Widening Free Choice

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Abstract

Disjunctions scoping under possibility modals give rise to the free choice effect. The effect also arises if the disjunction takes wide scope over possibility modals; it is independent of the modal flavor at play (deontic, epistemic, and so on); and it arises even if disjunctions scope under or over necessity modals. At the same time, free choice effects disappear in the scope of negation or if the speaker signals ignorance or unwillingness to cooperate. I show how we can account for this wide variety of free choice observations without unwelcome side-effects in an update-based framework whose key innovations consist in (i) a refined test semantics for necessity modals and (ii) a generalized conception of narrow and wide scope free choice effects as arising from lexically or pragmatically generated prohibitions against the absurd state (an inconsistent information carrier) serving as an update relatum. The fact that some of these prohibitions are defeasible together with a binary semantics that distinguishes between positive and negative update relata accounts for free choice cancellation effects.

1 The Scope of Free Choice

It is a well-worn story that disjunctions scoping under possibility modals give rise to the *free choice* effect (Kamp 1973, von Wright 1968):

(1) You may take an apple or a pear.
$\rightsquigarrow$ a. You may take an apple.
$\rightsquigarrow$ b. You may take a pear.

(2) Mary might be in Rome or in Paris.
$\rightsquigarrow$ a. Mary might be in Rome.
$\rightsquigarrow$ b. Mary might be in Paris.

In both (1) and (2), the possibility of a disjunction seems to entail the possibility of each disjunct. This is unexpected on the standard analysis of modals and disjunction since the possibility of a disjunction is classically consistent with the impossibility of one of its disjuncts. The question addressed in this paper is how to do better.

One part of the explanandum is that free choice effects are not tied to some specific modal flavor: in (1) the modal is deontic, whereas in (2) it is epistemic. Another is that free choice effects may also arise if the disjunction takes *wide* as opposed to *narrow* scope with respect to the modal (see Kamp 1978 and also Geurts 2005; Simons 2005; Zimmermann 2000):

(3) You may take an apple, or you may take a pear.
$\rightsquigarrow$ a. You may take an apple.
$\rightsquigarrow$ b. You may take a pear.

(4) Mary might be in Rome, or she might be in Paris.
$\rightsquigarrow$ a. Mary might be in Rome.
$\rightsquigarrow$ b. Mary might be in Paris.

The examples in (3) and (4) seem to entail a conjunction of possibilities just as much as (1) and (2) do. A comprehensive story about the free choice effect must thus address both its narrow scope and its wide scope incarnations. It is, of course, tempting to reduce the latter to the former by appealing to Simons's (2005) proposal that across-the-board LF movement may transform

(3) into (1) and (4) into (2), respectively. But Starr (2016) observes that this approach faces an over-generation problem: if the relevant transformation could move a disjunction, it should also be able to move a conjunction—LF movement is a type-driven process, after all—and yet by everyone's agreement (5a) does not entail (5b).

(5) a. You may have an apple, and you may have a pear.
b. You may have an apple and a pear.

An important goal of this paper is to explain how a successful story about narrow free choice effects can also address their wide scope cousins without creating overgeneration problems.

Necessity modals form another part of the picture. It has often been observed that free choice effects arise if *must*s take scope over disjunction (see e.g. Aloni 2007). And again it looks as if the effect also arises if the disjunction takes wide scope, as the following examples indicate (assume that the *must* at play has a deontic flavor):

(6) You must wear a tuxedo or a black suit.
$\rightsquigarrow$ a. You may wear a tuxedo.
$\rightsquigarrow$ b. You may wear a black suit.

(7) You must wear a tuxedo, or you must wear a black suit.
$\rightsquigarrow$ a. You may wear a tuxedo.
$\rightsquigarrow$ b. You may wear a black suit.

None of this shows that possibility and necessity modals trigger free choice effects in exactly the same way: Aloni (2007), for instance, offers a pragmatic explanation of the entailments in (6) and a semantic explanation of the corresponding effect with possibility modals. The point is that any account that aims at explaining why disjunctions scoping under necessity modals trigger free choice effects should also have something to say about the inferences in (7).

The final piece of the puzzle is that free choice effects are in principle cancellable. Specifically, disjunction behaves classically if a disjunctive possibility is embedded under negation (Alonso-Ovalle 2006; Fox 2007):

(8) You may not take an apple or a pear.
$\rightsquigarrow$ a. You may not take an apple.
$\rightsquigarrow$ b. You may not take a pear.

