exemplified in (3). Chemla (2009b) provides evidence that, when embedded under universal quantification as in (3), the embedded FC inferences in (3a)-(3b) are as robust as in the unembedded case of (1).

(3) Every boy is allowed to eat ice cream or cake. $\forall x \Diamond(Px \vee Qx)$

a. $\rightsquigarrow$ Every boy is allowed to eat ice cream. $\forall x \Diamond Px$

b. $\rightsquigarrow$ Every boy is allowed to eat cake. $\forall x \Diamond Qx$

A prima facie plausible analysis of the inferences in (3) may be based on a local derivation of FC: *every boy* takes scope over an enriched FC meaning, with whatever mechanism we might have for enriching (1) applying in the scope of *every boy* (see Singh, Wexler, Astle-Rahim, Kamawar & Fox 2016 for a possible explanation for the relative robustness of this putative local implicature).

As Chemla (2009b) points out, a local derivation is in fact the *only* way standard implicature-based accounts can derive universal FC (see §2 and in particular fn. 9 for the results of applying Fox's mechanism globally). In this light, (3) may just seem like yet another argument in favor of deriving implicatures at an embedded level (Chierchia, Fox & Spector 2012).

(drive.google.com/file/d/0B6BSDIYuatIpLWtjS1lNYmhhWHc) that by forcing semantic identity between (1) and (2) using VP ellipsis we can rule out accounts which rely on ambiguity such as Aloni (2007). As William Starr has pointed out to us, this argument doesn't carry over (at least not straightforwardly) to other accounts with a non-standard semantics which don't rely on ambiguity (see Starr 2016 and references therein). We hope to have a more thorough discussion of accounts of FC that assume a non-standard semantics for *or* or *allowed* in future work.

1.3 Negative universal Free Choice as an argument for a global derivation

However, as Chemla (2009b) notes, a local derivation cannot explain a very similar universal inference that arises in the negative case in (4):[2]

(4) No student is required to solve both problem A and problem B.
$\neg\exists x\Box(Px \wedge Qx) \Leftrightarrow \forall x\Diamond(\neg Px \vee \neg Qx)$

a. $\rightsquigarrow$ No student is required to solve problem A. $\neg\exists x\Box Px \Leftrightarrow \forall x\Diamond\neg Px$

b. $\rightsquigarrow$ No student is required to solve problem B. $\neg\exists x\Box Qx \Leftrightarrow \forall x\Diamond\neg Qx$

Semantically, the inferences from (4) to (4a)-(4b) completely parallel the universal FC inferences in (3). As the formulas on the right indicate, the inference can be restated as a universal FC inference: from *every student is allowed not to solve problem A or not to solve problem B* (=(4)) to *every student is allowed not to solve problem A* (=(4a)) and *every student is allowed not to solve problem B* (=(4b)).

An account of (4) along the lines of (3) is thus needed. However, a local derivation is not applicable in this case: such a derivation would require an embedded syntactic position at which the enriched FC meaning can be derived. However, no such position exists in (4). Since the scope of *no student* only contains strong scalar items—*required* and *and*—no further strengthening can occur at any embedded position.

Because the inferences cannot be derived from embedding the mechanism we have for (1), they must be derived at the matrix level, above negation, namely they necessitate a global derivation. Given the parallelism between (3) and (4), a global account of the positive case in (3) should be applicable to the negative case in (4) as well. We set our goal then to provide a global account of universal FC.

1.4 Interim summary

What we need is an account which satisfies the desiderata in (5).

(5) **Desiderata**: Provide an account of Free Choice which

a. treats it as an **implicature**, and

b. can provide a **global derivation** for universal Free Choice.

To our knowledge, no existing account provides a principled analysis that satisfies these goals.

The remainder of the paper is structured as follows: In §2 we build on Fox's (2007) analysis, which meets the requirement in (5a) but fails to meet (5b), and

2 Chemla's (2009b) results show a significant difference in robustness between the universal FC inferences in (3) and (4). We will not attempt to explain this difference.

modify it in order to meet (5b) by introducing the notion of Innocent Inclusion on top of Fox's notion of Innocent Exclusion. In §3 we provide further motivation for Innocent Inclusion from the presupposition of *only*. In §4 we show that the distinction between Innocent Exclusion and Innocent Inclusion allows us to capture differences between FC inferences and other scalar implicatures.

2 Proposal

2.1 Disjunction and its alternatives

A key point in analyzing FC disjunction is understanding the distinction between (6) and (7). While from simple disjunction we infer the exclusive inference in (6a), for Free Choice disjunction we infer what we might call the opposite inference in (7a), namely FC.

(6) **Simple disjunction**:
Mary ate ice cream or cake $a \vee b$
a. $\rightsquigarrow$ Mary didn't eat both ice cream and cake. $\neg(a \wedge b)$

(7) **Free Choice disjunction**:
Mary is allowed to eat ice cream or cake. [=(1)] $\Diamond(a \vee b)$
a. $\rightsquigarrow$ Mary is allowed to eat ice cream and allowed to eat cake. $\Diamond a \wedge \Diamond b$

Since we view both the exclusive inference in (6a) and the FC inference in (7a) as implicatures, and since implicatures can only be determined after alternatives are specified, we should first ask what alternatives we generate for those sentences.

Standardly, the following sets of alternatives are assumed: disjunction gives rise to disjunctive alternatives, that is alternatives where we replace the disjunction with the individual disjuncts (see, e.g., Kratzer & Shimoyama 2002; Sauerland 2004; Katzir 2007); and to a conjunctive alternative—an alternative where we replace disjunction with conjunction. When applied to the sentences in (6) and (7), we generate the alternatives in (8a) and (8b), respectively.

(8) a. **Set of alternatives for simple disjunction**:
$$Alt(a \vee b) = \{ \underbrace{a \vee b}_{\text{Prejacent}}, \underbrace{a, b}_{\text{Disjunctive alt.}}, \underbrace{a \wedge b}_{\text{Conjunctive alt.}} \}$$
b. **Set of alternatives for Free Choice disjunction**:
$$Alt(\Diamond(a \vee b)) = \{ \underbrace{\Diamond(a \vee b)}_{\text{Prejacent}}, \underbrace{\Diamond a, \Diamond b}_{\text{Disjunctive alt.}}, \underbrace{\Diamond(a \wedge b)}_{\text{Conjunctive alt.}} \}$$

Looking at those sets of alternatives in light of the inferences we get in (6) and (7), we can see a striking difference between simple disjunction and FC disjunction with regard to the conjunction of their disjunctive alternatives:

(9) **Observation**:

a. From simple disjunction we infer that the conjunction of the disjunctive alternatives ($a \wedge b$) is **false**.

b. From Free Choice disjunction we infer that the conjunction of the disjunctive alternatives ($\Diamond a \wedge \Diamond b$) is **true**.

