Free Choice effects and exclusive disjunction [*]

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1 Introduction

The *free choice effect* is the effect whereby a permission sentence like

(1) You may take an apple or a pear.

carries a felt entailment to permission to take each of an apple and a pear (Kamp, 1973). Schematically:

$$\text{(FC)} \qquad \text{May}(p \text{ or } q) \Rightarrow \text{May}(p) \text{ \& May}(q)$$

This entailment is *prima facie* surprising. I mark the felt entailment with an arrow ($\Rightarrow$) to stay as neutral as possible on what sorts of factors—semantic, pragmatic, or a combination of both—explain the relevant empirical phenomenon.

While a free choice sentence like (1) carries a felt entailment to the addressee's being able to choose between (permissibly) taking an apple and (permissibly) taking a pear, it emphatically does *not* communicate that the hearer may take *both* an apple and a pear, and perhaps even entails that the conjunction is *forbidden*. The general form of this latter intuition is sometimes called 'exclusivity':

$$\text{(Exclusivity)} \qquad \text{May}(p \text{ or } q) \Rightarrow \neg\, \text{May}(p \,\&\, q)$$

I will call the weaker form of the same intuition, a mere *non*-entailment, 'joint neutrality':

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(Joint Neutrality) May(p or q) $\not\Rightarrow$ May(p & q)

Joint Neutrality is very strongly associated with free choice sentences: see, for example, Barker (2010, pg. 1) and Simons (2005), who calls it 'a consensus in the literature' (pg. 272, footnote 2). Indeed, theorists like Fox (2007) have proposed theories on which the mechanism which rules out May(p & q) plays an essential role—via Neo-Gricean mechanisms—in explaining (FC) itself.

My purpose here is to use experimental data to gain a greater understanding of the free choice effect where there are more than two disjuncts under the relevant modal operator. Call this the 'n-disjunct' (or 'n-ary') case. There are open questions about how (Exclusivity), (Joint Neutrality), and (FC) generalise in such cases, which have not been subject to previous empirical study.

2 n Disjuncts: separability and redundancy

A simple generalization of (FC) to the n-ary case would be that a free choice sentence of the form

(2) May(p_1 or p_2 or... or p_n)

... is interpreted entailing the wide-scope conjunction of permission statements corresponding to each disjunct. Call this pattern '(n-Each)':

(n-Each) May(p_1 or p_2 or... or p_n) $\Rightarrow$ May(p_i)
... for any $p_i \in \{p_n\}$.

Likewise, at an intuitive level, the most straightforward generalization of (Joint Neutrality) to the n-ary case would be that a many-disjunct free choice sentence is interpreted as *failing* to entail the permissibility of *any* conjunction of its embedded disjuncts. Call this pattern '(n-Neutrality)':

(n-Neutrality) May(p_1 or p_2 or... or p_n) $\not\Rightarrow$ May(p_i & p_j)
... for any $p_i, p_{j\neq i} \in \{p_n\}$.

Does (n-Each) hold when (n-Neutrality) fails? The question arises in cases in which May(p_1 or p_2 or... or p_n) is accepted in context, but, for a given disjunct p_i, it is *impossible*—again, in context—for p_i to be true while every sentence of the form (p_i & p_j) is false. In such a context, is

(3) May(p_i)

still a felt entailment of (2)?[1]

It is helpful to cash the question out in terms of a condition on the embedded disjuncts $\{p_n\}$ of (2) themselves. To fix terminology, say that the $\{p_n\}$ are **modally separable** in a contextually relevant modal space W_C just in case each p_i can be true in W_C while all the other p_j's are false; that is, if for all $p_i \in \{p_n\}$, p_i &$(\&_{j \neq i} \neg p_j)$ is nonempty in W_C. I will say the $\{p_n\}$ **overlap** just in case they fail to be modally separable: that is, just in case at least one p_i cannot be true at any world in W_C while all the others are false. We relativise to W_C because what matters in context is not the *logical* possibility of separability, but separability as a matter of what the agent can in fact bring about in her situation.