(9) Mary cannot be in Rome or in Paris.
$\rightsquigarrow$ a. Mary cannot be in Rome.
$\rightsquigarrow$ b. Mary cannot be in Paris.

Free choice effects also disappear if the speaker signals ignorance (Kamp 1978) or uncooperativeness (Simons 2005). Neither (10a) nor (10b), for instance, suggest that one may choose between taking a pear and taking an apple:

(10) a. You may take an apple or a pear, but I don't know which.
b. You may take an apple or a pear, but I won't tell you which.

A comprehensive account of free choice effects not only has to explain why these effects occur, but also why they sometimes fail to occur.

Discussions of the free choice effect abound and a comprehensive review of what is currently on the market is better left to another day.[1] My goal here is to improve on the existing literature by telling a story that has something to say about all of the data discussed here so far.

[1] Pragmatic treatments of the free choice effect include Alonso-Ovalle 2006; Fox 2007; Franke 2011; Klinedinst 2007; Kratzer and Shimoyama 2002; Schulz 2005. Semantic approaches include Aher 2012; Aloni 2007, ms.; Barker 2010; Fusco 2015; Geurts 2005; Hawke and Steinert-Threlkeld ms., Roelofsen ms., Simons 2005; Starr 2016; Willer 2015, forthcoming; Zimmermann 2000.

2 Framework

The story told here draws inspiration from the relational analysis of modality and disjunction in Willer 2015, forthcoming, which again owes inspiration to seminal work in the dynamic and the inquisitive semantic tradition (in particular Aher 2012; Groenendijk and Roelofsen 2015; Veltman 1985, 1996). The target language $\mathcal{L}$ contains a set of sentential atoms $\mathcal{A} = \{p, q, ...\}$ and is closed under negation ($\neg$), conjunction ($\wedge$), disjunction ($\vee$), and the modal possibility and necessity operator ($\Diamond, \Box$), embellished with e, d, etc., as subscripts to distinguish between epistemic, deontic, and other modal flavors. The remaining connectives are defined as usual.

The proposal in Willer 2015, forthcoming treats semantic values as *update relations* and distinguishes between *positive* and *negative* updates. It makes sense of the initial observation that disjunctions scoping under possibility modals give rise to the free choice effect, and it also explains why the effect disappears if the disjunctive possibility occurs in the scope of a negation operator or in an ignorance/uncooperativeness context. But it remains silent on free choice effects that arise if the modal at play expresses a necessity or is outscoped by a disjunction. My goal here is to fill this lacuna.

The key idea idea of this paper is that—from an update-centric perspective anyway—free choice effects flow from a prohibition against updates that are inconsistent with some distinguished information carrier, and that such a prohibition may have a lexical source (e.g. the semantics for modals) but may also arise at the discourse level from general (and defeasible) assumptions of competence and cooperativeness. Together with a refined semantics for necessity modals—they test for compatibility in addition to testing for entailment—this idea provides the foundation for explaining the wide variety of free choice observations that were described earlier.

To get the revised test semantics for necessity modals off the ground, we have to explain how a state may support a disjunction of necessities such as (7) while rejecting both disjuncts if taken in isolation.[2] The key idea I wish to pursue here is that what makes the disjunction acceptable is a combination of two criteria: (i) each disjunct is supported given additional constraints on the modal domain and (ii) the constraints thus brought into play jointly exhaust logical space and hence amount to a trivial assumption. To make this idea precise, I let input contexts be pairs consisting of an inquisitive state—a set of consistent propositions, which I label here *alternatives*—and a proposition that may play the role of a restrictor on modal domains.

Definition: Input Contexts, States, Alternatives. w is a *possible world* iff $w\colon \mathcal{A} \mapsto \{0,1\}$. W is the set of such w's, $\mathcal{P}(W)$ is the powerset of W. The function $[\![\cdot]\!]$ assigns to nonmodal formulas of $\mathcal{L}$ a *proposition* in the familiar fashion. An *input context* s_x is a pair consisting of an *inquisitive state* $s \subseteq \mathcal{P}(W)\backslash\{\varnothing\}$ and a *restrictor* $x \subseteq W$. Each element of an inquisitive state is an *alternative*. The *information* carried by a state s is the set of possible worlds compatible with it so that $\mathtt{info}(s) = \{\bigcup\sigma\colon \sigma \in s\}$. S is the set of all states and I is the set of all input contexts. $\perp$ represents any input context s_x with $s = \varnothing$ (any absurd context) while $\not\perp$ represents any context s_x with $s \neq \varnothing$ (any non-absurd context).