What distinguishes the two cases and yields the opposite results in (9)? Certain analyses of Free Choice disjunction (Fox 2007; Chemla 2009a; Franke 2011) rely on *closure under conjunction* as the distinguishing property: whereas $Alt(a \vee b)$ is closed under conjunction, $Alt(\Diamond(a \vee b))$ is not.

Specifically, the crucial difference between the two sets is in (10):

(10) a. The conjunction of the disjunctive alternatives a and b, i.e., $a \wedge b$, **is** a member of $Alt(a \vee b)$.

b. The conjunction of the disjunctive alternatives $\Diamond a$ and $\Diamond b$, i.e., $\Diamond a \wedge \Diamond b$, **is not** a member of $Alt(\Diamond(a \vee b))$.

To see how this fact is responsible for the opposite results derived for the two cases, let us focus on the account of FC in Fox (2007).

2.2 Towards an account: Innocent Exclusion

Within the grammatical theory, scalar implicatures are generated by applying a covert exhaustivity operator, EXH, akin to overt *only*.

This operator takes a prejacent and a set of alternatives. What should it return as an output? If we let EXH 'blindly' negate every alternative that is stronger than the prejacent, we will sometimes derive contradictions, for example when exhaustifying $a \vee b$ with respect to $Alt(a \vee b)$. Since both a and b are stronger than $a \vee b$, EXH would negate them and yield the contradiction $(a \vee b) \wedge \neg a \wedge \neg b$.

We must find a way to let EXH exclude as many alternatives as possible consistently with the prejacent.

To achieve this, Fox (2007) argues in favor of using the notion of Innocent Exclusion (inspired by Sauerland 2004).

(11) **Innocent Exclusion procedure**:

a. Take all maximal sets of alternatives that can be negated consistently with the prejacent.

b. Only exclude (i.e., negate) those alternatives that are members in all such sets—the **Innocently Excludable** (=IE) alternatives.

Let us show now how Innocent Exclusion avoids contradiction when applied to $a \vee b$ and to $\Diamond(a \vee b)$. To apply Innocent Exclusion to $a \vee b$ we first have to identify the maximal sets of alternatives in $Alt(a \vee b)$ that can be negated consistently with the prejacent. There are two such sets: $\{a, a \wedge b\}$ and $\{b, a \wedge b\}$. The second step, by the Innocent Exclusion procedure, is to exclude those alternatives which are in all of those sets; there is only one such alternative, $a \wedge b$, which is thus the only IE alternative.

A parallel result is derived by applying Innocent Exclusion to $\Diamond(a \vee b)$. The maximal sets of alternatives in $Alt(\Diamond(a \vee b))$ that can be negated consistently with the prejacent are $\{\Diamond a, \Diamond(a \wedge b)\}$ and $\{\Diamond b, \Diamond(a \wedge b)\}$, and consequently the only IE alternative is $\Diamond(a \wedge b)$.

The result of Innocent Exclusion for the two cases is represented schematiclally in figure 1.

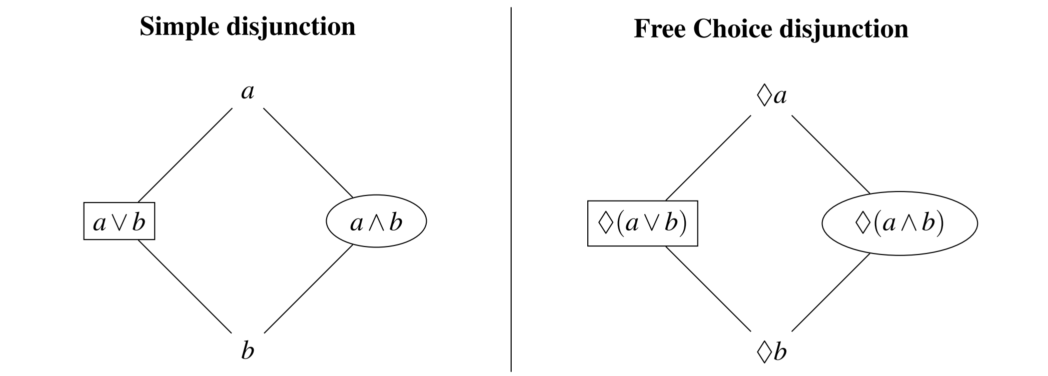

Figure 1 Results of Innocent Exclusion for simple and Free Choice disjunction. The lines represent entailment relations from right to left, the prejacent is marked with a rectangle and the IE alternatives with a circle.

At this level, for simple disjunction we derive that the prejacent $a \vee b$ is true and that the conjunctive alternative $a \wedge b$ is false, and similarly for Free Choice disjunction: the prejacent $\Diamond(a \vee b)$ is true and the conjunctive alternative $\Diamond(a \wedge b)$ is false.[3] This

3 As has been claimed by Simons (2005), FC inferences are often not accompanied by the negation of the conjunctive alternative $\Diamond(a \wedge b)$. It is crucial to note that our derivation of FC in what follows does not depend on deriving the negation of the conjunctive alternative (in fact it follows even if the conjunctive alternative is omitted altogether from the set of alternatives). See §4, in which it would become clear that the question of whether an IE alternative is negated depends on whether it is relevant. Assuming that the only constraint on relevance is closure under Boolean operations (conjunction and negation), it is possible for $\Diamond a$ and $\Diamond b$ to be relevant without $\Diamond(a \wedge b)$ being relevant. A simplifying assumption in the discussion here and in what follows is that all alternatives are relevant, but this should not be seen as an empirical claim that we always infer the negation of the IE alternatives. See Fox & Katzir (2011); Singh et al. (2016) for relevant discussion.

result gives us the first hint as to why we derive opposite results for the two cases: Since $Alt(a \vee b)$ is closed under conjunction, the output of applying Innocent Exclusion to $a \vee b$ which ensures the falsity of $a \wedge b$ *is not comaptible* with both disjunctive alternatives a and b being true. In contrast, since $Alt(\Diamond(a \vee b))$ is not closed under conjunction, the output of applying Innocent Exclusion to $\Diamond(a \vee b)$ which ensures the falsity of $\Diamond(a \wedge b)$ *is comaptible* with both disjunctive alternatives $\Diamond a$ and $\Diamond b$ being true.

