Dispositions and modals
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1. Dispositions and philosophers: A short history

The philosophical literature on dispositions begins with the work of Rudolf Carnap, and specifically his 1937 paper 'Testability and Meaning.' Carnap's immediate goal in the paper is to defend an empiricist criterion of meaning that trades in absolute *verification* for *confirmation to some degree* (which Carnap went on in later work to explicate in great detail via probabilistic confirmation functions). The basic story is that the confirmable and thus meaningul sentences of our language will be either *observation sentences* or *reducible* to observation sentences.

The phenomenon of 'disposition concepts' – that is,

> *...[P]redicates which enunciate the disposition of a point or body for reacting in such and such a way to such and such conditions, e.g. 'visible', 'smellable', 'fragile', 'tearable', 'soluble', 'indissoluble' etc.[1]*

presents a compelling problem for the reduction of all meaningful language to observation statements: though dispositions appear meaningful, play substantial roles in scientific theories, and present straightforward examples of empirical confirmation (the solubility of the sugar is well-confirmed by its dissolving upon being placed in water) , dispositions are *not* observable according to Carnap. When we hit a fragile vase with a hammer, we do not observe that it is fragile – only that is broken.

In order to save the meaningfulness of disposition concepts from their unobservability, Carnap tries to come up with reduction sentences connecting disposition ascriptions to observation statements. For Carnap and virtually everyone writing on dispositions since, dispositional terms like 'fragile' and 'soluble' are taken to be associated with a *test condition* and a *response condition* or *manifestation condition*: e.g. 'fragile' has something like *being stressed* as its test condition and *breaking* as its response condition. Carnap's first try analysis take the form of an explicit definition, for object x, disposition D, associated test condition T, and associated response condition R:

(T&M1) $D(x) \leftrightarrow (T(x) \rightarrow R(x))$

where '$\rightarrow$' and '$\leftrightarrow$' are the material conditional and biconditional.

Carnap observes the obvious inadequacy: $\neg T(x)$ entails $D(x)$. Because it hasn't ever been placed in a solvent [$\neg T(x)$] the computer I am typing this paper on is soluble [$D(x)$]. That's not right.

Carnap is forced to settle for an *implicit definition*

(T&M2) $T(x) \rightarrow (D(x) \rightarrow R(x))$

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[1] Carnap 1937, p. 440.

which has the less-bad-but-still-bad consequence that D(x) is *undefined* (rather than trivially true) when ¬T(x).

The subsequent philosophical literature on dispositions has followed a Carnapian trajectory of providing analyses of disposition ascriptions which draw on a broad range of considerations from the semantics of 'is disposed' and dispositional predicates like 'fragile' and 'soluble', the epistemology (or confirmation) of disposition ascriptions, and metaphysics of science (Which properties if any are fundamentally dispositional? How do dispositional or non-dispositional properties play with laws of nature, causation, counterfactuals, universals, particulars to explain what's going on fundamentally with what is and what could be?)

However, what Carnap has obviously not captured in these analyses is the *modal* significance of disposition ascriptions: the information they communicate about non-actual possibilities. Knowledge that a certain object is fragile doesn't tell me anything about whether it has been stressed or broken; what it does tell me is something like, *if the object were stressed, it would break*. The philosophical project of providing an analysis of disposition ascriptions has in the years since Carnap largely centered on what I'll call *the modal question* or *modal problem* of disposition ascriptions: what sort of modal claims do disposition ascriptions express? (By putting the question in this way, I don't intend to rule out the answer 'there is no shared modal character common to disposition ascriptions'. But I take it as given that disposition ascriptions do have some modal significance, and that part of giving an adequate semantics for 'is disposed' and dispositional predicates is elucidating this modal significance). Just now when I tried to restate the meaning of 'fragile' as 'if stressed, would break', I offered a partial answer to the modal question (albeit an incorrect one): disposition ascriptions express the sort of modality that counterfactuals do.

Not long after 'Testability and Meaning' there was widespread convergence on this partial answer to the modal question[2]: 'x is disposed to ψ when φ' means the same thing as 'if it were the case that φ(x), it would be the case that ψ' – which is to say that the modal character of disposition ascriptions is identical to the modal character of counterfactual conditionals. Here is a relevant passage from W.V.O. Quine in 'Word and Object':

> *The subjunctive conditional is seen at its most respectable in the disposition terms. To say that an object a is (water-) soluble at time t is to say that if a were in water at t, a would dissolve at t. To say that a is fragile at t is to say that if a were struck smartly at t, a would break at t. The ordinary* [material] *conditional would not suffice here, for it loses its point when the truth value of its antecedent is known. We want to speak of a as soluble or fragile at t though knowing that it is not immersed or struck at t. Clearly the subjunctive conditional is the one involved.[3]*

This schema is the Simple Conditional Analysis:

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[2] Or at least views in the vicinity: see Quine 1960 pp. 222-223, Goodman 1954 pp. 39 - 49, and Ryle 1949 pp. 127-128.

[3] Quine 1960, pp. 222-223.

(SCA)   'x is disposed to R when T' is true just in case if x were in T, x would R.

For most of the latter half of the twentieth century, the (SCA) enjoyed widespread tacit acceptance.
     We have a clearer picture today of the modal relations expressed by counterfactual conditionals (and modal auxiliaries, and modal adverbs, and so on) than we did when Quine wrote that. (The passages cited in fn. 2 give a pretty good picture of the time.) Though there are significant points of difference between existing accounts of counterfactuals (e.g. the Limit Assumption, Conditional Excluded Middle, making the antecedent a safe environment for NPIs), the basic possible worlds story is relatively uncontroversial: 'if φ were the case, ψ would be the case' roughly expresses the modal relation that all of the possible worlds in which φ that are most similar to ours all-things-considered are worlds in which ψ. Putting aside the serious problem of cases like Alan Anderson 'arsenic' sentence,[4] counterfactuals are generally uttered in a context in which it is taken for granted that φ is not the case. The idea is roughly that if you were to minimally tinker with the world to make φ the case, ψ would be the case.
     The fact that counterfactuals quantify over the most all-things-considered similar worlds where the antecedent is satisfied is *not* a feature that generalizes to most or all modal claims. I will repeat this point throughout the paper; I think a lack of appreciation for the diversity of modals is part of what led philosophers to inadequate counterfactual analyses. For example, if Andrew breaks the rules and his teacher says,

     (1) Andrew, you must go to the principal's office.

she is not saying that the most similar worlds are ones where Andrew goes to the principal's office. Rather she says roughly that (ignoring some nuances) all of the worlds in which Andrew complies with the rules are worlds in which he goes to the principal's office. The point is simply that in natural language we have express a plurality of modal relations; the claim that disposition ascriptions express the same sort of modal relations as counterfactuals is a very substantive claim about the particular modal character of disposition ascriptions.
     In this paper, I will defend an alternative account of disposition ascriptions influenced by considerations from possible worlds semantics for modals according to which disposition ascriptions express modals relations characterized by a particular restriction on accessible worlds. My focus will be on the modal problem for disposition ascriptions, and the approach I adopt reflects this starting point. Most analyses – like the (SCA) – have explained disposition ascriptions by suggesting schematic truth-conditional equivalences with other modal claims in English. This only indirectly addresses the modal problem – for instance by first drawing a truth-conditional equivalence between disposition acriptions and counterfactuals. and then explaining the modal relation expressed by counterfactuals. I will try to give a 'direct' answer to the modal question – that is, to analyse disposition ascriptions in a general possible worlds framework in which we can compare the analysis to actual and potential related analyses for other modals – in particular, counterfactuals. My hope and belief is that a 'direct' approach will significantly clarify the relation between disposition ascriptions and counterfactuals.

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[4] See Anderson 1951 p. 37.

Here's a rough outline of how the paper will proceed. First, I will consider the standard counterexamples to the (SCA) and say a few words on the problem the counterexamples illustrate for a counterfactual answer to the modal question. Then I will discuss one of the most well-developed accounts of disposition ascriptions – Michael Fara's habitual analysis – and present some counterexamples to that analysis. I will discuss a particular semantically-oriented motivation that Fara raises that has a significant influence on the account I propose here – basically that an account of explicit disposition ascriptions ('is disposed' sentences) should partition the semantic work done by 'is disposed' and the semantic work done by the infinitive in its scope.

I will then turn to another recent analysis – David Manley and Ryan Wasserman's proportional quantificational analysis – which, in line with the approach I'm pushing, directly characterizes the modal flavor of dispositions in terms of quantification over possibilities. I will defend their analysis, which I take to be extensionally adequate (for most disposition ascriptions at least); I will illustrate why it avoids the classic counterexamples to the (SCA); defend it against an object in a recent paper by Daniel Bonevac, Joshua Dever, and David Sosa; characterize what sort of case would constitute a counterexample to their account; and give some reasons why it's hard to come up with such cases. However, I'll suggest that they leave some explanatory currency on the table by using a metalanguage with a cooked up disposition-specific modal term, the notion of a 'T-case'. ('C-case' is their term; 'C' for stimulus condition, but I'll use 'T-case' for test condition to keep my terminology uniform). In doing so they deprive themselves of resources to satisfy Fara's constraint (semantic division of labor between 'is disposed' and infinitival complement) and to compare the analysis of disposition ascriptions to other modal claims. However, with a general possible worlds framework for modals we can give a Manley and Wasserman-style analysis which wears on its sleeve both (a) the division of semantic labor between 'is disposed' and the infinitival complement and (b) the entailment relations between disposition ascriptions and other modal expressions – most importantly counterfactuals.

The framework I'll use is a simple version of Angelika Kratzer's relational analysis of modals which puts most of the theoretical weight on three factors at work in modal quantification: modal (quantificational) force, modal base, and ordering source. I will discuss how Kratzer uses these notions to characterize the semantics of a variety of natural language modal terms – in particular I'll be looking at her work in 'The Notional Category of Modality.' One interesting thing I found is that Kratzer actually gives a characterization of a recognizably dispositional German modal adjective in 'Notional Category' – *zerbrechlich* ('fragile') – which is quite similar to M & W's analysis. I'll try to synthesize the observations of Kratzer and Manley and Wasserman, and then discuss at length some advantages and disadvantages of the proposed synthesis – the Manley-Wasserman-Kratzer analysis. Two problems in particular will come in for extended discussion – the challenge of purportedly 'extrinsic dispositions', and the problem of the granularity of the possibilities we're quantifying over Accommodating ascriptions of extrinsic dispositions will require weakening some of the generalizations about dispositional modal bases that form the core of the M-W-K analysis, but ultimately I think we can retain the basic core of the account. The granularity issue will require dispensing with the possible worlds framework for a situation theoretic approach; in the final sections of the paper I will discuss some basic features of situation theory and tentatively offer a M-W-K style situation semantics for disposition ascriptions.