Inquisitive states have informational content in the sense that they rule out certain ways the world could be. In addition, they encode this information as a set of alternatives (which do not have to be mutually exclusive). A context couples a state with a proposition that can play the

[2] Not everyone immediately agrees that (7) lends itself to a free choice interpretation, and indeed it is natural to interpret the speaker here as being uncertain about some particular dress code. Nonetheless it strikes me as uncontroversial that a free choice reading is available and that such a reading can be explicitly enforced, as in, e.g., "You must wear a tuxedo, or you must wear a black suit, it's up to you."

role of a restrictor on the modal domain—more on this momentarily—and the resulting pairs then play the role of update relata in our semantics.

Following a recent trend in the literature, I adopt a binary system that distinguishes between *positive* and *negative* update relations. Atomic sentences update as follows:

$$(\mathcal{A}) \quad \begin{array}{l} s_x[p]^+t_y \text{ iff } x = y \text{ \underline{and} } t = \{\sigma \in s : \sigma \cap [\![p]\!] = \sigma\} \\ s_x[p]^-t_y \text{ iff } x = y \text{ \underline{and} } t = \{\sigma \in s : \sigma \cap [\![p]\!] = \varnothing\} \end{array}$$

A positive update with a sentential atom p effectively eliminates from a state all alternatives that fail to entail p. A negative update with a sentential atom p eliminates from a state all alternatives that are compatible with p. This is just to say that a positive update with p removes all $\neg p$-worlds from the input context's informational content, while a negative update with p removes all p-worlds. Note that the restrictor is left alone in any case.

Not surprisingly, negative updates matter for the semantics of negation: we now say that an update with $\ulcorner\neg\phi\urcorner$ is a negative update with ϕ. The requirement that a negative update with $\ulcorner\neg\phi\urcorner$ is a positive update with ϕ delivers the law of double negation:

$$(\neg) \quad \begin{array}{l} s_x[\neg\phi]^+t_y \text{ iff } s_x[\phi]^-t_y \\ s_x[\neg\phi]^-t_y \text{ iff } s_x[\phi]^+t_y \end{array}$$

The current setup is, so far, only a complicated version of Update Semantics. The additional complexity, however, allows us to plug in an inquisitive analysis of disjunction as well as a sophisticated test analysis of modals. Here is the proposal for the former:

$$(\vee) \quad \begin{array}{l} s_x[\phi \vee \psi]^+t_y \text{ iff } s_x[\phi]^+t_y \text{ \underline{or} } s_x[\psi]^+t_y \\ s_x[\phi \vee \psi]^-t_y \text{ iff } \exists u_z : s_x[\phi]^-u_z \text{ \underline{and} } u_z[\psi]^-t_y \end{array}$$

A disjunction relates an input context to two potentially distinct output contexts: the result of updating with the first and the result of updating with the second disjunct.

Given some input context, a positive update with a conjunction $\ulcorner\phi \wedge \psi\urcorner$ proceeds via a positive update with ϕ and then via a positive update with ψ:

$$(\wedge) \quad \begin{array}{l} s_x[\phi \wedge \psi]^+t_y \text{ iff } \exists u_z : s_x[\phi]^+u_z \text{ \underline{and} } u_z[\psi]^+t_y \\ s_x[\phi \wedge \psi]^-t_y \text{ iff } s_x[\phi]^-t_y \text{ \underline{or} } s_x[\psi]^-t_y \end{array}$$

The rules for negative updates with disjunctions and conjunctions enforce the validity of De Morgan's Laws. This, I should add, is negotiable and it would be easy to change the negative entries if De Morgan's Laws turn out to be invalid (as argued by, for instance, Champollion et al. 2016, forthcoming). Let me instead move on to the update rules for modal expressions.

Modals are interpreted in light of a set of contextually provided modal selection functions, which map each state to a modal domain (another state) that can then be further restricted by the proposition provided by the input or output context:

Definition: Modal Selection Functions, Modal Domain Restrictions. A contextually provided *modal selection function* $f : S \mapsto S$ maps each state to a *modal domain* (another state). Given some state $s \in S$ and proposition p, we define the *restriction* of $f(s)$ with p as $f(s){\upharpoonright}_p = \{y \cap p : y \in f(s)\}\backslash\{\varnothing\}$.