Note that FC is not yet derived for Free Choice disjunction. Given what we have said so far we can only explain why it would be in principle possible to derive a conjunctive meaning for Free Choice disjunction but not for simple disjunction: such a meaning is consistent with the result of applying Innocent Exclusion in the case of FC disjunction but not in the case of simple disjuntion. We still have to find a way to actually derive the FC inferences.

The Innocent Exclusion procedure in (11) leads to the lexical entry for the exhaustivity operator EXH^{IE} in (12a): given a set of alternatives C and a prejacent p, it would assert the prejacent and negate all the IE alternatives which are defined in (12b).

(12) **Innocent-Exclusion-based exhaustivity operator**: (Fox 2007)

a. $[\![\text{EXH}^{IE}]\!](C)(p)(w) \Leftrightarrow p(w) \wedge \forall q \in \text{IE}(p,C)[\neg q(w)]$

b. $\text{IE}(p,C) = \bigcap\{C' \subseteq C : C' \text{ is a maximal subset of } C, \text{ s.t. } \{\neg q : q \in C'\} \cup \{p\} \text{ is consistent}\}$

In the next section we introduce the notion of Innocent Inclusion, and suggest a different lexical entry for EXH than (12a), one that implements both Innocent Exclusion and Innocent Inclusion and can directly derive FC inferences.

2.3 Introducing Innocent Inclusion

How do we derive the Free Choice inferences for Free Choice disjunction? This is where we depart from Fox (2007).

The FC inferences $\Diamond a$ and $\Diamond b$ are derived in Fox (2007) *indirectly*, by applying EXH^{IE} recursively. Our proposal is to define EXH differently from (12a), such that those inferences would be derived *directly*, by letting EXH "include", i.e., assert the alternatives $\Diamond a$ and $\Diamond b$.

We suggest that EXH has a dual role: it doesn't only *negate* certain alternatives, it also *asserts* some other alternatives. The empirical motivation for this move is that it would allow us to derive universal FC globally, as we will show in §2.4. At this point we would like to mention the underlying conception that has guided our thinking, namely (13).

(13) **Possible underlying conception**:
Exhaustifying p with respect to a set of alternatives C should get us as close as possible to a cell in the partition induced by C.

Namely the goal of EXH is to assign a truth value to every alternative, thereby yielding a cell in the partition the set of alternatives produces. In other words, EXH is designed such that when possible it would yield the complete answer to the question formed by the set of alternatives.

From this conception it follows that EXH shouldn't only exclude as many alternatives as possible, but also include, i.e., assert, as many alternatives as possible once the exclusion is complete.

What are the alternatives we want EXH to include? One possibility we might entertain is that EXH blindly includes all non-IE alternatives. But this would sometimes lead to contradictions: exhaustifying $a \vee b$ with respect to $Alt(a \vee b)$ would yield a contradiction, because including a and b, which are both non-IE, would contradict the derived falsity of $a \wedge b$.

For the same reasons we needed Exclusion to apply *innocently*, namely avoiding contradictions, we also need Inclusion to apply *innocently*. We thus suggest the procedure of Innocent Inclusion in (14).

(14) **Innocent Inclusion procedure**:
a. Take all maximal sets of alternatives that can be asserted consistently with the prejacent and the negation of all IE alternatives.
b. Only include (i.e., assert) those alternatives that are members in all such sets—the **Innocently Includable** (=II) alternatives.

Note the similarity between Innocent Exclusion and Innocent Inclusion: Innocent Inclusion is only different from Innocent Exclusion in two respects: (i) that we include instead of exclude, and (ii) that we check for consistency not only with respect to the prejacent but also with respect to the negation of all the IE alternatives.[4]

Let us see now how Innocent Inclusion applies to simple and Free Choice disjunction to derive the desired results. Having Innocent Inclusion changes nothing for simple disjunction: The only II alternative is the prejacent $a \vee b$. This is since the

4 Why do we have to consider the set of IE alternatives for determining the set of II alternatives, and not vice versa? Let us consider what would happen if we first considered what's II: take for example the sentence *some boy came* and its alternative *every boy came*. If we were to include first, we would derive that the alternative *every boy came* is true. Namely exhaustifying over *some boy came* would yield a meaning equivalent to *every boy came*. This would make for a very inefficient tool to use in conversation: by choosing an utterance from the set of alternatives {some boy came, every boy came} the speaker would only be able to convey one epistemic state she might be in (one cell in the partition); she would not be able to convey an epistemic state in which *some but not all boys came*. By prioritizing exclusion over inclusion we allow the speaker to convey more epistemic states.

maximal sets of alternatives that are consistent with the truth of $a \vee b$ (the prejacent) and the falsity of $a \wedge b$ (the IE alternative) are $\{a \vee b, a\}$ and $\{a \vee b, b\}$, and the only member in their intersection is the prejacent $a \vee b$.

For FC disjunction, on the other hand, we derive the desired FC inferences with our procedure, since $\Diamond a$ and $\Diamond b$ are II. In this case, all the alternatives which are not IE are together consistent with the truth of $\Diamond(a \vee b)$ (the prejacent) and the falsity of $\Diamond(a \wedge b)$ (the IE alternative). That is, we only have one maximal set of alternatives to consider, $\{\Diamond(a \vee b), \Diamond a, \Diamond b\}$, and all alternatives within this set are II. Therefore applying Innocent Exclusion and Innocent Inclusion yields a cell in the partition (a complete answer) in this case; the output tells us of every alternative whether it is true or false.

The result of Innocent Exclusion and Innocent Inclusion for the two cases is represented schematiclally in figure 2.