2.   What's wrong with the (SCA)?

Ultimately I'm going to claim that the particular modal character of disposition ascriptions is closely tied to a familiar platitude about dispositions: that dispositions are *intrinsic properties*. Assuming any precise version of this vague intrinsicness thesis spells doom for the (SCA), and it will be useful to illustrate the problem with a quote from Lewis:

> *I have replied to the resister by wielding an assumption that dispositions are an intrinsic matter. (Except perhaps in so far as they depend on the laws of nature. I myself would wish to insist on that exception, but this is a controversial matter that need not be considered now.) That is: if two things (actual or merely possible) are exact intrinsic duplicates (and if they are subject to the same laws of nature) then they are disposed alike. I do not deny that the simple conditional analysis enjoys some plausibility. But so does the principle that dispositions are an intrinsic matter. The case of the sorcerer sets up a tug-of-war between conflicting attractions, and to me it seems clear that the simple conditional analysis has the weaker pull.[5]*

What Lewis calls 'the case of the sorcerer' in the block quote above is a counterexample to the (SCA) in his paper 'Finkish Dispositions.' The story can be told either as a *masking case* (a variety of counterexample to the (SCA) first appearing in print in Johnston 1992) or a *fink case* (a different variety of counterexample first appearing in the more frequently cited Martin 1994). A masking case is one in which though x is disposed to R when T, if x were in T it wouldn't R because of preventative interference which *doesn't* affect the object's having of the disposition. A fink case involves prevention by removal of the disposition: though x is disposed to R when T, if it were in T, it would lose the disposition.

Here's the story: a powerful and attentive sorcerer has a beloved and very fragile glass in her possession. (i) *Fink version*: whenever the glass is subjected to a 'fragility test' ('struck smartly' as Quine put it), the sorcerer transmutes the glass into a very durable material (let's say steel). As a result, the glass doesn't break; when it was put to the test it was transmuted into something *not* fragile. (ii) *Mask version*: as before, exception instead of prevention-by-transmutation the sorcerer doesn't change the glass to remove its fragility but rather somehow prevents the stress of being smartly struck. Johnston's original masking case involved a fragile glass prevented from breaking when struck by a support structure inside of it (but not intrinsic to it – Lewis-style intrinsic duplicates can differ with respect to whether or not they have a support structure inside them).[6] in this paper, I will generally lump them all together under the heading 'the classic counterexamples'.

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[5] Lewis 1997, pp. 147 - 148.
[6] I discuss the different kinds of counterexamples at length in Anthony 2010; here I'll generally lump them all together as 'the classic counterexamples.'

Let me describe two less baroque cases in order to bolster the intuition that there is a genuine mismatch between the truth-conditions of a disposition ascription and 'corresponding' conditional.

The first example is adapted from Michael Fara. Suppose (sadly contrary to fact) that I am disposed to sleep when I'm tired, and in fact almost always sleep when I'm tired. It happens that I always and only sleep in my own bed in my apartment – if I get sleepy anywhere, I jet home for a nap. Knowing this about myself, I say

(2)   'I'm disposed to sleep when I'm tired.'

And I try to reiterate by uttering the conditional

(3)   'If I were tired… I'd be out like a light.'

But with a little further description of the context we can see that (2) wasn't a restatement of (1) at all. Suppose despite being so disposed, it happens (unbeknown to me) that when I'm uttering (1) and (2) there is an apocalyptically loud construction project taking place outside my apartment. If I were tired, I'd be trying to sleep in my apartment just like always, but given such unfavorable conditions I would certainly not be out like a light. The noise 'masks' the disposition. The disposition ascription analysandum is true but the counterfactual analysans is false.

Second example. 'Poisonous' means something like disposed to cause death when ingested. (This is obviously rough. For instance, ingestion is not the only mode of exposure to a poison: a case in which a poison kills someone who *inhaled* rather than ingested it is no less a manifestation of its poisonousness.) Suppose Jane studies poisonous snakes. Because she's always around these poisonous snakes and values her life, she also keeps antidotes handy for every variety of venom in her lab. The 'poisonous'-related conditionals uttered about the snakes or venoms I'm Jane's lab – 'If someone were exposed to this snake's cobratoxin, the cobratoxin would cause her death' – are *false*: presumably if someone were bitten by the snake and exposed to the cobratoxin, they would take the antidote and thus not be killed. The 'poisonous'-ascriptions are true, but 'corresponding' counterfactuals given a plausible choice of test and response conditions are intuitively not true.

If we assume that intrinsic duplicates share dispositions, we get a relatively simple explanation *why* the counterexamples work and the (SCA) fails. The presence of the apocalyptically loud noise preventing sleep is not shared by me by most of my possible intrinsic duplicates (in some vague intuitive sense of 'most'). The counterexample plays on the presence of a particular preventative factor which is not shared by most intrinsic duplicates. The presence of the antivenom plays the same role in the 'poisonous'-case.

I press the Lewisian construal of the counterexamples as a clash between counterfactuals and intrinsicness intuitions to sow the seed of an idea I'll repeat ad nauseum which I think should motivate anyone moved by the intrinsicness intuitions: the domain of possibilities disposition ascriptions quantify over is ***not*** the domain of possibilities counterfactuals quantify over, i.e. ***not*** the test condition-satisfying worlds most comparatively similar in the sense of Lewis, or minimal in a totally realistic ordering in the sense of Kratzer. If we take disposition ascriptions to be ascribe the sort of properties which are always shared by intrinsic duplicates, the proposed truth-conditions should reflect that. The easiest and most natural way to do that in the modal

quantificational framework is to rig things so that disposition ascriptions to distinct intrinsic duplicates quantify over the same possibilities.

3. Dispositions and habituals

The counterexamples to the (SCA) were all cases in which an object either (a) is disposed to ψ when φ, is φ'd, and *doesn't* ψ or (b) *isn't* disposed to ψ when φ, is φ'd, and *does* ψ. In an influential recent paper, Michael Fara takes this general feature of the counterexamples to illustrate the invalidity of what we can call 'dispositional modus ponens' – the inference from 'x is disposed to ψ when φ' and 'φ(x)' to 'ψ(x)'.

> *The lesson that should be drawn from the preceding discussion is that conditionals are simply not suited to the task of stating the truth conditions of disposition ascriptions. It is a constitutive feature of conditionals that* modus ponens *is a valid rule of inference for them. Yet what the phenomenon of masking shows is that an analogous rule of inference is not valid for disposition ascriptions: from the fact that* N *is disposed to* M *when* C, *together with the fact that* C, *it does not follow that* N M*s. There is an entrenched mismatch between disposition ascriptions and their corresponding conditionals.*[7]

While Fara may be onto something, I am not sure that *modus ponens* is of central significance in the counterexamples. Suppose he's right that the validity of modus ponens is a constitutive feature of conditionals. I'm able to use modus ponens to infer that ψ when I believe that φ and believe that φ⇒ψ for some conditional '⇒.' But again bracketing the serious problem of cases like Anderson's 'arsenic'-counterfactuals, we generally utter and entertain counterfactuals when we assume that the antecedent is *not* true. If we assume the (generally accepted) Strong Centering entailment 'φ ∧ ψ' ⊨ 'φ □→ ψ,' modus ponens *does* hold for counterfactuals. But for most counterfactuals that we actually utter and entertain modus ponens is beside the point – it's the *modal* inference pattern that is more germane.

All of the counterexamples to the (SCA) can be told in a way in which they are not cases in which dispositional modus ponens fails. A counterexample to dispositional modus ponens is a case in which 'x is disposed to ψ when φ' is true, 'φ(x)' is true, and 'ψ(x)' is not true. And we can tell the counterexamples that way: 'Suppose it actually happens that the sorcerer is protecting the fragile cup, the cup gets hit by a bus, but the sorcerer transmutes it into steel upon impact and it doesn't break'. But we can also tell it another way in which it *isn't* a counterexample to dispositional modus ponens: 'Suppose it actually happens that the sorcerer is protecting the cup, but the cup is never stressed. But if it *were* stressed, he would transmute it into steel and it *wouldn't* break.' The counterexample is not a case in which 'x is disposed to ψ when φ' is true, 'φ(x)' is true, and 'ψ(x)' is not true. Rather, the counterexample works because we intuitively assess the counterfactual to be false: if it were to be stressed, it would be transmuted into steel and wouldn't break. And because it

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[7] Fara 2005, p. 61.

is a *fink* case – that is, if it were in the test condition, it would no longer have the disposition – in those worlds, x does not have the disposition to break when struck. All this is just to suggest that the upshot of the counterexamples is not (entirely) that there exist dispositional modus ponens-invalidating cases in which an object is disposed, tested, and doesn't manifest the disposition; in addition, the counterexamples play on the *modal* mismatch of counterfactuals and disposition ascriptions. To anticipate my central claim: while Fara thinks that there is a mismatch between the force of quantification (counterfactuals universal, disposition ascriptions less-than-universal and restricted to tolerate 'permissible exceptions') he does *not* seem to believe there is a mismatch between the domain of possibilities quantified over by disposition ascriptions and counterfactuals, and I take this to be is a crucial mistake.

Fara suggests that these counterexamples illustrate the 'exception tolerance' of disposition ascriptions – sometimes an object is disposed and test but doesn't give the response. As a result, Fara ditches conditionals for the more tolerant *habitual sentences*.

Habituals, which are also sometimes called *generics* or *characterizing sentences*, are sentences expressing the sort of generalizations like (4) – (6):

(4)   John smokes when he's angry.
(5)   Sugar dissolves when it's placed in water.
(6)   Fragile objects break when they're stressed.

Ultimately, while Fara actually gives a bound-variable semantics for habituals he urges us to judge his proposal on the basis of our truth-value intuitions for habitual sentences rather than any specific formal semantics. I'll take Fara's suggestion and discuss some of the characteristic intuitive truth conditional features of habituals rather than diving into his semantics for habituals (which will come up later in the discussion of modal quantifiers).