Suppose, for example, that I am aiming a ball down the lane of a bowling alley. As a matter of my agential powers—because I am not perfectly skilled with the ball—I cannot knock down the head pin (pin 1) without knocking over the front six pins. Propositions of the form *pin* j for $j < 6$ thus fail to be modally separable at my context. Our question is what a free choice sentence like (4):

(4) You may knock down (pin 1 or pin 2 or …or pin n)

entails in such a case. If (n-Each) still holds in this case, (4) gives me permission to knock down pin 1. If (n-Each) does not hold, then (4) is quite weak in the bowling case, and may not guarantee permission to knock down anything at all.

The question is important because of the *proportion* of cases a presumption of modal separability affects—for example, in a formal system in which we might want (FC), or something like it, to be valid.[2] As the number of disjuncts n in a free choice sentence increases, the number of possibilities for modal overlap increases *faster* than the number of possibilities in which overlap does not hold. The growing concern about overlap cases can be framed via the question: what proportion of nonempty subsets of an n-element set (viz., cases in which the n-ary disjunction is true) have at least 2 elements (viz., are cases where more than one disjunct is true)? The answer is $1 - [n/(2^n - 1)]$, which rapidly approaches 1 as n increases.[3]

There is a second, more categorical reason for moving beyond the case of $n = 2$ when seeking to understand free choice. When a free choice sentence has only two disjuncts—the case that is usually studied—modal separability cannot fail unless a further condition

[1] Where, again, 'felt entailment' is understood as neutrally as possible.

[2] By the *general* validity of (FC), I mean the hypothesis that $\ulcorner$May(ϕ or ψ)$\urcorner$ (felt-)entails $\ulcorner$May(ϕ) & May(ψ)$\urcorner$ more generally. If so, then $\ulcorner$May(p or (q or r))$\urcorner$ $\Rightarrow$ $\ulcorner$May(p) & May(q) & May(r).$\urcorner$

[3] In other words, the proportion being calculated is $\frac{\{s: \exists p_i p_j \in \{p_n\} \text{ s.t. } s \models (p_i \,\&\, p_j)\}}{\{s: s \models p_1 \text{ or} \ldots \text{or } p_n\}}$ as n increases, where a state s is a line on a truth-table for $p_1 \ldots p_n$.

holds, which is that one of the embedded disjuncts is *redundant*:

(Redundancy) p_i is redundant in $(p_1 \text{ or } p_2 \text{ or } \ldots \text{or } p_n)$ iff there is some $p_j \in \{p_n\}$ such that $p_i \vDash p_j$.

Figure 1 illustrates redundancy in the two-disjunct case. In order for modal separability to fail with two disjuncts, things much be such that e.g. A can only be true if $(A \,\&\, B)$ is true as well. If so, then, A entails B, and B is redundant.

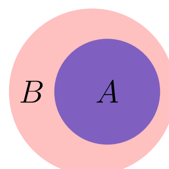

Figure 1: An overlap configuration in W_C with $n = 2$.

However, as Simons (2005)—following on Hurford (1974)—notes, disjunctions with redundant disjuncts strike speakers as anomalous, and do so independently of whether those disjunctions appear under in modal constructions.[4]

When $n > 2$, on the other hand, it is possible for modal separability to fail *without* the condition in (Redundancy) obtaining. This happens, for example, when three disjuncts overlap in modal space without strict containment obtaining between any pair. In Figures 2 and 3, region C is contained completely inside the space occupied by the union of regions A and B, without being entirely contained inside either. With this arrangement of W_C, the embedded disjuncts of a schematic free choice sentence

(7) May(A or B or C)

[4]Simons considers two sentences:

(5) ?? Jane owns a truck or a red truck.