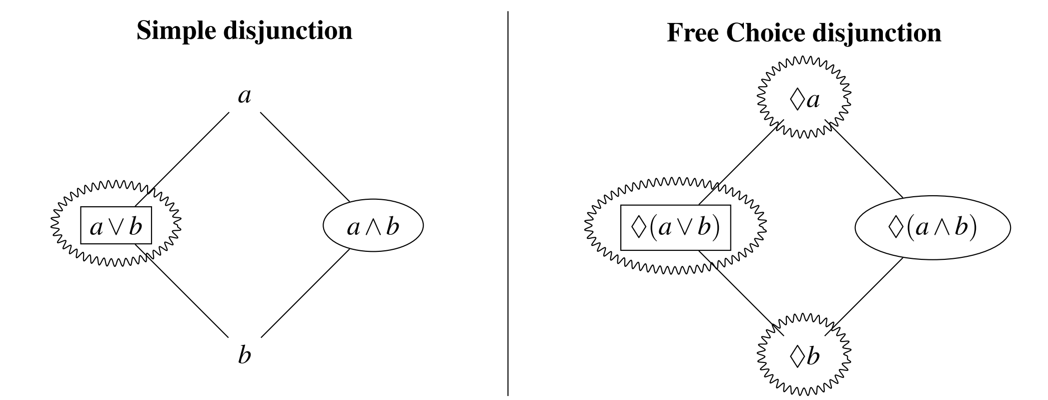

Figure 2 Results of Innocent Exclusion and Innocent Inclusion for simple and Free Choice disjunction. The II alternatives are marked with a wavy circle.

We have seen that applying Innocent Exclusion and Innocent Inclusion yields the desired results for simple and Free Choice disjunction: an exclusive *or* meaning for simple disjunction and an FC meaning for Free Choice disjunction. For these two cases, the results we derive are identical to those Fox (2007) derives with the recursive application of $\textsc{exh}^{IE}$.

Before we move on to show that Innocent Inclusion allows us to derive universal FC while a recursive application of $\textsc{exh}^{IE}$ doesn't, let us state the lexical entry of the exhaustivity operator we are assuming here, $\textsc{exh}^{IE+II}$, which implements both Innocent Exclusion and Innocent Inclusion. We first define the sets of IE and II alternatives: the set of IE alternatives remains as in Fox (2007), and the set of II alternatives is defined in parallel in (15b), with the two key differences between

Innocent Exclusion and Innocent Inclusion discussed above.

(15) Given a sentence p and a set of alternatives C:

a. $\text{IE}(p,C) = \bigcap\{C' \subseteq C : C'$ is a maximal subset of C, s.t. $\{\neg q : q \in C'\} \cup \{p\}$ is consistent$\}$ [=(12b)]

b. $\text{II}(p,C) = \bigcap\{C'' \subseteq C : C''$ is a maximal subset of C, s.t. $\{r : r \in C''\} \cup \{p\} \cup \{\neg q : q \in \text{IE}(p,C)\}$ is consistent$\}$

With these definitions at hand we can write the lexical entry of EXH^{IE+II} in (16): Given a set of alternatives C and a prejacent p, it would negate all the IE alternatives and assert all the II alternatives.[5,6]

(16) **Innocent-Exclusion+Innocent-Inclusion-based exhaustivity operator**:

$$[\![\text{EXH}^{IE+II}]\!](C)(p)(w) \Leftrightarrow \forall q \in \text{IE}(p,C)[\neg q(w)] \wedge \forall r \in \text{II}(p,C)[r(w)]$$

2.4 Deriving universal Free Choice

As mentioned above, for both simple disjunction and Free Choice disjunction the view promoted here yields the same result Fox (2007) derives by applying EXH^{IE} recursively. However, the current proposal and Fox (2007) make different predictions

5 As far as we can see, EXH^{IE+II} is definable in terms of a recursive application of EXH^{IE}, once we assume that the only alternatives EXH^{IE} projects are its sub-domain alternatives, i.e., alternatives generated by replacing the set of alternatives EXH operates on with its subsets. Namely, (ia) yields the same result as (ib) in all cases we checked.

(i) a. $\text{EXH}^{IE}_{C'}\ [\text{EXH}^{IE}_{C}\ p]$ (where $C' = \{\text{EXH}^{IE}_{C''}(p) : C'' \subseteq C\}$)

b. $\text{EXH}^{IE+II}_{C}\ p$

We will not attempt to prove that (ia) and (ib) are equivalent at this point though, neither are we going to claim for the superiority of any of these versions. Note, however, that our proposal in §3 for the semantics of *only* and the different treatment we give for IE and II alternatives in §4 crucially rely on the distinction between IE and II alternatives, namely on the version with EXH^{IE+II} in (ib). Furthermore, distributive inferences for sentences of the form $\forall x(Px \vee Qx)$ (see fn. 7) can be derived with recursive application of EXH^{IE+II} using Fox's assumptions about how alternatives project; recursive application of EXH^{IE} with the assumption about projection in (ia) won't do in this case.

6 Note that p (the prejacent) can never be in $\text{IE}(p,C)$ and it will always be in $\text{II}(p,C)$ (assuming that the prejacent p must be in C, and that C is finite). Namely, $p(w)$ in (i) is redundant since it is entailed by $\forall r \in \text{II}(p,C)[r(w)]$. So (i) is equivalent to (16), where $p(w)$ is taken out. We set aside for now the consequences for infinite sets of alternatives.

(i) $[\![\text{EXH}^{IE+II}]\!](C)(p)(w) \Leftrightarrow p(w) \wedge \forall q \in \text{IE}(p,C)[\neg q(w)] \wedge \forall r \in \text{II}(p,C)[r(w)]$

regarding universal FC, to which we now turn.