Exception tolerance is one of the hallmark features of habituals in the sense that (4) – (6) do not entail their stronger universally quantified counterparts (7) – (9):

(7)   John always smokes when he's angry.
(8)   Sugar always dissolves when it's placed in water.
(9)   Fragile objects always break when they're stressed.

The inference from a habitual 'x ψ's when φ' and '$\varphi(x)$' to '$\psi(x)$' is bad, just as in the case of disposition ascriptions; since we want disposition ascriptions to turn out exception tolerant in our analysis, it makes sense to analyze them in terms of exception tolerant expressions. The exception tolerance of habituals makes them a good fit.

Though Fara doesn't claim that his analysis covers such cases, it can at least in principle be extended to sentences involving dispositional *predicates* like (10) – (12) in addition to explicit disposition ascriptions ('is disposed' sentences).

(10)   Sugar is soluble.
(11)   Andre is irascible.
(12)   That gold bar is malleable.

The standard picture of how such an extension would look is David Lewis's 'two-step' analysis[8]: we can cover such cases by providing, in addition to a general analysis of 'N is disposed to ψ when φ'd', predicate-to-explicit-ascription linking sentences:

(L-1) N is soluble iff N is disposed to dissolve when submerged in a solvent.
(L-2) N is irascible iff N is disposed to become angry when provoked.
(L-3) N is malleable iff N is disposed to deform when subjected to compressive stress.

In this paper, I will primarily be discussing explicit disposition ascriptions, but will sometimes draw on intuitions about dispositional predicates.

One thing Fara discusses which I will draw on significantly is the syntactic form of explicit disposition ascriptions – particularly, the fact that they decompose into 'is disposed' and an infinitival complement. A number of other similar ascriptions also take infintival complements:

(13)   Mark is disposed to smoke when he is stressed.
(14)   Mark is reluctant to smoke when he is stressed.
(15)   Mark is able to smoke when he is stressed.
(16)   Mark is permitted to smoke when he is stressed.

Call the class of English adjective ascriptions taking infinitival complements *the Fara class*. A compositional semantics for sentences in the Fara class will presumably trace the truth-conditional difference between (13) – (16) to the semantic contribution of the particular adjectives. The simplest and most desirable theory would predict the intuitive truth conditions by connecting a story about the semantics of infinitival complements to an account of the lexical semantics of different adjectives. Call this constraint *the Fara constraint*. It isn't clear whether Fara would actually endorse the constraint as stated here, but I think this is roughly what he has in mind in his discussion of these other sentences and the shared syntax.

The 'habitual' part of the habitual analysis concerns the infinitival complement: on Fara's analysis the infinitival complement common to (13) – (16) expresses the habitual (17):

(17)   Mark smokes when he is stressed.

As I mentioned already, Fara does offer a bound-variable semantics for habituals but urges us to take the substance of the habitual analysis to be provided by our truth-value intuitions about habituals rather than any particular formal semantics. For now I'll follow Fara's advice and ignore the semantics for habituals.

Fara treats 'is disposed' as expressing a simple unary operator on a habitual, DISP, with the following truth condition:

(FARA1)   'DISP(x ψ's when φ)' is true   iff   'x ψ's when φ' is true in virtue of an intrinsic property of x

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[8] See Lewis 1997.

Here's what we get when we put together the two elements, in Fara's own words:

> *How should the operator DISP be interpreted? Notice first that it appears to be factive… What else can be said about DISP? …[T]o attribute to an object a disposition to do so-and-so is to say not just that it does so-and-so* [the habitual] *but that it has some intrinsic property in virtue of which it does so-and-so. In full, the account of disposition ascriptions that I am proposing is:*
>
> **The Habitual Account**
>
> *'N is disposed to M when C' is true iff N has an intrinsic property in virtue of which it Ms when C.*[9]

In summary, (i) infinitival complements of sentences in the Fara class express habituals and (ii) 'is disposed' expresses the operator characterized by the truth condition: 'DISP(x ψ's when φ)' is true just in case '(x ψ's when φ)' is true in virtue of an intrinsic property of x.

I believe there are straightforward counterexamples to this analysis, which I'll discuss only briefly here.[10]   The cases I have in mind are ones in which a disposition ascription is true and the habitual it supposedly is a factive operator on is not true. This doesn't show that no habitual analysis is right – just that an analysis treating 'is disposed' as a *factive* operator on a habitual can't be right.

Case one: Mark is disposed to smoke when he's stressed. Nothing ignites his nicotine craving more than stress. When he is stressed, his temples begin to pound, his pulse quickens, and his mind uncontrollably turns to Camel Joe. It happens however, that the only thing that causes Mark to be stressed is his girlfriend, Mary. Mary is a doctor and since she'd rather not see Mark succumb to an early death she does everything in her power to prevent Mark from smoking when he's in her sight. In fact, she is uniformly successful – every time she's with Mark, she prevents him from smoking. Mark doesn't smoke when he's stressed – in fact, he never smokes when he's stressed. Yet he is disposed to smoke when he's stressed.

Case two: Andre is disposed to fart when he eats really cheesy foods. Years ago, Andre used to fart when he ate really cheesy foods. But then Andre's girlfriend Anne got fed up and started slipping a lactase supplement in his meal when he eats really cheesy foods. Now, thanks to Anne, he doesn't fart when he eats really cheesy foods, but he is still so disposed.

If the examples aren't convincing on their own, they are significantly bolstered if we accept some version of the intrinsicness thesis for dispositions. Intrinsic duplicates don't necessarily share habitual facts – which habituals are true depends on facts which may differ between intrinsic duplicates. Even though Mark doesn't smoke when he's stressed and Andre don't fart when he eats cheesy foods, intrinsic duplicates without girlfriends presumably would.

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[9] Fara 2005, pp. 69 – 70.

[10] For more detailed discussion of the purported counterexamples to Fara's analysis, see Anthony 2010 pp. 41 – 46 and 69 – 82.

What went wrong? Habituals get us exception tolerance ('Andre farts when he eats cheesy foods' does not entail 'Andre always farts when he eats cheesy foods.') But they make no significant advance on counterfactuals in accurately characterizing the *modal profile* of disposition ascriptions. Part of the problem is that the modal character of habituals is tricky and not super well understood. It is a familiar problem that some utterances of habituals (like 'Mark smokes when he is stressed') have truth conditions that apparently involve quantification over predominantly or exclusively *actual* cases – if Mark is actually stressed on 100 occasions and smokes on none of those occasions, the habitual is false regardless of how things go at other possible worlds. Other habituals, on the other hand, seem to obviously quantify over some or even predominantly *non-actual* possibilities:

(18)   My car goes 130 miles per hour.

may be true even though in no actual case have I driven it at that speed. So part of the problem with getting an answer to the modal question from Fara's account is that he has explained the modal character of dispositions in terms of expressions which themselves have a shifty and ill-understood modal character. I think that in fact the answer to the modal problem for disposition ascriptions is much simpler than the answer to the modal problem for habituals.

But the explanatory inadequacy is independent of the counterexamples. The counterexamples are a more significant problem – we should at least approximate extensional adequacy before quibbling too much about explanatory lacunae. The analysis is subject to counterexamples because Fara fails to make good on the lesson of the (SCA) counterexamples according to those of us who assume intrinsicness. We want the domain of possibilities quantified over to be the same for disposition ascriptions to distinct intrinsic duplicates: Fara fails to do this.

In fact, quite surprisingly, Fara's own semantics for habituals relies on a familiar Lewisian comparative possibility ordering that results in habituals looking a lot like counterfactuals:

> So it does seem right to say, as I did, that a habitual is true just in case every exception to it is a permissible exception, provided we count not just actual exceptions but some merely possible ones as well.
>
> Which merely possible exceptions should we include? Not all of them, for then we would have that a habitual is true iff every possible exception to it is a permissible exception, which in turn would have the consequence that a habitual sentence is necessarily true if it is true at all (given that which situations are possible is not a contingent matter), which is clearly wrong. Instead, we should consider only those exceptions, if there are any, <u>in the possible worlds closest to the actual world in which the when-clause of a habitual is satisfied</u>. Thus according to the interpretation I am proposing, a habitual "N Ms when C" is true just in case every exception in every C-world closest to the actual world is a permissible exception. For most habituals, this will amount to the requirement that every actual exception is permissible, since the

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actual world is the unique closest world to the actual world. But for
some habituals… this inclusion of non-actual exceptions is crucial.[11]

What this passage illustrates is that Fara has ditched counterfactuals for habituals in order to gain exception tolerance but aside from the 'permissible exceptions' clause understands habituals *just like counterfactuals* – as involving universal quantification over maximally similar antecedent ('when'-clause) satisfying worlds.

In a recent paper[12], Juhani Yli-Vakkuri emphasize this point, and claims that on a plausible interpretation, Fara's exclusion of permissible exceptions serves the same role as a *ceteris paribus* clause. Together with the counterfactual-like modal profile for habituals we see in the block quote above, this results in Fara's habitual analysis giving truth-condition predictions which are basically the same as *ceteris paribus* - qualified counterfactual analyses, which he argues quite persuasively against. (Yli-Vakkuri points out that 'to say that something φ holds in all cases except for some unspecified range of exceptions is to say just very little'[13] – about as much, he suggests, as those who respond to the counterexamples by modifying their conditional analysans with a *ceteris paribus* or 'in normal conditions' qualification.[14] However, in fairness to Fara, he says quite a lot of specific things about his notion of a 'permissible exception' in his unpublished 2001 dissertation. I think Yli-Vakkuri's criticisms are nonetheless essentially correct, but if we read into Fara's analysis the specific role of 'permissible exceptions' described in Fara 2001 §4.4, it is not the case that it serves a vaguely specified function basically equivalent to a *ceteris paribus* qualification.)

I want to defend an alternative approach. I will claim that disposition ascriptions need a semantics which does *not* care about all-things-considered comparative similarity. Let's turn now to an account that does just that, and answers the modal question directly in terms of possibility-talk – David Manley and Ryan Wasserman's modal quantificational analysis.