(6) ?? Jane may wear a dress or a red dress.
(pg. 303; degraded acceptability judgements in original)

(6) is a free choice sentence in which one embedded disjunct ('Jane wears a red dress') entails the other ('Jane wears a dress.') As a result, if (FC) holds for (6), then (Exclusivity) fails. However, Simons notes that bare redundant disjunctions like (5) also strike speakers as strange. She concludes that the data is unclear regarding the status of free choice entailments for sentences like (6), since it is difficult to set aside the 'badness' of the premise.

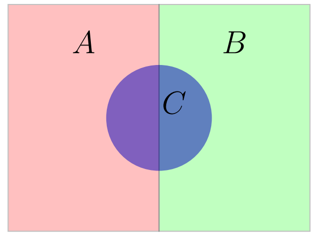

Figure 2: An overlap configuration in W_C with $n > 2$ (where A, B are mutually exclusive)

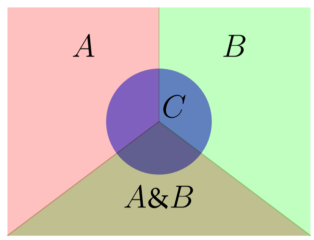

Figure 3: Another overlap configuration in W_C with $n > 2$ (where A, B are not mutually exclusive).

fail to be modally separable, and the witness to this failure is the proposition C. However, C is not redundant in the sense of (Redundancy). If competent speakers tend to judge that in such cases, (7) (still) entails

(8) May(C)

this would lend support to the claim that (n-Each)—the general form of Free Choice—holds even when the general form of (Neutrality) fails. If, on the other hand, speakers do *not* infer (8), the data would suggest that the form of the felt entailment is not so straightforward as (n-Each). The experiments reported here feature a free choice premise like (7) in a Figure 2-type case and Figure 3-type case, respectively.

To sum up, there are two hypotheses:

H_0: modal separability is statistically irrelevant to (n-Each)

$\neg H_0$: modal separability is not statistically irrelevant to (n-Each).

3 Experiment 1

3.1 Methods

120 participants were recruited through Amazon Mechanical Turk (AMT). Pre-registration for Experiment 1, as well as Experiment 2, are available at http://aspredicted.org/blind.php?x=cx9aa3. All participants were given the vignette below, which features a three-disjunct free choice sentence (underlined).

> *Klingsor's Keep*. While playing the video game *Klingsor's Castle*, you realise your character is locked in Klingsor's castle keep.
>
> After several hours, a helpful imp comes to you. The imp points the way to the glassblowers' studio. 'The key to the exit', he says, 'is sealed within a bottle. A sharp-eyed owl guards the bottles, which are all valuable.'
>
> 'However,' he adds, 'the owl can be bribed.'
>
> He then hands you a magic coin. 'Give the owl this coin,' he says, 'and you may break bottle A or B or C.'
>
> As the imp returns to his hole in the wall, he adds: 'if you are still here tomorrow night, I will bring you something else to help you escape.'

Participants were then randomly assigned to an overlap and a non-overlap condition, and shown both a picture and some additional description. In the overlap case, the additional description highlighted non-separability:

As you make your way into the glassblower's studio, you see bottle C next to bottles A and B:

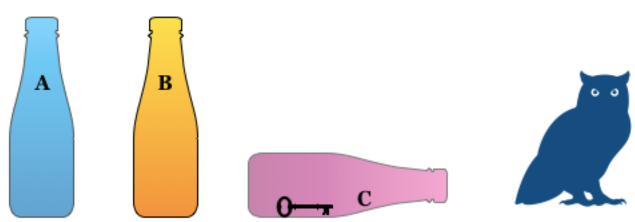

Figure 4: The SEPARATION condition.

As you make your way into the glassblower's studio, you see that bottle C is contained half inside bottle A and half inside bottle B. So in this case, in order to break C, you must also break A or also break B.