Consider the set of alternatives we generate for (3), in (18). We assume that alternatives where the universal quantifier *every* is replaced with the existential one *some* are generated, and thus the set of alternatives is multiplied by 2 compared to the 4 alternatives of unembedded Free Choice disjunction; we end up with the 8 alternatives in (18).[7]

(17) Every boy is allowed to eat ice cream or cake. [=(3)] $\forall x \Diamond (Px \vee Qx)$

(18) **Set of alternatives for universal Free Choice**:

$$Alt(\forall x \Diamond (Px \vee Qx)) = \{ \underbrace{\forall x \Diamond (Px \vee Qx)}_{\text{Prejacent}}, \underbrace{\forall x \Diamond Px\,,\ \forall x \Diamond Qx}_{\text{Universal-disjunctive alt.}}, \underbrace{\forall x \Diamond (Px \wedge Qx)}_{\text{Universal-conjunctive alt.}},$$
$$\underbrace{\exists x \Diamond (Px \vee Qx)}_{\text{Existential alt.}}, \underbrace{\exists x \Diamond Px\,,\ \exists x \Diamond Qx}_{\text{Existential-disjunctive alt.}}, \underbrace{\exists x \Diamond (Px \wedge Qx)}_{\text{Existential-conjunctive alt.}} \}$$

The universal FC inference follows straightforwardly with one application of EXH^{IE+II},

7 We assume that deriving weaker alternatives is possible, contra Fox (2007: fn. 35), and therefore alternatives where *every* is replaced with *some* are generated. The reason for this assumption is that otherwise we would in fact predict the opposite of what we want: If *every* generated no *some*-alternatives, the application of EXH^{IE+II} would lead to the *negation* of $\forall x \Diamond Px$ and of $\forall x \Diamond Qx$. This bad result is avoided by dispensing with the stipulation in Fox (2007: fn. 35).

See Bar-Lev & Fox (2016); Gotzner & Romoli (2017) for why this stipulation isn't needed to begin with: the original motivation for it was to derive for *every boy ate ice cream or cake* the distributive inferences that *some boy ate ice cream* and *some boy ate cake*. But given that EXH^{IE} can apply recursively those inferences are derived, and furthermore the negated inferences that *not every boy ate ice cream* and *not every boy ate cake* are not derived, a result which has been argued by Crnič, Chemla & Fox (2015) to be desired. Our proposal here is compatible with this view: in this case recursive application of EXH^{IE+II} yields the same result as recursive application of EXH^{IE}.

The assumption that weaker alternatives are generated is relevant also for a problem discussed in Nouwen (2017). Nouwen's concern is with deriving FC for sentences where an existential modal takes scope above a universal quantifier which in turn takes scope above disjunction, namely sentences of the form $\Diamond \forall x(Px \vee Qx)$. He claims that Fox (2007) incorrectly predicts the disjunctive alternatives $\Diamond \forall x Px$ and $\Diamond \forall x Qx$ to be IE and therefore that their negation would be derived. But this claim is only correct insofar as we ignore the weaker alternatives $\Diamond \exists x Px$ and $\Diamond \exists x Qx$. Admitting the latter alternatives makes the former non-IE.

Nouwen's more general claim is that implicature-based analyses of Free Choice rely on *distribution over disjunction* as a necessary condition for deriving FC: If $\phi(a \vee b) \Leftrightarrow \phi(a) \vee \phi(b)$ FC might follow under those approaches, namely we can derive $\phi(a) \wedge \phi(b)$, but not otherwise. This point applies to universal FC too, since *distribution over disjunction* doesn't hold in this case: $\forall x \Diamond (Px \vee Qx) \not\Leftrightarrow (\forall x \Diamond Px) \vee (\forall x \Diamond Qx)$. Since our analysis derives universal FC, namely we derive $(\forall x \Diamond Px) \wedge (\forall x \Diamond Qx)$, it suffices to show that unlike the analyses he discusses ours does not have *distrbution over disjunction* as a necessary condition for deriving FC.

For space reasons we have to rely on the reader to verify that generating weaker alternatives and assuming Innocent Inclusion we can derive FC for the case Nouwen discusses too (i.e., the inference from $\Diamond \forall x(Px \vee Qx)$ to $(\Diamond \forall x Px) \wedge (\Diamond \forall x Qx)$). We intend to pursue this issue in detail in future work.

since $\forall x\Diamond Px$ and $\forall x\Diamond Qx$ are II. Let us show how this result is achieved.

In order to determine which alternatives are II, we first have to determine which are IE. The maximal sets of alternatives that can be negated consistently with the prejacent are in (19a), and their intersection which is the set of IE alternatives is in (19b). The IE alternatives are then $\forall x\Diamond(Px \wedge Qx)$ and $\exists x\Diamond(Px \wedge Qx)$.[8]

(19) a. **Maximal sets of alternatives in** $Alt(\forall x\Diamond(Px \vee Qx))$ **that can be negated consistently with** $\forall x\Diamond(Px \vee Qx)$:
(i) $\{\forall x\Diamond Px, \forall x\Diamond Qx, \forall x\Diamond(Px \wedge Qx), \exists x\Diamond(Px \wedge Qx)\}$
(ii) $\{\forall x\Diamond Px, \exists x\Diamond Px, \forall x\Diamond(Px \wedge Qx), \exists x\Diamond(Px \wedge Qx)\}$
(iii) $\{\forall x\Diamond Qx, \exists x\Diamond Qx, \forall x\Diamond(Px \wedge Qx), \exists x\Diamond(Px \wedge Qx)\}$

b. $IE(\forall x\Diamond(Px \vee Qx), Alt(\forall x\Diamond(Px \vee Qx)))) = \bigcap$(19a) $=$ $\{\forall x\Diamond(Px \wedge Qx), \exists x\Diamond(Px \wedge Qx)\}$

We can now ask what is II: we should check what are the maximal sets of alternatives that can be asserted consistently with the prejacent and the negation of all IE alternatives. Namely, what are the maximal sets of alternatives that are consistent with the truth of the prejacent $\forall x\Diamond(Px \vee Qx)$ taken together with the falsity of $\exists x\Diamond(Px \wedge Qx)$ (we can ignore the other IE alternative, $\forall x\Diamond(Px \wedge Qx)$, since its falsity is entailed by the falsity of $\exists x\Diamond(Px \wedge Qx)$)? As in the case of unembedded FC disjunction, there is only one such set since all the non-IE alternatives together are consistent with the prejacent and the negation of all IE alternatives, as in (20a). Therefore the set of II alternatives in (20b) contains all the non-IE alternatives.