4. Manley and Wasserman

Manley and Wasserman have argued (convincingly, by my lights) for the claim that disposition ascriptions don't care about all-things-considered comparative similarity – that is, they don't quantify over the domain of possibilities characteristic of counterfactuals, the most comparatively similar worlds where the 'when'-clause condition (understood on par with the counterfactual 'if'-clause) is satisfied. While I think M & W's account is essentially correct as it stands, I think recasting the view in a general framework for the analysis of modality with an eye towards compositional semantics will help clarify some potential issues and lend certain advantages to the account. (I'll discuss these in §7)

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[11] Fara 2005, p. 67. My underlining.
[12] Yli-Vakkuri 2010.
[13] Yli-Vakkuri 2010, p. 630
[14] This approach to disposition ascriptions has been one of the most popular since the decline of the (SCA); for two versions frequently cited in the literature, see Mumford 1998, p. 88 and Malzkorn 2000, pp. 457 – 458. The two analyses I discuss in this paper – Fara's habitual analysis and Manley and Wasserman's modal quantificational analysis – are two of the only analyses that do not proceed by considering alternative ways of minimally tweaking the (SCA) to get extensional adequacy.

M & W bring out the overall comparative similarity-indifference of disposition ascriptions conditional analyses via what they call 'the problem of accidental closeness.' Here's an illustrative example of the problem:

> *Consider any ordinary concrete block that is not disposed to break when dropped. Suppose such a block is disposed to break if dropped from any height of at least twenty metres… Now suppose the block happens to be sitting on a windowsill twenty metres above ground. Then the closet world in which it is dropped… is a world in which it is dropped from twenty metres… Moreover, the block would break; so the present proposal* [a variant of the (SCA)] *wrongly tells us that it is fragile. And note that the block would not satisfy the conditional if it were sitting on a windowsill only nineteen metres above the ground instead.*[15]

I agree. An object which is disposed to break when stressed need not break in every possible or actual case in which it is stressed. An object which is indisposed to break when stressed need not fail to break in every possible or actual case in which it is stressed. M & W use the illustrative metaphor of an *Achilles Heel*: an Achilles Heel case is one of those exceptional (possible or actual) cases in which an *indisposed* object gives the response to the disposition test. Achilles was indisposed to succumb to injury, but that doesn't mean *no* kind of injury whatsoever would cause his death. A *reverse Achilles Heel* is one of those exceptional (possible or actual) cases in which a disposed object fails to give the response. Because counterfactuals look to the comparative similarity-maximal worlds, on the (SCA) the particular *kind* of disposition test quantified over may fall in some narrow range. An ordinary utterance of 'If I dropped this cup, it would break' does not tell us much about the cup's behavior across a broad spectrum of circumstances in which it could be dropped; rather, it says as much about the surface the cup is suspended over as it does about the cup's fragility.

The ascription of a disposition to break when struck intuitively conveys information about an object's behavior in a range of possible cases in which it is struck – some in which it is struck hard, some in which it is struck not so hard, etc. The problem of accidental closeness is the problem that counterfactuals *don't* necessarily quantify over a variegated bunch of antecedent-worlds – they quantify over antecedent-worlds most like they actual world. The problem of accidental closeness is roughly that counterfactuals may quantify over possibilities all of which are Achilles Heel or reverse Achilles Heel cases. M & W's sturdy brick comes out fragile (or disposed to break when stressed) on the (SCA) because, given the relevant comparative similarity facts, all the 'stressed'-possibilities quantified over are quite severe stresses which cause the brick to break. It wouldn't break if it were subjected to not so severe stresses; but those possible stresses occur in worlds less similar all-things-considered than the severe stresses.

Manley and Wasserman's solution to the problem is to suggest that disposition ascriptions quantify over a 'broader' space of possibilities. 'x is disposed to break when struck' quantifies over all sorts possibilities in which x is struck, not just those at worlds most similar all-things-considered

[15] Manley and Wasserman 2008, p. 70.

to the actual world. To achieve this end, they introduce the notion of a 'stimulus condition case' or 'C-case.' Since what they call the stimulus condition I've called the test condition, I'll use the term 'T-case' to keep the terminology uniform. The T-cases are all of the *nomologically possible* cases in which the object ascribed the disposition is *intrinsically just as it actually is* and is subjected to the associated test condition.

For example, I say about a cup in front of me on my desk 'That is disposed to break when stressed.' The T-cases are those possible cases in which (a) the laws of nature are just as they actually are (b) all of the intrinsic properties of the cup are just as they actually are and (c) the cup is stressed. Building on the characterization of a T-case, their analysis is

(M & W)   x is disposed to R when T   iff   x would R in most T-cases

The 'would' in their analysans doesn't seem to have any intended modal significance; that is, 'T-cases' is a way of referring to possible cases of a certain sort and the claim is that the disposition ascription holds just in case 'R(x)' is true in a certain proportion of T-cases.

I believe that Manley and Wasserman's analysis is basically extensionally adequate (with caveats discussed in §7). It is easy to see how it handles the counterexamples to the (SCA) and habitual analysis: because those counterexamples play on extrinsic facts about the circumstances (the presence of the electro-fink; the availability of cobra antivenom; the fact that the brick is precariously perched at 20m; the prevention of Mark and Andre's smoking and farting by their girlfriends) *which are not present in the vast majority of the T-cases,* the disposition will manifest in most of the T-cases.

A purported counterexample to (M & W) has appeared in a recent paper by Daniel Bonevac, Joshua Dever, and David Sosa.[16] Here's the case: suppose x is not fragile but has an Achilles Heel (fragility test in which it would break) in conditions C. Hook x up to a machine – the cleverly named *Apollo Machine* – which has the following function: whenever x is in a fragility-associated T-case (i.e. roughly a case of being stressed in some particular way), the Apollo Machine subjects x to the precise fragility test condition C. Because C is an Achilles Heel of x, the story goes, in *every* T-case x gives the response, because in every T-case the Apollo Machine puts it in conditions C which will cause it to break.

The example is clever but incorrect because it misses Manley and Wasserman's specific modal claim about which possibilities are T-cases. The T-cases for this case are all and only the possibilities in which x is (a) intrinsically just as it actually is (b) subject to laws just like the actual laws (c) subjected to some variety of the test condition (stressed in such-and-such a way). Their mistake is here: lots of those cases are possibilities in which there is no Apollo Machine hooked up to x. It is plausible that Bonevac, Dever, and Sosa are correct that x breaks in every case in which it subjected to a fragility test and attached to the Apollo Machine, but the point of specifying T-cases in terms of (a), (b), and (c) is that T-cases will include mostly cases where the non-intrinsic, non-law facts are very different. That x is attached to an Apollo Machine is in not an intrinsic property of x nor a law of nature. So the T-cases needn't be cases in which x is hooked up to an Apollo Machine. And the presumption, which is admittedly a vague and hand-wavy (and will come up for discussion in §7f), is that 'most' of the T-cases aren't cases where x is attached to an Apollo

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[16] Bonevac, Dever, and Sosa forthcoming, p. 23.

Machine. This is precisely the reason Manley and Wasserman's proposal advances on the (SCA) and habitual analysis with respect to the modal problem of dispositions. If x is hooked up to the Apollo Machine, the counterfactual's comparative similarity will take 'If x were stressed, it would break' to all and only possibilities in which x is stressed while hooked up to the machine and in which it breaks. M & W's T-cases include these possibilities (the ones in which x has the same intrinsic properties and the laws are the same, at least) but many more besides. The quantificational force of the modal is less than universal ('most') and the cases in which the indisposed object doesn't break are intuitively supposed to swamp the rare cases in which circumstances conspire to target the Achilles heel (e.g. the Apollo Machine).

Manley and Wasserman mention that the account may need to be weakened to take into account *some* non-intrinsic / non-lawful facts in restricting the possibilities disposition ascriptions quantify over, and I will discuss this issue further in §7g. I think *prima facie* (M & W) is much harder to counterexample than the (SCA) or habitual analysis. Counterexamples that play on factors other than the intrinsic properties and laws are hard to get going because the general idea is that 'T-cases' are supposed to be diverse in every respect besides intrinsics + laws that no particular element of preventative interference or happenstance will mask the disposition in most of the T-cases. We will see some counterexamples later in the paper, but for now I want to adopt for the sake of further development Manley and Wasserman's proposal.

Despite its prima facie plausibility, I think M & W's analysis leaves considerable explanatory currency on the table. In the first place, (M & W) does not satisfy the Fara constraint; Manley and Wasserman haven't told us what work is done by 'is disposed' and by the infinitival complement is explicit disposition ascriptions. I think it is natural to see how their analysis might be factored. I'll suggest that the 'intrinsic + laws' restriction and the force of the quantifier is the part done by 'is disposed,' while the infinitival complement maps the 'when'-clause into the restrictor and the main clause into the scope of the modal quantifier. I'll suggest that this template is feasible not only for disposition ascriptions but for other ascriptions in the Fara class. The move to a general framework for analyzing modal vocabulary will allow us to characterize the particular modal character of disposition ascriptions.

5.   The simple Kratzerian framework

The general framework for the semantics of modal vocabulary I'm going to adopt here is a simple version of Angelika Kratzer's relational semantics for modals. In the framework, we'll be able to (a) identify the contents expressed by modal claims and (b) tell a simple story about the lexical semantics of different modal terms in terms of quantification over possibilities characterized in terms of three dimensions: *modal force*, *modal base,* and *ordering source*. I'll rehearse the basics of the Kratzer story and then turn to the application to disposition ascriptions.

As anyone who has thought even a little bit about modals knows, modal claims in natural language come in a variety of different 'flavors' – epistemic, deontic, alethic, bouletic, etc. Putting the flavor metaphor aside, what the observation amounts to is that different modals convey information about different possibilities – epistemic modals tell us how things go in the possibilities compatible with at particular body of knowledge, deontic modals tell what how things go in the

possibilities compatible with rules or norms, and so on. Many natural language modal terms can express different flavors in different contexts; to take an example from Kratzer (1977),

> (19)   All Maori children must learn the names of their ancestors.
> (20)   The ancestors of the Maoris must have arrived from Tahiti.

in (19) 'must' expresses a deontic modal and in (20) expresses an epistemic modal. Other modal terms play favorites: 'might', unlike 'may' for instance, likes expressing epistemic modality but doesn't like expressing deontic modality (21) – (24).

> (21)   You might be lying.
> (22)   You may be lying.
> (23)   #You might have a piece of candy if you'd like.
> (24)   You may have a piece of candy if you'd like.

Kratzer observes that even within a single 'flavor' of modality we see variation in the modal content expressed. Suppose Maori tribal law requires that children learn the names of their ancestors but British colonial regulations aimed to undermine local culture dictate that Maori children must not learn the names of their ancestors. Intuitively, in the mouth of someone trying to say what tribal law requires, an utterance of (18) is true; but in the mouth of someone expressing what colonial regulations dictate, an utterance of its negation (25) is true.