Different modal flavors call for different modal selection functions and we will label them in the obvious way: e for epistemic, d for deontic, and so on. The restriction of a modal domain with a proposition p proceeds as expected: we eliminate from each alternative in the state those worlds at which the proposition p is false and collect the results, leaving out the empty set.

We are now ready to present the proposal for modal expressions. Let us focus on the positive update rules first:

$$(\Diamond_f^+/\Box_f^+) \quad \begin{array}{l} s_x[\Diamond_f \phi]^+ t_y \text{ iff } t = \{\sigma \in s \colon \langle f(s)_W, \underline{\perp}\rangle \notin [\phi]^+\} \text{ \underline{and} } x = y \\ s_x[\Box_f \phi]^+ t_y \text{ iff } t = \{\sigma \in s \colon \langle f(s)_W, \underline{\perp}\rangle \notin [\phi]^+\} \text{ \underline{and} } \langle (f(s)\upharpoonright_y)_W, \underline{\not\perp}\rangle \notin [\phi]^- \end{array}$$

Possibility modals are effectively tests à la Veltman 1996: for an input context to pass the test imposed by a positive update with $\ulcorner \Diamond_f \phi \urcorner$, the relevant modal domain must not be related to the absurd state via a positive update with the prejacent ϕ. Necessity modals test for consistency, too, but in addition require that the output context come with a restrictor enforcing the necessity of the prejacent in the modal domain: thus restricted, the modal domain is only related to the absurd state via a negative update with the prejacent.

It is straightforward to define the negative update rules for modals:

$$(\Diamond_f^-/\Box_f^-) \quad \begin{array}{l} s_x[\Diamond_f \phi]^- t_y \text{ iff } s_x[\Box_f \neg\phi]^+ t_y \\ s_x[\Box_f \phi]^- t_y \text{ iff } s_x[\Diamond_f \neg\phi]^+ t_y \end{array}$$

The negative entries effectively require that the possibility and the necessity modal be duals.

It remains to explain what it takes to update a state. As a preparation, define what it takes for a state and a restriction to be positively related to some state s via ϕ.

Definition: Positive Update Relata. Define a function $\Delta \colon S \times \mathcal{L} \mapsto S$ and a function $\Gamma \colon S \times \mathcal{L} \mapsto \mathcal{P}(W)$ as follows:

1. $\Delta(s, \phi) = \{t \colon \exists y.\, s_W[\phi]^+ t_y \text{ \underline{and} } y \neq \varnothing\}$
2. $\Gamma(s, \phi) = \{y \colon \exists t.\, s_W[\phi]^+ t_y \text{ \underline{and} } t \neq \varnothing\}$

An update of a state s with ϕ is the union of the states positively related to s via ϕ, provided that the union of restrictions positively related to s via ϕ amounts to a tautology—otherwise, the update returns the empty set. More precisely:

Definition: Updates on States, Support. An update function $\uparrow \colon S \mapsto S$ is defined as follows:

$$s \uparrow \phi \quad = \quad \begin{cases} \bigcup \Delta(s, \phi) & \text{if } \bigcup \Gamma(s, \phi) = W \\ \varnothing & \text{otherwise} \end{cases}$$

We say that s *supports* ϕ, $s \Vdash \phi$, iff $\texttt{info}(s \uparrow \phi) = \texttt{info}(s)$.

As we will see momentarily, this update procedure allows necessity modals to test for entailment, but in a roundabout way. A necessity modal effectively identifies which assumptions are required so that the modal domain entails the prejacent. The entailment test flows from the *general* requirement on updating that the restrictions thus brought into play amount to a trivial restriction of the modal domain.

Finally, we define entailment in the familiar dynamic fashion:

$$\phi_1, \ldots, \phi_n \textit{ entails } \psi,\ \phi_1, \ldots, \phi_n \vDash \psi, \text{ iff for all } s \in S,\ s \uparrow \phi_1 \ldots \uparrow \phi_n \Vdash \psi$$

A state supports ϕ just in case a positive update of s with ϕ does not add to the s's informational content. Entailment is guaranteed preservation of support. This setup will take care of all the narrow scope free choice data and—given suitable pragmatic supplementation—make sense of wide scope free choice as well.