(20) a. **Maximal sets of alternatives in** $Alt(\forall x\Diamond(Px \vee Qx))$ **that can be asserted consistently with** $\forall x\Diamond(Px \vee Qx) \wedge \neg\exists x\Diamond(Px \wedge Qx)$:
(i) $\{\forall x\Diamond(Px \vee Qx), \forall x\Diamond Px, \forall x\Diamond Qx, \exists x\Diamond(Px \vee Qx), \exists x\Diamond Px, \exists x\Diamond Qx\}$

b. $II(\forall x\Diamond(Px \vee Qx), Alt(\forall x\Diamond(Px \vee Qx)))) = \bigcap$(20a) $=$ $\{\forall x\Diamond(Px \vee Qx), \forall x\Diamond Px, \forall x\Diamond Qx, \exists x\Diamond(Px \vee Qx), \exists x\Diamond Px, \exists x\Diamond Qx\}$

As in the case of unembedded FC disjunction, exhaustification here yields a complete answer: it assigns a truth value to every alternative. Most importantly, the alternatives $\forall x\Diamond Px$ and $\forall x\Diamond Qx$ are members in the set of II alternatives. Applying EXH^{IE+II} would then assert them and derive the desired universal FC inferences, as in (21).

(21) $\text{EXH}^{IE+II}_{Alt(\forall x(\Diamond(Px \vee Qx))}\forall x\Diamond(Px \vee Qx)$
$\Leftrightarrow \forall x\Diamond Px \wedge \forall x\Diamond Qx \wedge \neg\exists x\Diamond(Px \wedge Qx)$

The results of Innocent Exclusion and Innocent Inclusion are represented in figure 3.

8 As in the case of unembedded FC disjunction (see fn. 3), the following derivation of universal FC does not depend on the exclusion of any of the IE alternatives. In many cases they would not be relevant and thus would not be negated.

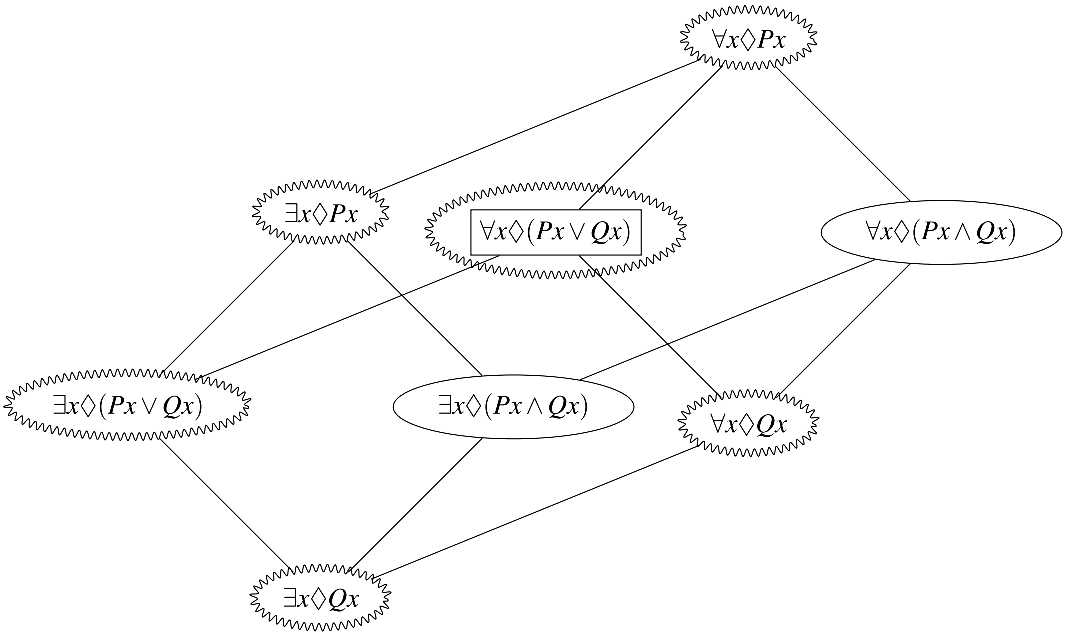

Figure 3 Results of Innocent Exclusion and Innocent Inclusion for universal Free Choice.

The notion of Innocent Inclusion which applies directly to the set of alternatives is what is responsible for our derivation of universal FC. If we were to apply Fox's (2007) EXH^{IE} recursively in this case, we would only derive the weak inferences $\exists x\Diamond Px$ and $\exists x\Diamond Qx$, but would fail to derive the stronger $\forall x\Diamond Px$ and $\forall x\Diamond Qx$.[9]

9 This is since the set of exhaustified alternatives for the second level of exhaustification is as follows:

(i) $Alt(\text{EXH}^{IE}(\forall x\Diamond(Px \vee Qx))) =$
$\{\text{EXH}^{IE}(\forall x\Diamond(Px \vee Qx)) = \forall x\Diamond(Px \vee Qx) \wedge \neg\exists x\Diamond(Px \wedge Qx),$
$\text{EXH}^{IE}(\forall x\Diamond Px) = \forall x\Diamond Px \wedge \neg\exists x\Diamond Qx,$
$\text{EXH}^{IE}(\forall x\Diamond Qx) = \forall x\Diamond Qx \wedge \neg\exists x\Diamond Px,$
$\text{EXH}^{IE}(\forall x\Diamond(Px \wedge Qx)) = \forall x\Diamond(Px \wedge Qx),$
$\text{EXH}^{IE}(\exists x\Diamond(Px \vee Qx)) = \exists x\Diamond(Px \vee Qx) \wedge \neg\exists x\Diamond(Px \wedge Qx) \wedge \neg\forall x\Diamond(Px \vee Qx),$
$\text{EXH}^{IE}(\exists x\Diamond Px) = \exists x\Diamond Px \wedge \neg\forall x\Diamond Px \wedge \neg\exists x\Diamond Qx,$
$\text{EXH}^{IE}(\exists x\Diamond Qx) = \exists x\Diamond Qx \wedge \neg\forall x\Diamond Qx \wedge \neg\exists x\Diamond Px,$
$\text{EXH}^{IE}(\exists x\Diamond(Px \wedge Qx)) = \exists x\Diamond(Px \wedge Qx) \wedge \neg\forall x\Diamond(Px \vee Qx)\}$

The last five alternatives contradict the prejacent and hence can be trivially excluded. The only non-trivially IE alternatives are $\text{EXH}^{IE}(\forall x\Diamond Px)$ and $\text{EXH}^{IE}(\forall x\Diamond Qx)$, the negation of both yields $(\forall x\Diamond Px \rightarrow \exists x\Diamond Qx) \wedge (\forall x\Diamond Qx \rightarrow \exists x\Diamond Px)$. Taken together with the prejacent, this yields the result of the second application of EXH^{IE} in (ii):

(ii) $\forall x\Diamond(Px \vee Qx) \wedge \neg\exists x\Diamond(Px \wedge Qx) \wedge \exists x\Diamond Px \wedge \exists x\Diamond Qx$

Recall the motivation we presented for providing a global account of universal FC, namely the negative universal FC case in (4). Since the same kind of entailment relations hold between the alternatives in the negative case (4) and the positive case (3), the result is parallel as can be seen in (24).