> (25)   All Maori children must not learn the names of their ancestors.

In order to bring out the difference in the modal claims expressed, Kratzer suggests that we consider modals which make explicit reference to the relevant possibilities with the phrase 'in view of':

> (26)   In view of tribal law, all Maori children must learn the names of their ancestors.
> (27)   In view of the oppressor's regulations, all Maori children must not learn the names of their ancestors.

On Kratzer's view, modals express relations between a proposition or propositions and a *body of information* – the rules, regulations, knowledge, beliefs, essences, or whatever *in view of which* the prejacent must or might be the case. In (25) the information characterizes one body of rules, Maori tribal law; in (26), it's a different body of rules, the British regulations. For epistemic modals, the relevant body of information is *what is known* (by some relevant person or persons). For bouletic modals, it's a relevant body of desires; for nomological modals, it's laws; and so on.

At the heart of Kratzer's account are two importantly different ways of talking about the relevant body of information. The first way of thinking about the body of information is as a *set of propositions* or, taking propositions to be sets of possible worlds, a *set of sets of possible worlds*. This is called *the premise set*. Frequently I will drop the propositional structure of premise sets and speak of the set of worlds compatible with a premise set (set of worlds where every premise is true

/ intersection of all of the elements of the premise set). Premise sets are importantly different than unstructured sets of possible worlds in at least two respects: (a) they connect modal relations to familiar semantic relations like consistency and entailment and (b) allow Kratzer to describe some modal reasoning in terms of the resolution of inconsistent premise sets. But since philosophers are much more familiar with the unstructured possible worlds framework, I will assume we're working with consistent premise sets and go back and forth freely between the two ways of speaking.

Premise sets are a central element of the semantics but they haven't capture one element of the 'modal flavor' metaphor – the set of premises itself is not recognizable as being 'epistemic', 'denotic', 'alethic', etc. Suppose that Fundamentalist Fred knows *all* and *only* what the laws of nature are; when an epistemic modal concern's Fred knowledge, the relevant premise set is identical to the premise set relevant to claims concerning nomological possibility; *qua* set of propositions there is nothing intrinsically making it the body of information characterizing what Fred knows or the body of information characterizing the laws of nature. If Fred's knowledge had been different, epistemic modal claims concerning what must or can be in light of Fred's evidence would have expressed something different but claims about nomological possibility wouldn't.

Kratzer gets at the 'flavor' metaphor with the concept of a *conversational background*, which acts like the condition specified by an 'in view of' phrase. The content expressed by 'in view of tribal law' depends on the what the tribal laws are; we can identify this specific conversational background with *the function from a world w to the premise set A characterizing the tribal laws at w*. If the epistemic Fred premise set = the laws of nature premise set, we can still distinguish the 'flavors' of the modals on the basis of the conversational background: in the epistemic case, the background is a function from worlds to the premises characterizing what Fred knows in that world, and in the nomological case a function from worlds to premises characterizing the laws in that world.

Modals terms express familiar semantic relations between the prejacent and premise set like consistency and entailment: 'A proposition is necessary with respect to a premise set if it follows from it… A proposition is possible with respect to a premise set if it is compatible with it.'[17] When we talk about unstructured worlds instead of premise sets, necessity is truth at all worlds and possibility truth at some worlds. The *modal force* of some modal proposition is this dimension of quantificational strength or strength of semantic relation, and the paradigmatic poles are the necessity and possibility modal: the former with universal or entailment force, the latter with existential or consistency force.

The other two central notions in the triad used to characterize modal contents correspond to two different functions of the premise sets determined by conversational backgrounds. One thing we've already seen a premise set do is restrict the quantification to a specific set of worlds – those compatible with the premise set. We've seen that role in sentence (20) which is true just in case all worlds in the premise set characterizing the relevant body of knowledge are worlds in which the Maori's ancestors come from Tahiti. When a premise set restricts the modal quantifier to worlds compatible with the premise set, we call it a *modal base*.

But sometimes premise sets play a different role. Here's an example. Here's one thing the Bible says about stealing.

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[17] Kratzer 1977 / forthcoming, p. 10.

(28)   If a man gives to his neighbor money or goods to keep safe, and it is stolen from the man's house, then, if the thief is found, *he must pay double*.[18]

Suppose you lend me some money or goods to keep safe, and it's stolen, but the thief is found. Then (29) is true.

(29)   In view of what the Bible teaches, the thief must pay double.

Suppose we treat this modal and the Biblical premise set analogously to (20) and propose that (29) is true just in case all of the worlds compatible with what the Bible teaches are worlds in which the thief pays double. Despite some prima facie plausibility, this won't work. There are no worlds compatible with what the Bible teaches in which the thief steals the goods you lent me, because the Bible also says

(30)   Thou shalt not steal.[19]

All of the worlds compatible with everything the Bible prescribes are worlds where there is no theft, no usury, no murder, and so on. And as a result we certainly don't get the right semantics for Biblical prescriptions which are conditional upon violation of these teachings – that is, the rules that say what's supposed to happen when things go wrong.

The fix is to recognize the difference between the different roles a premise set can play. To begin with, (29) intuitively says what must be the case in worlds where details of the situation are the same – worlds where you lent me goods or money, the thief stole them, and is caught. Let the modal base characterize these relevant details of the situation; that way we ensure that aren't missing the possibilities we care about.

What the premise set characterizing Biblical teachings does is *induce an ordering* – that is, partially orders the possibilities compatible with the modal base (the possibilities where you lent me money or goods, the thief stole it, and the thief was caught) with respect to how well they satisfy the prescriptions of the Bible. Intuitively some of those worlds will be worlds where, following the Bibcal teaching, the thief pays double; others will be worlds where he doesn't. What the account says is that (27) is true just in case the all of the worlds compatible with the modal base (i.e. where you me the money or goods, the thief stole it, and the thief was caught) which are 'best' or minimal in the induced ordering (i.e. those which most satisfy the prescriptions of the Bible) are worlds in which the thief pays double. And this is intuitively right – among the possibilities compatible with the modal base, the ones where the thief pays double are better by the lights of the Biblical induced ordering, because they make at least one more proposition in that premise set true.

This framework and its three central notions (force, base, ordering) allow us to do a number of different things, but there are two things in particular I want to focus on. First, it gives us a way of describing particular modal contents expressed on a given occasion of utterance – we can say that (20) expresses a strong modal relation between the prejacent and an epistemic base characterizing contemporary knowledge (of Maori history or whatever relevant information we

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[18] Exodus 22:7
[19] Exodus 20:15

need) with an empty ordering source, and that (29) expresses a strong utterance expresses a strong modal relation between the prejacent and a realistic modal base characterizing relevant features of the situation and Biblical teachings as the ordering source. The second thing we can do is describe what sort values for the three central notions (force, base, ordering) difference lexical items ('might', 'can', 'may', 'able', 'permitted', 'allowed' etc.) can take. An example of the first use of the framework is to say for instance that the difference between the truth conditions of an utterance of

(31)   I am able to play the piano.

and

(32)   I am allowed to play the piano.

can be captured by differences in the modal bases and ordering sources involved: roughly, (31)'s modal base characterizes the fundaments of my piano-playing ability (my know-how, ten fingers, and   properly functioning central nervous system) with an empty ordering while (32) has an ordering induced by the relevant permissions. An example of the second use of the framework is to point out that this different in specific contents is an instance of the general phenomenon which distinguishes the lexical meanings of 'able' and 'allowed' (even though they are both possibility modals): 'able' modals like to take realistic modal bases comprising the relevant 'ability'-facts for an agent (intrinsic skills, some relevant non-intrinsic circumstances) and 'allowed' modals like to take deontic ordering sources comprising the relevant 'allowance'-facts (some body of permissions, rules, or regulations).

6.   Disposition ascriptions in the Kratzerian framework

In 'The notional category of modality', Kratzer sets about the second task for a broad class of German modal expressions including unpronounced / generic modals, adjectives with modal suffixes, modal auxiliaries, and modal adverbs. The resulting picture is one of incredible diversity of modal meanings with many modal terms having a characteristic and often unique range of admissible modal bases and ordering sources. Here's a few examples:

I could say

(26) Ich bin nicht imstande, Posaune zu spielen.
I am not able trombone to play.

if I have asthma or weak nerves or if I have no talent. I doubt whether I could say it in a situation where I haven't learnt how to play the trombone. And I could never say it on the island with my trombone lost at sea. The relevant circumstances for imstande sein

are concerned with the strength of the body, character or intellect. For kann, *there is another restriction:*

(27) # Dieses Messer kann nicht schneiden.
This knife can not cut.

(28) # Dieser Hut kann den Kopf warmhalten.
This hat can the head keep warm.

(29) # Dieser Ofen kann nicht richtig heizen.
This stove can not properly heat.

(27) to (29) sound funny. They suggest that the knife, the hat or the stove are agents taking an active part in the cutting, the warming of the head or the heating. To avoid this effect, we would have to say:

(28) Dieses Messer schneidet nicht.
This knife cuts not.

(29) Dieser Hut hält den Kopf warm.
This hat keeps the head warm.

(30) Dieser Ofen heizt nicht richtig.
This stove heats not properly.

One of the factors responsible for the deviance of (27) to (29) relates to agency...[20]

The suffixes -bar *and* -lich *allow all kinds of ordering sources, depending on the adjective they are attached to.*

(57) Dieses Eintrittsbillet ist nicht übertragbar.
This admission ticket is not transferable.

According to the regulations, it is not possible to give this ticket to anyone else.[21]

I present these cases to illustrate that it is quite common that modal terms be associated with particular or general kinds of modal bases / ordering sources they can and cannot take. If

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[20] Kratzer 1981 / forthcoming, p. 30
[21] Kratzer 1981 / forthcoming, p. 37

disposition ascriptions are going to be treated in this manner, the central element we need to specify is the particular kind of modal bases / ordering sources disposition ascriptions can take.

Manley and Wasserman have done a preliminary job of addressing this by introducing the 'T-cases': we want possibilities compatible with (a) the intrinsic properties of the object ascribed the disposition and (b) the laws of nature. In Kratzerian terms: we want a modal base characterizing the intrinsic properties and laws; and that's all, so we'll have an empty ordering source.