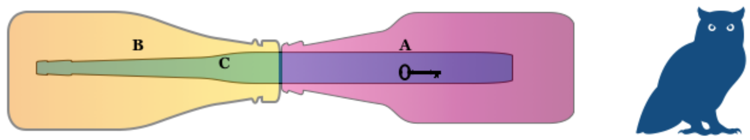

Figure 5: The OVERLAP condition.

Finally, each participant was asked a single multiple-choice question about the permissibility of C. The question was prefaced with 'In this particular case' to direct participants away from reading the modal as a *generic* ascription of permission (Krifka et al., 1995):

> Is the following true?:
> <u>In this particular case</u>, you may break bottle C.
>
> – Yes.
>
> – No.

In the overlap condition, the propositions *break bottle A*, *break bottle B*, and *break bottle C* are arranged in logical space just as the propositions A, B and C are arranged in Figure 2: though *break* C is not entailed by either of *break* A or *break* B alone, and so is not redundant, the set $\{$*break* A, *break* B, *break* $C\}$ is not modally separable. The action the player wants to perform is C, and this cannot be done without doing (at most) one of the others as well. The question is posed in the context of a video game because the presumption of full cooperativity and informativeness is somewhat suspended in such contexts, where players routinely anticipate riddles and surprise obstacles.[5]

3.2 Results and Discussion

We excluded from the analysis all subjects who either failed one of two test questions involving a nondisjunctive modal sentence, took less than 60 seconds to complete the survey, or reported that they were not native speakers of English. The study was restricted to US IP addresses. In all, 113 participants completed the study and 12 were excluded.

[5]See, for example, https://www.pcgamer.com/great-puzzles-in-pc-gaming. For a similar methodological move, see the game show scenario of Fox (2014).

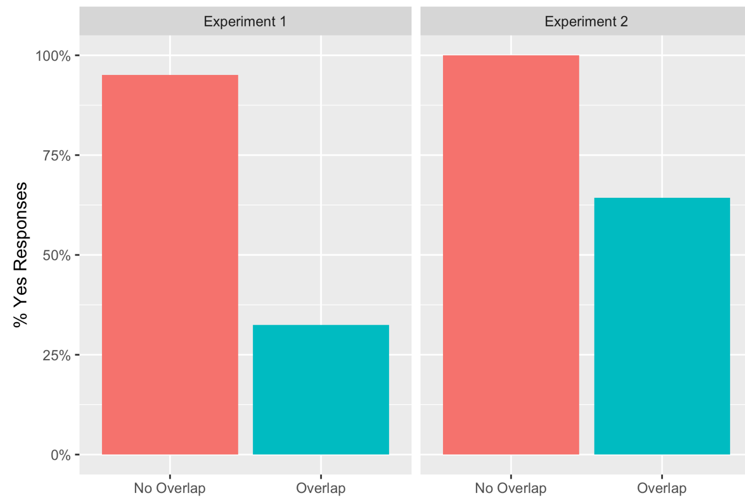

Figure 6: Percentage of participants agreeing the modal is true in Experiments 1 and 2, by condition.

Results for Experiment 1 are displayed in Figure 6.[6] The proportion of participants in the overlap condition who said that the modal was true (32.5%) was significantly lower than the proportion in the no overlap condition (95.1%), $\chi^2(1, N = 113) = 45.314, p < .001$. The results support the hypothesis that fewer speakers draw (FC)-type inferences when modal separability fails.

4 Experiment 2

The results of Experiment 1 are striking. To ensure they are replicable, however, we ran a second experiment, which tested the overlap configuration in a Figure 3-type scenario (where the other two disjuncts fail to be mutually exclusive), rather than a Figure 2-type scenario.

4.1 Methods

120 participants, all distinct from the participants of Experiment 1, were recruited through Amazon Mechanical Turk (AMT). All participants were given the vignette below, which features a three-disjunct free choice sentence (underlined):

> *Klingsor's Castle.* While playing the video game *Klingsor's Castle*, you discover a treasure chest. However, the chest is locked, and you

[6]All data and R code for Experiments 1 and 2 are available at https://osf.io/9ekr2.

don't have the key.