(22) No student is required to solve both problem A and problem B [=(4)]
$\neg\exists x\Box(Px \wedge Qx)$

(23) $Alt(\neg\exists x\Box(Px \wedge Qx)) =$
$\{\neg\exists x\Box(Px \wedge Qx), \neg\exists x\Box Px, \neg\exists x\Box Qx, \neg\exists x\Box(Px \vee Qx),$
$\neg\forall x\Box(Px \wedge Qx), \neg\forall x\Box Px, \neg\forall x\Box Qx, \neg\forall x\Box(Px \vee Qx)\}$

(24) $\text{EXH}^{IE+II}_{Alt(\neg\exists x(\Box(Px\wedge Qx))} \neg\exists x\Box(Px \wedge Qx)$
$\Leftrightarrow \neg\exists x\Box Px \wedge \neg\exists x\Box Qx \wedge \forall x\Box(Px \vee Qx)$

To summarize, building on Fox's notion of Innocent Exclusion we have introduced the notion of Innocent Inclusion. We have suggested a revision of the exhaustivity operator such that it would not only negate all the IE alternatives but also assert all the II alternatives. The empirical motivation for Innocent Inclusion came from the need for a global derivation for universal FC inferences. As a conceptual motivation we have suggested that EXH should be able to assign a truth value to every alternative as long as it wouldn't lead to a contradiction or choosing arbitrarily between the alternatives.

In the next section we argue that Innocent Inclusion isn't only motivated by considerations that come from the covert exhaustivity operator EXH, but by considerations that come from the overt exhaustivity operator *only* as well. In §3.1 we suggest a way to incorporate Innocent Inclusion in the semantics of *only* in order to maintain the analogy between the overt and the covert exhaustivity operators, and in §3.2 we motivate this suggestion based on the interaction between *only* and FC disjunction discussed in Alxatib (2014).

3 Further motivation for Innocent Inclusion: the presupposition of *only*

3.1 The connection between EXH and *only*

EXH was stated originally as a covert analog of *only*, with the minimal difference that while *only* presupposes its prejacent, EXH asserts it (see Fox 2007):

(25) a. EXH^{IE} **asserts** that its prejacent is true and asserts that all IE alternatives are false.
b. *only* **presupposes** that its prejacent is true and asserts that all IE alternatives are false.

When we add Innocent Inclusion into the definition of EXH in (16), one might wonder whether this analogy is disrupted.

We claim it does not. the minimal difference can still be maintained if we assume that Innocent Inclusion is at play in the case of *only* too: What *only* presupposes is the positive part of the meaning EXH asserts, namely Inclusion. The analogy can then be stated as in (26): while *only* presupposes all the II alternatives, EXH asserts them.

(26) a. EXH^{IE+II} **asserts** that *all* II *alternatives* are true and asserts that all IE alternatives are false.
b. *only* **presupposes** that *all* II *alternatives* are true and asserts that all IE alternatives are false.

We propose the lexical entry for *only* in (28), which following (26) is only different from the entry for EXH^{IE+II} in presupposing rather than asserting that all II alternatives are true.

(27) $$[\![\text{EXH}^{IE+II}]\!](C)(p) = \lambda w.\forall r \in \text{II}(p,C)[r(w)] \wedge \forall q \in \text{IE}(p,C)[\neg q(w)]$$ [= (16)]

(28) $$[\![only]\!](C)(p) = \lambda w : \forall r \in \text{II}(p,C)[r(w)].\ \forall q \in \text{IE}(p,C)[\neg q(w)]$$

3.2 Motivation for Innocent Inclusion with *only*: Alxatib (2014)

An empirical motivation for the entry we suggested in (28) comes from work by Alxatib (2014) on the interaction between FC disjunction and *only*. Embedding FC disjunction in the scope of *only*, as in (29), yields the FC inferences in (29a)-(29b).

(29) We are only allowed to eat [ice cream or cake]$_F$.
a. ⇝ We are allowed to eat ice cream.
b. ⇝ We are allowed to eat cake.

Furthermore, Alxatib (2014) claims that FC inferences become presuppositions when FC disjunction is embedded in the scope of *only*. As (30) shows, they project out of questions, as we would expect from presuppositions. The contrast between (30) and (31) shows that *only* is the culprit: in the absence of *only*, as in (31), we do not infer FC.[10]

10 We do not claim that (31) has nothing to do with FC, but rather that FC is not a presupposition. As Chris Barker pointed out to us, a *yes* answer to (31) could lead (in certain contexts) to the inference that we are free to choose between ice cream and cake, and a *no* answer would naturally convey that we are allowed neither ice cream nor cake. We set aside the question of how this is derived for now.

(30) Are we only allowed to eat [ice cream or cake]$_F$?

a. $\rightsquigarrow$ We are allowed to eat ice cream.
b. $\rightsquigarrow$ We are allowed to eat cake.

(31) Are we allowed to eat ice cream or cake?

a. $\not\rightsquigarrow$ We are allowed to eat ice cream.
b. $\not\rightsquigarrow$ We are allowed to eat cake.

Given the entry for *only* in (28), the FC inferences in (29) and (30) are straightforwardly predicted to be part of the presupposition triggered by *only*. Since *only* presupposes all the II alternatives, applying *only* to FC disjunction $\Diamond(a \vee b)$ and its set of alternatives $Alt(\Diamond(a \vee b))$ would presuppose $\Diamond a$ and $\Diamond b$, which are II as has been established in §2.