As it happens Kratzer herself gives an analysis along these lines in 'Notional Category' for the recognizably disposition German modal adjective 'zerbrechlich':

> *(58) Diese Tasse ist zerbrechlich.*
> *This cup is fragile.*
>
> *(58) has a realistic modal base and an empty ordering source. It is in*
> *view of certain properties inherent in the cup that it is possible for it*
> *to break. [38]*

In order to guarantee that a modal base characterizing the properties of the cup doesn't take us to worlds where those properties don't play their usual causal roles (e.g. worlds where platinum breaks easily and thin glass is indestructible) I follow Lewis's suggestion to add a restriction to possibilities compatible with the laws of nature. With this minimal revision, Kratzer's account looks almost exactly like Manley and Wasserman's.

My proposal is essentially just a restatement of the revised Kratzer analysis of 'zerbrechlich' and the (M & W) account recast in Kratzerian terms:

(M-W-K1) $[\![N \text{ is disposed to } \psi \text{ when } \varphi]\!]^w = 1$ iff $[\![\text{Most}\langle[\![\varphi]\!]\cap B(w),[\![\psi]\!]\rangle]\!]^w = 1$

where

$B(w)$ = modal base characterizing the intrinsic properties of N and laws of nature at w

and

$[\![\text{Most}\langle\chi, \tau\rangle]\!] = 1$ just in case most ($\geq.5$) objects in the domain satisfying χ satisfy τ

Informally, a disposition ascription is true just in case more than half of the accessible worlds in which it's tested are worlds in which it gives the response. The accessible worlds are those in the compatible with the dispositional modal base – the worlds where all of the intrinsic properties of

the referent of 'N' and the laws of nature are just as they are at w. The modal force – 'most' – is the least worked-out element, and I will return to it (though with little to add) in §7f.

(M-W-K1) is truth-conditionally equivalent to (M & W) on the assumption that $[\![\varphi]\!] \cap B(w) =$ the T-cases. Significant revisions of (M-W-K1) will be needed to account for certain kinds of disposition ascriptions, but since I hope I made the case earlier that (M & W) is truth-conditionally in the right ballpark, I want to discuss the explanatory advantages of the Kratzerian reformulation before considering some challenges to the extensional adequacy of (M-W-K1).

7. Merits and demerits of the M-W-K analysis

In this section I'll consider some merits and demerits of this analysis. Subsections (a) – (d) detail four merits, and subsections (e) – (g) detail three demerits.

a. Fara's constraint

One advantage of (M-W-K1) is that it lends itself to a simple explanation of the semantic division of labor between 'is disposed' and the embedded infinitival complement. Here are the elements of (M-W-K1): there's (a) the 'most' quantifier, (b) $[\![\varphi]\!]$, (c) $[\![\psi]\!]$, (d) the modal base B(w), and (e) an empty ordering source. Even though (e) plays no role in (M-W-K1), it will figure in the schematic generalization to cover other sentences in the Fara class.

I follow Fara in assuming 'a widely accepted principle of syntax', namely 'that infinitival clauses must have subjects.'[22] In particular, in these simple disposition ascriptions the subject of the infinitival clause will just be the subject of the sentence, i.e. the object ascribed the disposition. I'm going to ignore any other complications of English syntax and assume that our example disposition ascription

(13)   Mark is disposed to smoke when he is stressed.

as well as the similar Fara class sentences like

(14)   Mark is reluctant to smoke when he is stressed.
(15)   Mark is able to smoke when he is stressed.
(16)   Mark is permitted to smoke when he is stressed.

are parsed into three semantically significant units: the adjective phrase ('is disposed' / 'is reluctant' / 'is able' / 'is permitted'), the main clause of the infinitive ('Mark smokes') [note that following the 'widely accepted principle of syntax' it includes the subject], and the 'when'-clause ('when he is stressed.') I am interpreting Fara's constraint as requiring a minimally plausible mapping from the three units to the elements in the analysis of disposition ascriptions capturing the semantic contribution of each unit. We will see a stark difference between the (M-W-K) analysis and Fara's habitual analysis: while Fara's habitual analysis treats 'is disposed' as

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[22] Fara 2005, p. 62.

contributing an operator on the quantificational structure contributed by the unpronounced habitual quantifier (universal force, totally realistic ordering source), on (M-W-K1) 'is disposed' contributes it's particular force ('most'), modal base (intrinsics + laws), and ordering source (empty). On this approach, the different truth conditions of sentences like (13) – (16) reflect the different modal force, modal base, and ordering source contributed by 'is disposed', 'is reluctant', 'is able', etc., rather than different operators they contribute on the habitual quantification0. In each case, the main clause of the infinitive and the 'when'-clause do nothing more than provide conditions in the scope and restrictor of the quantifier, respectively.

Here's a simple illustration in which each label connects a semantically significant unit of the sentence to the elements in the semantics it contributed:

'Mark is disposed to smoke when he is stressed.'

Most⟨[[Mark is stressed]]∩B(w),[[Mark smokes]]⟩ [23]

My optimistic position is that in this general setup we can provide analogous truth-conditional analyses for other sentences in the Fara class reasonably that are informative and prima facie plausible.

(13)   Mark is disposed to smoke when he is stressed.
(14)   Mark is reluctant to smoke when he is stressed.
(15)   Mark is able to smoke when he is stressed.
(16)   Mark is permitted to smoke when he is stressed.
(33)   Mark is inclined to smoke when he is stressed.
(34)   Mark is believed to smoke when he is stressed.
(35)   Mark is known to smoke when he is stressed.
(36)   Mark is destined to smoke when he is stressed.
(37)   Mark is afraid to smoke when he is stressed.
(38)   Mark is wise to smoke when he is stressed.
(39)   Mark is required to smoke when he is stressed.

In particular, I think we can understand the shared logical form of many or all sentences of this kind along the following schematic lines, for name N, adjective A, main infinitive clause ψ and 'when'-clause φ:

(M-W-K GEN) $[[N \text{ is } A \text{ to } \psi \text{ when } \varphi]]^w = 1$ iff $[[Q\langle B(w) \cap \min(\leq_0,[[\varphi]]), [[\psi]]\rangle]]^w = 1$

for binary quantifier Q

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[23] Color coding:
main clause of infinitive
'when'-clause
adjective phrase

modal base B

and $\leq_0$ induced by ordering source O

And in particular, we can say which bits get provided by what: the mapping of the main clause of the infinitive to the scope and 'when'-clause to the restrictor is common to all these sentences, but different adjective phrases contribute different values for Q, B, and O. The one we've been most interested in is 'is disposed', which I've suggested, building on Manley and Wasserman, contributes

Q   =   'most'

B(w)   =   {w*: laws of nature and intrinsics of referent of 'N' are just as they are in w}

O   =   empty

I think this type of analysis is very plausible for the adjectives manifestly expressing familiar modalities getting operator treatment in normal modal logics – that is, adjectives like 'believed', 'known', 'permitted'. Here some potential instances of the schema for some of those adjectives:

(16)   Mark is permitted to smoke when he is stressed.

⟦Some ⟨B(w) ∩ min($\leq_0$, ⟦Mark is stressed⟧), ⟦Mark smokes⟧⟩ ⟧

Quantifier: Existential

B(w) =   set of worlds compatible with realistic base characterizing any
                relevant facts apart from the rules

$\leq_0$ =   ordering induced by relevant body of permissions, rules, or
                regulations

Gloss: true just in case some worlds in which Mark is stressed among those
                most compliant to the rules and preserving certain relevant facts
                are worlds in which Mark smokes.

(39)   Mark is required to smoke when he is stressed.
        ⟦All ⟨B(w) ∩ min(($\leq_0$, ⟦Mark is stressed⟧, ⟦Mark smokes⟧⟩⟧

Quantifier: Universal

B(w) =   set of worlds compatible with realistic base characterizing any
                relevant facts apart from the rules

$\leq_0$ =   ordering induced by relevant body of permissions, rules, or
                regulations

Gloss: true just in case some worlds in which Mark is stressed among those most compliant to the rules and preserving certain relevant facts are worlds in which Mark smokes.

(34)   Mark is believed to smoke when he is stressed.
              $[\![$All $\langle B(w) \cap \min((\leq_0, [\![$Mark is stressed$]\!], [\![$Mark smokes$]\!])\rangle]\!]$

       Quantifier: universal

       $B(w) =$ set of worlds compatible with modal base characterizing relevant propositions believed

       $\leq_0 =$ empty ordering

       Gloss: true just in case all the worlds compatible with what is believed by relevant person or persons in which Mark is stressed are worlds in which Mark smokes

(35)   Mark is known to smoke when he is stressed.
              $[\![$All $\langle B(w) \cap \min((\leq_0, [\![$Mark is stressed$]\!], [\![$Mark smokes$]\!])\rangle]\!]$

       Quantifier: universal

       $B(w) =$ set of worlds compatible with modal base characterizing relevant propositions known

       $\leq_0 =$ empty ordering

       Gloss: true just in case all the worlds compatible with what is known and in which Mark is stressed are worlds in which Mark smokes

I don't have anything in particular to say in favor of these analyses, but I take their similarity to existing analyses to constitute some evidence in favor of the general approach. Nor do I have any defense that plausible accounts could be produced for other adjectives like 'inclined', 'destined', 'determined', 'expected' which lack the familiar treatment in possible worlds frameworks of those adjectives considered above.

        Let's compare-and-contrast this approach with Fara's own analysis. Recall that Fara takes disposition ascriptions to express an operator DISP on a habitual which has the truth condition 'DISP(x ψs when φ)' = 1 just in case x ψs when φ in virtue of an intrinsic property of x. The habitual is given a quantificational semantics: Fara takes habituals to express (a) universal quantification over possibilities (b) restricted to exclude 'admissible exceptions' (c) restricted to

the most comparatively similar possibilities satisfying the 'when'-condition. What this gives us is roughly the following division of semantic labor:

'Mark is disposed to smoke when he is stressed.'

$\text{DISP}_{\text{Mark}}((\forall w : w \in [\![\neg AE]\!] \cap \min(\leq, [\![\text{Mark is stressed}]\!]))([\![\text{Mark smokes}]\!]))$

where $[\![\neg AE]\!]$ is the set of possibilities which aren't admissible exceptions, $\leq$ is an overall similarity ordering (like a Lewisian comparative similarity ordering or a Kratzerian totally realistic ordering) and $\min(\prec, A)$ for binary relation $\prec$ and set A denotes $B \subseteq A$ such that $b \in B$ just in case (i) $b \in A$ and (ii) for any $a \in A$, if $a \prec b$ then $a = b$.