Eventually, a helpful imp comes to you. The imp points the way to the walled elf gardens. 'The key to the chest', he says, 'is in the center of the walled gardens, blocked by flowerpots. The elves will give you permission to overturn the pots, on the condition that you bring them coins from outside the gardens as gifts.'

'Along the path, you should search for coins,' he explains. 'A blue coin will give you permission to overturn a cactus. A pink coin will give you permission to overturn a cactus or a fern. The gold coins are the most valuable of all. With a gold coin, <u>you may overturn a cactus, a fern, or a hibiscus flower</u>.'

As you make your way into the garden, you find a single gold coin.

Participants were then randomly assigned to an overlap and a non-overlap condition, and shown both a picture and some additional description. Again, the additional description highlighted non-separability in the overlap condition:

When you walk into the garden, you see
the hibiscus next to the fern and the cactus:

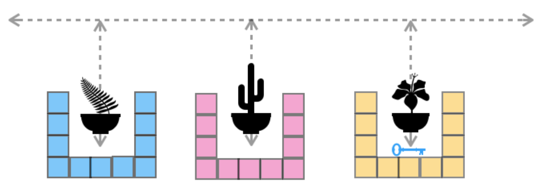

Figure 7: The SEPARATION condition.

When you walk into the garden, you see that the hibiscus flower lies on a path between the cactus and the fern. So in this case, in order to overturn the hibiscus flower, you must also overturn the Fern or also overturn the Cactus.

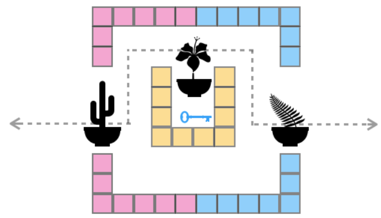

Figure 8: The OVERLAP condition

Finally, each participant was asked the same multiple-choice question:

> Is the following true?:
> In this particular case, you may overturn the hibiscus flower.
>
> – Yes.
>
> – No.

In the overlap condition, the propositions *overturn a cactus*, *overturn a fern*, and *overturn a hibiscus flower* are arranged in logical space just as the propositions A, B and C are arranged in Figure 3: though *hibiscus* (C) is not entailed by either of *cactus* (A) or *fern* (B) alone, and so is not redundant, the set {*cactus, fern, hibiscus*} (= $\{A, B, C\}$) is not modally separable. The action the player wants to perform is *hibiscus*, and this cannot be done without doing (at least) one of the others as well.

4.2 Results and Discussion

Again, we excluded from the analyses all subjects who either failed one of two test questions, took less than 60 seconds to complete the survey, or reported that they were not native speakers of English, and the study was restricted to US IP addresses. In all, 116 participants completed the study and 14 were excluded.

Results for Experiment 2 are displayed in Figure 6. All participants in the non-overlap condition (100%) rated the sentence true. The proportion of participants in the overlap condition who said that the modal was true (64.3%) was significantly lower than the proportion in the no overlap condition, $\chi^2(1, N = 102) = 25.123, p < .001$. The results again support the hypothesis that fewer speakers draw (FC)-type inferences when modal separability fails.

5 General Discussion

Both experiments strongly support the hypothesis that modal separability makes a difference to free choice: markedly fewer speakers draw free choice inferences when modal separability fails. The preliminary results here thus spell trouble for the unrestricted form of (n-Each), and suggest that more research into the n-ary case is needed.

There was a difference worth noting between the two studies: a majority of participants in the Flowerpots experiment (Experiment 2) rated the modal true in *both* the overlap *and* the non-overlap conditions. This contrasts with the overlap condition of Experiment 1, where most participants rated the modal false in the overlap condition. A simple explanation for this is the smaller implied cost, in Experiment 2, involved in doing more than is permitted: it is easier to set overturned flowerpots upright again than it is to repair broken bottles.