However, it is not otherwise trivial to explain why the FC inferences of FC disjunction under *only* should become presuppositions.[11]

4 Distinguishing FC inferences from other scalar implicatures

In previous sections we have shown that the distinction between the notion of Innocent Exclusion and the notion of Innocent Inclusion proved fruitful for deriving universal FC inferences and for explaining the interaction between *only* and FC disjunction. This section is devoted to point to another potential gain we can get from this distinction, which is that it provides a natural way to distinguish FC inferences from other scalar implicatures.

Several authors have questioned the idea that FC inferences are Scalar Implicatures (SIs). The main reasons in our opinion are the following:

(32) a. SI computation is costly while FC computation is not. (e.g., Chemla & Bott 2014)
b. Universal FC inferences are more robust than parallel universal SIs. (e.g., Chemla 2009b)

On the face of it, (32) seems to be at odds with accounts such as our own in which FC inferences are SIs. In order to make sense of this discrepancy, we conjecture that the distinction between FC inferences and other SIs pertains to whether or not they are obligatory.

(33) **Conjecture**: FC inferences are obligatory SIs; other SIs are optional.[12]

11 Alxatib suggests two possible accounts, both relying on the assumption that there is an embedded exhaustivity operator other than *only*. However, it is not clear why this exhaustivity operator should be *obligatorily* embedded. And without this assumption, the difficulty to cancel the presupposed FC inferences he points out is not predicted any more.

To be more precise, we suggest that FC inferences are derived with no need to appeal to contextual factors, while the derivation of other SIs is dependent on such factors.

If our conjecture is on the right track, we have a way of addressing the problems in (32). The cost of computation in the case of other SIs comes from the need to determine the makeup of the context; since the derivation of FC inferences is independent of contextual properties, the computation is not costly. And since universal FC can be derived globally (and locally), we also expect it to be obligatory and thus to be much more robust than other universal SIs.

On what basis can we distinguish FC from other SIs, such that FC inferences would become obligatory and other SIs wouldn't? If both FC inferences and other SIs are derived by Innocent Exclusion, as in Fox (2007), such a difference would not be expected. But given our proposal, the two kinds of inferences are derived by different procedures: FC inferences are derived with Innocent Inclusion and other SIs are derived with Innocent Exclusion. We are then provided with the tools to explain differences between FC inferences and other SIs, and our conjecture can be restated in more general terms as in (34):

(34) **Generalized conjecture**: Inclusion is obligatory; Exclusion is optional.

Independent evidence for (34) comes from phenomena which have been argued to involve obligatory implicatures, such as Bowler (2014) on Warlpiri *manu*, Bar-Lev & Margulis (2014) on Hebrew *kol*, Meyer (2016) on English *or else*, Bassi & Bar-Lev (2016) on Homogeneity with bare conditionals. In all those cases, the alternatives leading to the obligatory implicatures are, in our terms, II.[13]

In order to ensure (34), we assume that an alternative can be pruned (ignored) only if it is IE. Following Katzir (2014: attributed to Emmanuel Chemla and Ben-

12 It may seem that FC inferences can be cancelled as in (i), which would disprove (33):

(i) We are allowed to have ice cream or cake, but I don't know which.

However, (i) (and all cases where FC is absent) can be argued to involve wide scope disjunction. In fact, the conditions on ellipsis (sluicing) require this assumption. And a wide scope disjunction construal is not expected to give rise to FC to begin with. So we can still maintain that (33) holds: whenever FC is possible, it is obligatory.

Wide scope disjunction sentences sometimes do give rise to FC, for example with *you may eat cake or you may eat ice cream*, but not always, for example in *you either may eat cake or ice cream* (see Zimmermann 2000; Simons 2005; Alonso-Ovalle 2005; Fox 2007; Klinedinst 2007). See Meyer & Sauerland (2016) for a recent proposal.

13 It is also possible to interpret the facts about children's conjunctive interpretation of disjunction from Singh et al. (2016) along the same lines, assuming that children who didn't generate a conjunctive reading were tested at a different developmental stage than those who did. There are facts reported in the literature that might turn out to provide counter arguments, e.g., Deal (2011) on the Nez Perce modal affix *o'qa* and Davidson (2013) on coordination in ASL. We leave this issue for future research.

jamin Spector, p.c.), we understand pruning as letting EXH negate all *relevant* IE alternatives. As a result, if an alternative is irrelevant it is effectively 'pruned', i.e., not negated by EXH. But pruning doesn't affect the original set of alternatives: the IE set (and the II set) is solely defined with respect to the complete set of alternatives.

The definition of EXH^{IE+II} in (35) implements these ideas. EXH^{IE+II} negates the *relevant* IE alternatives, namely they are prunable; and asserts the II alternatives *regardless of relevance*, making them effectively unprunable. Together with the auxiliary assumption that EXH application is obligatory (Magri 2009) at matrix position, II alternatives would be obligatorily included but IE alternatives would be optionally excluded.

(35) $$[\![\text{EXH}^{IE+II}]\!](C)(p)(w) \Leftrightarrow \forall q \in \text{IE}(p,C)\underline{\cap R}[\neg q(w)] \wedge \forall r \in \text{II}(p,C)[r(w)]$$
(where R is the set of contextually relevant alternatives)

5 Summary

Chemla (2009b) has argued that an implicature-based account of FC requires a global derivation for universal FC in order to cover the negative universal FC case in (4) for which a local derivation is unavailable.

In order to provide such an account we introduced the notion of Innocent Inclusion, which is built upon Fox's (2007) notion of Innocent Exclusion. We proposed a modification of Fox's (2007) exhaustivity operator, EXH^{IE+II}, which implements both Innocent Exclusion and Innocent Inclusion: it asserts all the II alternatives and negates all the IE alternatives. We have shown that EXH^{IE+II} can derive universal FC inferences globally, thereby solving the universal FC puzzle. As a conceptual motivation for EXH^{IE+II} we suggested the idea that EXH should be able to give a complete answer to the question the set of alternatives gives rise to whenever possible.

Independent evidence for Innocent Inclusion came from the way *only* interacts with FC disjunction (Alxatib 2014), which motivated a lexical entry for *only* in which it presupposes all the II alternatives. Finally, we utilized the distinction between Innocent Inclusion and Innocent Exclusion to explain the observed differences between FC inferences and other SIs: while inferences derived from including II alternatives (FC) are obligatory, those derived from excluding IE alternatives (other SIs) are not.

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