According to Fara 'is disposed' (red highlighting) contributes only the disposition operator DISP. Observe that the truth-conditional contribution of DISP is not even exhausted by the contribution of 'is disposed' – it also requires the specification of a subject whose intrinsic properties the operator cares about.

The main clause of the habitual (blue) contributes the *matrix proposition* expressed by 'Mark smokes' and additionally *the unpronounced habitual quantifier* which can be broken down into three moving parts – *universal force*, *restriction to the most similar worlds*, and *restricting out 'admissible exceptions'.*

The 'when'-clause of the habitual (green) maps into the restrictor; altogether the habitual expresses the universal quantificational relation between the domain of order-minimal, non-'inadmissible exception' worlds where the 'when'-clause is satisfied and the domain of worlds in which the main clause of the habitual is satisfied.

I think it is easy to see that Kratzer's approach is far more adequate than Fara's to explaining the truth conditions of sentences in the Fara class. The central difference between the two is this: Fara treats 'is disposed' <u>as an operator on a modal quantifier (the habitual)</u> whereas on the (M-W-K) approach 'is disposed' is treated <u>as itself a modal quantifier</u>. Given the Fara constraint, the operator style story will explain the different truth conditions between sentences in the Fara class by telling a story about all these *different kinds of operators on habituals* there are.

As I illustrated above, one thing the modal quantifier approach has going for it, and least for some of the relevant sentences, is tradition – we know what to say about 'is known' or 'is believed' because the modal force, modal base. and ordering sources associated with knowledge and belief attributions are relatively well understood. However, on Fara's analysis, the force, base, and source are *independent of the adjectives* – they are provided by an unpronounced habitual quantifier. This seems bad for at least two reasons. First, we should prefer to explain the semantics in terms of pronounced elements before appealing to unpronounced elements like the generic quantifier. In generic sentences, we have good reason to posit the unpronounced habitual quantifier – the sentences seem quantificational, but there is are pronounced constituents can plausibly be understood as a quantifier. However, the sentences we've been looking at do have a pronounced element that can be understood as contributing a modal quantifier – the adjective phrase. The second reason the unpronounced habitual quantifier looks bad is precisely because we lose the explanatory power of the key elements of the modal quantifier story to the habitual, which does essentially no work. We want to avail ourselves of the descriptive resources of possible worlds

quantification to explain the differences between these sentences – we want to say e.g. that 'required' and 'allowed' can take similar bases and orderings in a context but are differentiated in terms of the former having universal and the latter having existential quantificational force. On Fara's approach, what we have is two operators which embed the generic quantifier – universal force, all-things-considered similarity ordering, restricted to bar 'permissible exceptions.' Since all of that is shared by all of the sentences under consideration, despite their obviously quite different truth conditions, the question arises, why should we think an unpronounced habitual quantifier is doing so much semantic work?

    b.   Entailments / nonentailments: counterfactuals

An important element of the Kratzerian approach to modals is its ability to capture entailments between modal sentences. For instance, given 'required' and 'allowed' ascriptions taking the same base and source, we can explain why the 'required' ascription entails the 'allowed' one in terms of the respective modal forces contributed by the adjectives.

When it comes to dispositions, the obvious entailment /non-entailment to scrutinize is with counterfactual conditionals. Luckily Kratzer has an analysis of conditionals within the framework. Counterfactuals are just one of a number of modalized conditionals:

> *The logical forms of such conditionals conform to the following rough schema, where an adjoined if-clause modifies a sentence that has a modal sitting in its left periphery:*
>
> *(If ....), (necessarily ......)*
> *(If ....), (possibly ......)*
> *(If ....), (probably ......)*
> *etc.*
>
> *The matrix clauses of such conditional constructions are run-of-the-mill overtly or covertly modalized sentences of the kind we have been discussing. The job of if clauses in modalized conditionals is simple: they restrict the modal base of the associated modal in the matrix clause.[24]*

In particular

> *A counterfactual is characterized by an empty modal base f and a totally realistic ordering source g.[25]*

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[24] Kratzer 1981 / forthcoming pp. 42 - 43
[25] Kratzer 1981 / forthcoming pp. 42 - 43

A 'totally realistic ordering source' is a set of premises completely characterizing the way the world is; the ordering induced by a totally realistic premise set is thus an ordering of comparative similarity to a world. Thus the informal truth-conditional gloss of Kratzer's analysis is just like the familiar Lewis story: 'if φ, it would be that ψ' is true just in case all the most comparatively similar worlds where φ are worlds where ψ.

Disposition ascriptions don't entail counterfactuals on a picture combining Kratzer's analysis of counterfactuals with (M-W-K1). Why? Essentially because of they are mismatch in every dimension: different modal force, different modal base, different ordering source. Manley and Wasserman's 'problem of accidental closeness' illustrates what I take to be the most important aspect of divergence: counterfactuals are primarily characterized by the totally realistic ordering source, whereas disposition ascriptions do not primarily care about the 'most similar' worlds, but rather about a 'broader' space of worlds preserving a very specific body of facts – those concerning the intrinsic properties of the object and the laws of nature.

This captures the basic element of the inferential role that dispositions play in ordinary and scientific reasoning, which seems quite different from the role of counterfactuals: if you know that some stuff is disposed to dissolve in water, then you are able to predict dissolution in cases of being placed in water without knowing anything else about the extrinsic circumstances of the setup. Of course this prediction is defeasible – the truth of the disposition ascriptions requires only that dissolution occurs in *most* test cases, and we may be able to identify preventative or unlucky circumstantial factors operative in separating the dissolution cases and the non-dissolution cases. But the important point is that the applicability of counterfactual knowledge to a possible case is in general as strong as that case is similar all-things-considered to the actual world, while the applicability of knowledge of dispositions to a possible case is not so dependent on overall similarity.

This gives us a picture of why dispositions don't entail the corresponding counterfactuals and why the classic counterexamples work. All of the counterexamples play on extrinsic circumstances that prevent manifestation in the most comparatively similar possibilities. But disposition ascriptions care about a 'wider' domain of possibilities. (The domain isn't strictly wider in the sense of having the counterfactual-relevant possibilities as a proper subset; some of the most similar worlds all-things-considered where the disposition is tested may violate the intrinsic-sameness requirement; though given a large role for laws in overall comparative similarity, the counterfactual-relevant worlds will likely all be compatible with the laws.) The Kratzerian formulation also suggests an answer to the much discussed question 'Do the counterexamples show that any conditional account of disposition ascriptions is wrong or just the (SCA)?' We want to isolate what went wrong with the (SCA) and what if any features of the counterfactual that might be shared by other expressions are mismatched to the analysis of disposition ascriptions. The answer suggested by this approach is that the failure of the (SCA) arises because of the particular modal mismatch between disposition ascriptions and counterfactuals: they simply quantify over different worlds, and with different quantificational force to boot. Kratzer's deflationary take on conditionals – that 'if'-clauses just mark restrictions on operators – suggests that she would likely not take the problems of the (SCA) to generalize to *any* conditional – after all, we could presumably cook up a conditional corresponding to any restricted modality. I think by and large the examples suggest (with caveats discussed in §7g) that disposition ascriptions just don't care which worlds are the

most comparatively similar – they quantify over some similar worlds, and some not-so-similar worlds, but similarity is beside the point (empty ordering source).

c. Relevance, test, and manifestation talk

A major motivation that has led me to the (M-W-K) analyses arises from the following constraint: since we have intuitions about which possibilities are relevant and which possibilities are irrelevant to specific disposition ascriptions, and we're understanding disposition ascriptions as quantifiers over possibilities, we'd like our quantificational treatment to predict that the intuitively relevant possibilities are in the domain of quantification of the analysans and the intuitively irrelevant possibilities are not in the domain of quantification. One reason the (SCA) fails to satisfy this constraint is that a lot of intuitively *relevant* possibilities are *not* in the domain counterfactuals quantify over. I have a fragile glass in front of me on my desk. I am considering various possibilities and wondering whether they or not they are relevant. My intuition is the following: possibilities quite dissimilar to the actual world in which the fragile glass is subjected to an appropriate stress, assuming the laws and intrinsics are the same, are still relevant – perhaps just as relevant – as the most comparatively similar possibilities in which it is stressed. In slogan form: *the relevant possibilities far exceed the inner sphere*.

Another example is the kind of analysis, which I discuss in my undergraduate thesis, which see the problem of the counterexamples to the (SCA) as arising because of its vaguely specified test and response conditions.[26] The analysis of 'x is fragile' as 'if x were struck it would break' isn't wrong because anything having to do with the counterexample; rather, the problem was that 'x is fragile' actually means 'if x were φ, x would ψ' for some highly precise conditions φ and ψ – e.g 'is x were struck with such-and-such force, in such-and-such conditions…' This approach does especially badly with respect to this relevance constraint: it restricts the test cases to such a narrow class of situations that almost every *intuitive* test for fragility is irrelevant to truth-conditions – really it is only this very narrow class that actually matters.

Another side of the coin here is 'manifestation'-talk. When a disposed object is put to the test and responds appropriately, we call that a manifestation of the disposition. I think ideally we should comply with a strong 'manifestation'-relevance constraint: that if c is a case in which a disposition manifests, then c should be (a) in the relevant domain of quantification and (b) one of the 'good cases' which satisfies the quantificational relation – that is, a case in which the object gives the response. But my intuition at least is that exotic, remote possibilities in which the glass breaks are no less manifestations of its fragility than the highly comparatively similar worlds where I knock it off of my desk and it breaks.

The idea is that once we've settled on a quantificational approach to disposition ascriptions, all we have to do to fill in the details is agree on (a) which test cases are relevant (b) which of those cases are manifestations and (c) the force of the quantification. What we want is an equivalence (or high degree of similarity) between the intuitive notions we use in our understanding of and reasoning about disposition ascriptions and the elements of our formal analysis that play similar roles in the characterization of truth-conditions.

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[26] Lewis 1997, Gundersen 2002, and Choi 2006 are exemplars of this approach.

The appeal to intrinsics + laws was Manley and Wasserman's way of capturing which test-possibilities are relevant, and to me it seems that the T-cases line up pretty well with intuitive disposition tests. Manifestations are easy – those are the test cases in which the disposition gives the response. Quantificational force is hard – more on that in §7f.

d. 'Absent stimulus conditions'

One problem that the (M-W-K) analysis does nothing to solve but does assimilate to an existing and tractable problem in linguistics is what M & W call the problem of 'absent stimulus conditions.' The problem is simple: some dispositions don't have 'when'-clauses, but their truth-conditions are not correctly characterized by taking that to indicate an empty restrictor.