3 Output

Narrow scope free choice effects arise both for possibility and for necessity modals:

Fact 1. $\Diamond_f(p \vee q) \models \Diamond_f p \wedge \Diamond_f q$ **Fact 2.** $\Box_f(p \vee q) \models \Diamond_f p \wedge \Diamond_f q$

The underlying observation here is that an update of s with "$\Diamond_f(p \vee q)$" or with "$\Box_f(p \vee q)$" results in the absurd state unless $\langle f(s)_W, \bot\rangle \notin [p \vee q]^+$. But suppose that $f(s)$ fails to contain a p-entailing and a q-entailing alternative: then $[p]^+$ or $[q]^+$ *does* relate $f(s)_W$ to $\bot$ and thus $\langle f(s)_W, \bot\rangle \in [p \vee q]^+$ after all. So whenever $s \uparrow \Diamond_f(p \vee q) \neq \varnothing$ or $s \uparrow \Box_f(p \vee q) \neq \varnothing$, then $s \uparrow \Diamond_f p = s$ and $s \uparrow \Diamond_f q = s$. Note that the free choice inference arises regardless of modal flavor. Note furthermore that $\Diamond_f(p \vee q) \not\models \Diamond_f(p \wedge q)$ since passing the test conditions under consideration does not require the presence of a $p \wedge q$-entailing alternative in $f(s)$.

We also account for the observation that embedding a disjunctive possibility or necessity under negation reverts disjunction to its classical behavior:

Fact 3. $\neg\Diamond_f(p \vee q) \models \neg\Diamond_f p \wedge \neg\Diamond_f q$ **Fact 4.** $\neg\Box_f(p \vee q) \models \neg\Box_f p \wedge \neg\Box_f q$

To see this, observe that our negative update rule for the possibility modal require that $s \uparrow \neg\Diamond_f(p \vee q) = s \uparrow \Box_f\neg(p \vee q)$. And if $f(s)$ were to include a p- or a q-entailing alternative, then $s \uparrow \Box_f\neg(p \vee q) = \varnothing$, which establishes Fact 3. Furthermore, our negative update rule for the necessity modal requires that $s \uparrow \neg\Box_f(p \vee q) = s \uparrow \Diamond_f\neg(p \vee q)$. The fact that $\Diamond_f\neg(p \vee q) \models \Diamond_f\neg p \wedge \Diamond_f\neg q$ establishes Fact 4 since $\ulcorner\Diamond_f\neg\phi\urcorner$ entails $\ulcorner\neg\Box_f\phi\urcorner$ by design.

It remains to comment on what the framework has to say about wide scope free choice effects. Start with the following observation: what drives narrow free choice effects is that modals require that their prejacents not relate the relevant modal domain to the absurd state. But of course such a prohibition need not only flow from the lexical semantics for modal expressions but also arises at the discourse level from general (and defeasible) assumptions of competence and cooperativeness. In fact, Stalnaker (1978) takes it a basic communicative principle that speakers should not assert what they presuppose to be false. We can capture this intuition in terms of the following QUALITY constraint, where s_c is the state capturing what is common ground in some context c:

Quality An assertion of ϕ in context c satisfies the quality constraint just in case $\varnothing \notin \Delta(s_c, \phi)$.

We may then define a pragmatically supplemented notion of entailment that evaluates arguments under the assumption that the QUALITY constraint is satisfied:

> $\phi_1, \ldots, \phi_n$ *pragmatically entails* ψ, $\phi_1, \ldots, \phi_n \gg \psi$, iff for all $s \in S$, if $\varnothing \notin \Delta(s, \phi_1)$ and … and $\varnothing \notin \Delta(s \uparrow \phi_1 \ldots \uparrow \phi_{n-1}, \phi_n)$, then $s \uparrow \phi_1 \ldots \uparrow \phi_n \Vdash \psi$

Every semantic entailment is also a pragmatic entailment, but the reverse need not hold.

Wide scope free choice effects are pragmatic entailments:

Fact 5. $\Diamond_f p \vee \Diamond_f q \gg \Diamond_f p \wedge \Diamond_f q$ **Fact 6.** $\Box_f p \vee \Box_f q \gg \Diamond_f p \wedge \Diamond_f q$

Assume that $f(s)$ fails to include a p- and a q-entailing alternative. Then either $[\Diamond_f p]^+$ or $[\Diamond_f q]^+$ relates s_W to $\bot$ and thus $\varnothing \in \Delta(s, \Diamond_f p \vee \Diamond_f q)$, violating QUALITY. And for parallel reasons, either $[\Box_f p]^+$ or $[\Box_f q]^+$ relates s_W to $\bot$—recall that necessity modals test for consistency as well—violating QUALITY again. Note here that the relational semantics is crucial for translating Stalnaker's principle into a constraint against updating with a disjunct one of whose disjuncts is taken to be incompatible with the common ground.