There are many approaches to free choice in the literature, and it is beyond the scope of this paper to satisfactorily evaluate whether each handles the empirical data presented here. The question will depend, not merely on delicate questions about how Gricean and neo-Gricean mechanisms often invoked to understand (FC) are affected by the move to n-ary cases (see, for example, Chierchia et al. (2011) on the n-ary exclusivity of 'or'), but also on how certain auxiliary assumptions about context, which are relatively underspecified by the binary case, extend to n disjuncts. To take one example mentioned above, Hurford (1974) argued that redundant disjunctions were infelicitous in the binary case.[7] Subsequent literature on Hurford's Constraint has broadened the claim in ways that are more obviously targeted at multiple subsentential constituents, for example Ciardelli & Roelofsen (2017)'s 'generalised local redundancy principle':

> (10) *Generalised local redundancy principle*
> A sentence is deviant in a context c [a set of possible worlds] if its logical form contains a node $O(A, B)$ obtained by application of a binary operator O to two arguments A and B such that, if S is the smallest sentential constituent containing $O(A, B)$, then $S[O, (A, B)]$ is equivalent, relative to c, to either $S[A]$ or $S[B]$. (Ciardelli & Roelofsen, 2017, pg. 204)

As written, it appears that Ciardelli & Roelofsen's version of the constraint does not apply to the embedded disjunction in e.g. (7); in particular, it seems to generate the conclusion

[7] See also Menéndez-Benito (2010), who argues that on Free Choice Items (FCIs) like the Spanish *cualquiera* must be interpreted as exclusive.

that for propositions A, B, and C arranged as in Figure 2, the *ordering* of the disjuncts matters.[8] A different, but related question about how to extend treatments of FC to the n-ary case applies to an approach via the *homogeneity presupposition* (Goldstein, 2019)—in the context of FC, the claim that $\Diamond(A \text{ or } B)$ presupposes $\Diamond A \leftrightarrow \Diamond B$—investigated by Tieu et al. (2019). In the three-disjunct case, whether there is a violation of the relevant redundancy principle or presupposition may turn on whether the disjunction is parsed as $((A \text{ or } B) \text{ or } C)$ or as $(A \text{ or } (B \text{ or } C))$.

Moreover, as recent work on agential Free Choice has emphasized, the classicality of 'or' must be treated with caution here. Nouwen (2018), picking up on a suggestion by Anthony Kenny (1976), has recently spotlighted the following apparent *failure* of entailment for free choice sentences with agential 'can':

(Kenny) Can$(p \text{ or } q) \not\Rightarrow$ Can(p) or Can(q)
(Kenny, 1976, pg. 215; Nouwen, 2018, §2)

Kenny's thought, in his 1976 paper, is that an agent with limited skills may be able to ensure some coarse-grained outcome (say, hitting the top *or* bottom half of a dartboard with a dart) without being able to ensure any finer-grained sub-outcome (hitting the top half; hitting the bottom half). In such a case, Kenny suggests, *Can (hit upper half or hit lower half)* may be true while both *Can(hit upper half)* and *Can(hit lower half)* are false. The thought is clearly relevant to the question of how an agent's powers in context relate to the question of modal separability (as in the bowling pins of §2.)

If, however, local implicature mechanisms that ensure an exclusive interpretation of disjunction are applied to p and q in (Kenny), a contradiction threatens. After all, on this view, the embedded $(p \text{ or } q)$ in (Kenny) is interpreted as $((p \,\&\, \neg q) \text{ or } (\neg p \,\&\, q))$. Hence the claim that one can hit the top half or the bottom half *does* mean that one can hit (the top half and not the bottom half) or (the bottom half and not the top half). As Nouwen points out, accommodating the datum in (Kenny) also makes trouble for other precedent-setting work on Free Choice, such as the account of Kratzer & Shimoyama (2002).