It follows that wide scope free choice effects arise as long as the QUALITY constraint is in place. Since the constraint is pragmatically generated given general assumptions about competence and cooperativeness, wide scope free choice effects disappear if the speaker signals ignorance or uncooperativeness, as we saw in (10). Assuming that "or" must take wide scope in all ignorance and uncooperativeness contexts (as argued in Fusco ms. on syntactic grounds), we thus take care of the cancelability data.

It is also useful to verify that the present story about free choice avoids unwelcome overgenerations. Let me point to two crucial results:

Fact 7. $\Box_f p \vee \Box_f q \not\gg \Box_f p \wedge \Box_f q$

Fact 8. $\Diamond_f p \wedge \Diamond_f q \not\gg \Diamond_f (p \wedge q)$

To see why Fact 7 holds, consider a state s such that $f(s)$ consists exclusively of $p \wedge \neg q$-entailing and of $\neg p \wedge q$-entailing alternatives. Then $s_W[\Box_f p]^+ s_{[\![p]\!]}$ and $s_W[\Box_f q]^+ s_{W \setminus [\![p]\!]}$, hence $\bigcup \Gamma(s, \Box_f p \vee \Box_f q) = W$ and so $s \uparrow (\Box_f p \vee \Box_f q) = \bigcup \Delta(s, \Box_f p \vee \Box_f q) = \bigcup \{s\} = s$. Note, furthermore, that $\varnothing \notin \Delta(s, \Box_f p \vee \Box_f q)$, so QUALITY is satisfied. Still, since $\bigcup \Gamma(s, \Box_f p) = [\![p \vee \neg q]\!] \neq W$, $s \uparrow \Box_f p = \varnothing$, hence $s \not\Vdash \Box_f p$, and for parallel reasons $s \not\Vdash \Box_f q$. Note here that $[\Box_f p]$ does not relate the input context to the absurd state—rather, the update identifies what modal restriction would be required to render the prejacent a necessity. Nonetheless a plain update with "$\Box_f p$" is eventually rejected since the union of the restrictions the update brings into play does not amount to the trivial proposition.

To see why Fact 8 holds, we can simply observe that whenever $f(s)$ includes a p-entailing and a q-entailing alternative but no $p \wedge q$-entailing alternative, s supports "$\Diamond_f p \wedge \Diamond_f q$" but not "$\Diamond_f (p \wedge q)$." The deeper fact here is that we do not appeal to LF-movement to explain wide scope free choice effects. Instead, the guiding idea is that the very same type of constraint on updating that drives narrow free choice effects also manifests itself as a pragmatic principle in discourse given defeasible assumptions about competence and cooperativeness.

Combining semantic and pragmatic ideas with a refined test semantics for modals and an inquisitive treatment of disjunction allows us to explain a wide variety of free choice effects. Let me briefly explore some additional applications of the apparatus developed so far.

4 Bonus

Given minimal assumptions, the framework predicts that an utterance of a plain disjunction implies that both disjuncts might be the case.

(11) Mary is in Paris or in Rome.
$\rightsquigarrow$ a. Mary might be in Paris.
$\rightsquigarrow$ b. Mary might be in Rome.

The inferences in (11) turn out to be pragmatically valid under the assumption that the epistemic selection function e is the identity function. This in fact delivers two important results:

Fact 9. $p \vee q \gg \Diamond_e p \wedge \Diamond_e q$

Fact 10. $\Box_e p \vDash p$

The QUALITY constraint requires the presence of a p-entailing and a q-entailing alternative in the input state s—if s is also the domain for epistemic modals, clearly p and q become epistemic possibilites. The second fact is just the familiar claim that epistemic *must* is strong (as argued in von Fintel and Gillies 2010).

The previous observation shows that the key idea behind our explanation of wide scope free choice effects also explains why disjunctions have a tendency to put forth both of their disjuncts as serious possibilities. This is a plus but it also raises an interesting question: since wide scope free choice effects are cancelable in ignorance contexts, so should be the inference in (11)—but what could be added by saying that one does not know which of the disjuncts is true?

In response, there is an intuitive distinction between a proposition being a serious epistemic possibility in discourse and it being merely compatible with the common ground. In fact, *might*-statements seem to be designed to transform plain possibilities into live possibilities in discourse (Willer 2013). We can make this more precise by thinking of an input state Σ as a set of inquisitive states: for p to be a live possibility in Σ, each element of Σ must include a p-entailing alternative; for p to be a plain possibility in Σ, it suffices that some element of Σ includes a p-entailing alternative. Sets of inquisitive states are updated as follows:

$$\Sigma + \phi = \{\tau \in S \colon \tau \neq \varnothing \text{ and } \exists \sigma \in \Sigma.\, \sigma \uparrow \phi = \tau\}$$

Such a state would then support ϕ just in case $\Sigma + \phi = \Sigma$. If the QUALITY constraint is enforced when updating locally, we get wide scope free choice effects and disjunctions put both of their disjuncts forward as live possibilities. Assuming that the speaker is ignorant (but still cooperative) we may implement a weaker requirement: perhaps most obviously, we may say that the QUALITY constraint is satisfied if we take union of Σ as input. Such a constraint will not predict wide scope free choice effects or that an utterance of a disjunction puts both disjuncts forward as a serious possibility. But it will still predict that the disjuncts must be plain possibilities. The upshot here is that the pragmatic entailments of a disjunction can in principle be cancelled: the question is whether the speaker intends to highlight both disjuncts as genuine possibilites or simply state that they cannot be ruled out.

The framework has no trouble predicting epistemic contradictions (Yalcin 2007):

(12) # It is raining and it might not be raining.

Assuming again that the modal selection function for epistemic *might* is the identity function, it follows that every state, once updated with p, will reject a claim that the negation of p might be the case. Reversing the order of conjuncts in (12) yields a sentence that is consistent but nonetheless incoherent in the sense that only the empty state supports it (Willer 2013).

A comprehensive discussion of the phenomenon of modal subordination must be left to another day but let me make one brief remark. It if often observed that the second disjunct in (13) is interpreted under the assumption that Mary is not in Chicago, that is, the negation of the first disjunct. Interestingly, the second disjunct in (14) is interpreted under the assumption that John will not practice the piano, that is, the falsity of the *prejacent* of the first disjunct (Klinedinst and Rothschild 2012):

(13) Mary is in Chicago, or she must be in New York.

(14) John should practice the piano, or his recital will be a disaster.

If *should* and *will* are necessity modals, we predict the modal subordination facts about (14) without further ado. Assuming that the domain for *should* is compatible but does not entail John's practicing the piano, the disjunction is supported just in case the modal domain for *will* entails (and is compatible with the fact) that John's recital is a disaster under the assumption that he does not practice: in that case, the union of the restrictions needed to enforce the propositions expressed by "John practices the piano" and "John's recital is a disaster" as necessities in the modal domains for *should* and *will*, respectively, is indeed identical to W.

How can we account for (13)? One option is to relativize updates to a contextual parameter that fixes modal quantifier domains and evolves dynamically as discourse proceeds (Willer 2015, forthcoming). But there now is an interesting alternative: if we assume that the first disjunct is an implicit epistemic necessity statement—that is, (13) is of the form $\ulcorner \Box_e \phi \vee \Box_e \psi \urcorner$—then the modal subordination facts about (13) follow once again from the semantics for disjunction and necessity modals presented here. While the underlying assumption is anything but trivial, it opens up a path for handling modal subordination that is worth exploring further.

5 Conclusion

The key claim of this paper is that free choice effects flow from a prohibition against updating with information that is taken to be incompatible with some relevant body of information. When it comes to narrow free choice effects, the prohibition is lexically generated and the relevant body of information is the modal domain. When it comes to wide free choice effects, the prohibition arises at the discourse level and the relevant body of information is the common ground. I have elaborated this idea in a relational binary update framework with a refined semantics for possibility and necessity modals. I am sure the core claims explored in this paper can be articulated in other technical settings as well, and that the list of prohibitions discussed is not exhaustive: attributions of disjunctive beliefs, for instance, also seem to require that the attributee's belief state is compatible with both disjuncts. The point remains that the story told here explains a wide range of free choice data. Its key ideas and technical innovations deserve to be taken seriously.

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