I will close by making a different observation in the direction of further work which is rooted in the pattern of responses in the present study. It picks up on a suggestion—due, to my knowledge, to van Rooij (2006)—that free choice and donkey anaphora pat-

[8] The relevance of ordering to Hurford's Constraint for examples involving conjunction is emphasized by Singh (2008). Further strengthenings of Hurford's Constraint, such Singh's, would classify the 3-disjunct disjunction in the experimental conditions (whose overlap conditions are illustrated in Figure 2) as infelicitous.

tern alike empirically. Donkey anaphora, as in (9a), are typically taken as cases where a narrow-scope indefinite ('a donkey') gives rise to a wide-scope universal interpretation at LF (as in (9b)):

(9) a. Every man who owns a donkey beats **it**.
b. $\forall xy((donkey(x)\,\&\,man(y)\,\&\,own(y,x)) \to beat(y,x))$

However, it has been noted since Pelletier & Schubert (1989) that these sentences sometimes give rise to weaker readings; the standard example is

(10) Everyone who had a dime put **it** in the meter.

Rather than having the force of (11), (10) seems to have the force of (12):

(11) $\forall xy((Dime(x)\,\&\,has(y,x)) \to put.meter(y,x))$

(12) $\forall xy((Dime(x)\,\&\,has(y,x)) \to \exists y[(Dime(y)\,\&\,has(y,x)\;\&\;put.meter(y,x)])$

A similar pattern can be seen in the experimental data presented in §4. Let $\textsc{ok}$ be the proposition that the agent is 'all clear'—viz., has violated no prohibitions—and let $\textsc{may}(p)$ be interpreted as the (perhaps nonmonotonic) conditional $\ulcorner p \to \textsc{ok}\urcorner$, to the effect that doing p (so long as this is done 'non-reprehensibly' (Kamp, 1978)) will leave the agent in the clear.[9] In this case, we can paraphrase the free choice effect hypothesised by the simple (n-Each) hypothesis as an entailment from (2) to

(13) $\forall q(q \in \{p_n\} \to (q \to \textsc{ok}))$

(14), below, sets out a weaker version of this entailment, which only gives rise to the 'all clear' signal when the agent is in a world where the disjunction $\ulcorner p_1$ or ... or $p_n\urcorner$ has a unique witness:

(14) $\forall q(q \in \{p_n\} \to \exists q[q \in \{p_n\}\,\&\,(q \to \textsc{ok})])$

Intuitively: for any y that has only one dime, x, we can conclude from (10) that y put x in the meter. If y had *more* than one dime, however, it doesn't follow that y put every dime in the meter; it only follows that *some* dime x is such that y put x in the meter. For free choice, the corresponding pattern in (14) might go like this: for any y who is the subject of a free choice permission sentence $\textsc{may}(p_1$ or ... or $p_n)$, if y performs only one

[9] For a more detailed formal treatment of this view, see e.g. Anderson (1958); Kanger (1971), and Asher & Bonevac, 2005.

disjunct p_i, it follows that it was 'okay' for y to do p_i. If y makes *more* than one disjunct true, however, it does not follow from (14) that *everything* y did is okay; it only follows that some p_i she did counts as okay.[10] It follows that if she cannot do some p_j without doing some other p_i as well, there may be no 'all clear' way of doing p_j at all. I leave these issues to further study.

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[10] In the agentive case, the pattern might be something like this: for any y who is the subject of a free choice ability ascription CAN(p_1 or ... or p_n), if y attempts only one disjunct p_i, we can conclude that y will succeed in doing p_i. (Here I follow a simple version of what Mandelkern et al. (2017) call 'the conditional analysis' of ability ascriptions. See *op. cit.*, §4.) In cases where one disjunct cannot be done without doing another simultaneously, however—for example, one cannot pick a lock l_i without picking another lock l_j first, because l_i is behind other locks (as in the overlap configurations in Figures 2 and 3), the ability ascription won't guarantee anything about the ability to pick l_i.

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