(40)   Corey is disposed to play tough defense.
(41)   Zach has this obnoxious disposition to prattle on incessantly.
(42)   Audrey is disposed to oversell the merchandise.

Sentence (40) does *not* intuitively mean that Corey plays tough defense on most possible occasions holding fixed intrinsics and laws. Rather, it means roughly that Corey plays tough defense on most possible occasions holding fixed intrinsics and laws and *in which he is playing defense*. The basic problem is that we don't get the right truth-condition predictions by supposing that no 'when'-clause means a null condition is mapped to the restrictor. Intuitively, it seems like context provides an implicit restriction – the restriction to possibilities in which Corey is playing defense, or Zach is in a conversation, or Audrey is trying to sell merchandise.

I don't really have anything to say about absent stimulus conditions except that on the quantificational approach I'm advocating the problem can be seen as a specific instance of a general problem very familiar to philosophers and linguists going back at least to Quine:

> *When adverbs do not wear their restrictions on their sleeve, there is work to be done between the surface appearance of a sentence and its ultimate interpretation. For example, Quine (1966: s37, pp. 90-92) noticed the ambiguity of (14):*
>
> *(14) Tai always eats with chopsticks.*
>
> *The preferred reading is clearly not the one which claims that in all situations, Tai can be found eating with chopsticks. Instead, the sentence is most naturally read as claiming that in all situations in which Tai eats, Tai eats with chopsticks. The interesting problem is how we arrive at this interpretation.*[27]

Kai von Fintel discusses two broad approaches we might take to this problem: on a *semantic approach*, 'the restriction on the adverb is made explicit in the logical form and is computed by

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[27] von Fintel 1995, p. 143

grammatical processes', while on a pragmatic approach, 'the domain of quantifiers is an anaphor whose reference is pragmatically determined.'[28]

The upshot is not that this diagnosis suggests a simple solution, but understanding the phenomenon as an instance of implicit quantifier domain restriction not only bolsters the case that disposition ascriptions have a modal quantificational structure but also allows philosophers interested in disposition ascriptions to avail themselves of existing resources from semantics to understand the phenomenon.

That concludes the merits subsections; let's turn now to some demerits of (M-W-K1) and consider some potential revisions to rectify the shortcomings. In (e) I discuss the problem of quantifying over possible *worlds* – shouldn't we be quantifying over smaller possibilities? I think we should be, and the subsequent sections of the paper are devoted to providing a reformulation that satisfies this constraint.   In (f) I discuss the problem of modal force – is 'most' right? Is it informative? I will have little to say about modal force and consider it a serious issue for the account. In (g) I discuss a particular class of cases which constitute counterexamples to (M-W-K1) – purportedly *extrinsic* dispositions – and reformulate the account to accommodate them.

e. Possible *worlds?*

One significant demerit of (M-W-K1) arises because in adopting the simple possible worlds framework for modality, we quantified over much bigger things than our talk about 'disposition tests' and 'manifestations' suggests. The relevant possibilities seem be smaller than worlds – more like cases, events, or situations. The simplest way to press this point is by considering the actual case – if I actually subject some object to what I intuitively count as 100 fragility tests (*whack!* 'One…'*whack!* '…two…'), I'd like to think that our semantics counts up 100 fragility tests. But given that possible worlds are *maximal* – they represent a way the world could be *in total* – the relevant counting unit is just one: the actual world.

In reframing the discussion in a possible worlds framework, I mischaracterized both Fara's semantics for habituals and Manley and Wasserman's original account, both of which are cast in terms of quantification over less-than-maximal possibilities. M & W call them 'T-*cases*' (as I have paraphrased, or 'C-cases' in the original) and not 'T-worlds' for a reason. Fara's semantics for habituals which I glossed as restricted quantification over worlds is actually presented in terms of a different formalism more suitable for smaller-than-world possibilities, a (Lewis 1975)-style unselectively binding case quantifier.

I think we would do better to treat disposition ascriptions as quantifiers over possibilities which needn't be maximal; they are (like generics) exemplary quantificational modals in the sense of '[incorporating] the semantics of an adverb of quantification with some sort of additional, more properly 'modal' meaning.'[29]

There is a large body of work in semantics on quantificational modality, but I will discuss just two approaches (which I think represent much of the mainstream): first and very briefly the

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[28] von Fintel 1995 p. 143
[29] Portner 2009 p. 213

Lewisian bound-variable approach (which Fara suggests for the semantics for habituals) and second the Kratzerian situation theoretic approach..

Michael Fara's analysis of the operator DISP is supplemented by a semantics for the habituals that DISP operates on. On Fara's account (and following the majority of work in semantics on generics) habituals carry a phonologically null habitual quantifier which is treated as an *unselective binder* ranging over admissible assignments to *any free variables* in its scope. The idea derives from Lewis's discussion of adverbs in quantification in (Lewis 1975). Here's an example due to Lewis:

(43)   Sometimes, p divides the product of m and n although p divides neither m nor n.[30]

On the Lewis-style treatment, (43) is true just in case 'p divides the product of m and n although p divides neither m nor n' is true on *some* admissible assignment to m, n, and p, and (44) is true just in case it is true on *every* such assignment:

(44)   Always, p divides the product of m and n although p divides neither m nor n.

Fara sees the habitual as a *non-numerical quantifier* over cases (admissible assignments), which is to say that it's truth conditions depend on more than just the number or proportion of cases quantified over satisfying the clause. The added non-numerical bit in Fara's account is the element of 'permissible exceptions.' The idea is that habituals, which don't entail their universally quantified counterparts, don't simply care how many or what proportion of cases satisfy the nuclear scope condition; rather, they care what proportion of admissible assignments *apart from permissible exceptions* satisfy the nuclear scope condition. According to Fara, a habitual 'x ψs when φ' is true just in case all exceptions are *permissible exceptions*. A permissible exception – developed in more detail in Fara's thesis – is essentially an exception (i.e. a case in which φ(x) but not ψ(x)) *due to the presence of some preventative interference*. So for instance, the habitual 'I sleep when I'm tired' is true just in case every case in which I'm tired and not sleeping is a case in which particular preventative factors are at work.

For no particularly good reason I'm going to focus on the other approach – Kratzer's situation theory – and develop a reformulation of (M-W-K1) in that framework. Before doing that, let's consider some other demerits of (M-W-K1) and try to supply any appropriate amendments.

f. Modal force

David Manley and Ryan Wasserman have very helpfully discussed several problems with taking the modal force of disposition ascriptions to be 'most.' The first problem is simply that their analysis (and my reformulation of it) give the incorrect predictions in some cases, e.g. ones in which the intended modal force is less than 'most.'

Consider two aeronautic engineers discussing hull materials for a new fighter jet they are designing. One says,

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[30] Lewis 1975, p. 7

(45)   Aluminum, though cheap and readily available, would not be a good choice for the
         hull – aluminum is fragile, so we should try a steel allow instead.

Intuitively, the engineer means that aluminum is relatively fragile – not that it would break in *most* cases of being stressed, but that it would break in a higher proportion of cases than the relevant comparison class of potential hull materials. Manley and Wasserman emphasize this similarity of disposition ascriptions to classic gradable adjectives, and suggest that we *parameterize* the modal force:

> *In short, different dispositional predicates may be associated with different proportions of the range of relevant C-cases. This suggests a more flexible approach:*
>
> *(PROP) N is disposed to M when C if and only if N would M in some suitable proportion of C-cases.*
>
> *How big a proportion is 'suitable' will depend not only on the dispositional predicate involved but also on the context of utterance. For instance, we saw that engineers working with slabs of concrete and chemists working with glass electrodes may ascribe different properties with the predicate 'fragile.'*[31]

I agree with M & W that our truth-condition intuitions seem to correspond to different proportions for different disposition ascriptions in different contexts of utterance; let's incorporate it into the Kratzer-ized version of their analysis:

(M-W-K2) $[\![N \text{ is disposed to } \psi \text{ when } \varphi]\!]^{w,\tau} = 1$ iff $\tau\langle[\![\varphi]\!]\cap B(w),[\![\psi]\!]\rangle^w = 1$

where τ is a contextually provided proportion relation

However, we'd like to give a systematic account of the mechanisms by which the relevant proportions come to be expressed. But Manley and Wasserman have no story about that and I don't either. Part of the problem is that these 'proportionality' intuitions are vague (and as we will see problematic in other ways). Once disposition ascriptions are taken to be quantificational modals it seems like we have to admit that the force of the quantifier is variable, but here does not seem to be any straightforward story to be had about how the quantificational force varies with context except to appeal to speakers' intentions.

The problem of quantificational force is compounded by the problem of comparing proportions of possibilities of presumably *infinite* cardinalities.

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[31] Manley and Wasserman 2008, p. 76

The remaining concern is a significant one. The view requires that we can make sense of claims like 'N₁ would break in more C-cases than N₂'. But presumably in ordinary cases where one thing is more fragile than another, there are (at least) continuum-many C-cases in which both objects would break. How are we to interpret 'more' when we are comparing sets of the same cardinality?[32]

Manley and Wasserman suggest two lines of response. The first line is that what matters to the semantics are speakers *intuitive*, *pre-theoretic* judgments of relative modality, which are likely *not* understood in terms of proportional relations of sets of possible worlds or situations, but rather as tracking some *intuitive measure*(*s*) which serve as our cognitive guide to the distribution response versus no-response throughout the possibility space. 'Fragile' is a good example: suppose we adopt the once-popular view that the test condition for fragility is *being dropped* and the response condition is *breaking*. On this view, the possibility space is naturally intuitively 'measured' along the dimensions (a) how high? (is it dropped from) and (b) how hard? (is the surface it's dropped onto). These measures are good ones for fragility because we can make plausible (though defeasible) generalizations on the basis of a single case: if x is dropped from six feet onto a hard surface and breaks, it probably breaks when its dropped from > 6 feet onto an equally hard or harder surface. If we test two objects in the same way for a disposition, and one gives the response while the other doesn't, we have good reason to suppose that response-giver is more disposed than the other on the assumption that we can generalize from the instance to other relevant cases, and intuitive measures give us a good basis for such generalizations.

The second line is that 'the structure of reality' may deliver a measure 'that decides the matter in a fashion that would match our intuitions of proportions of C-cases.'[33] They tentatively propose as possible measures (a) the Louisville measure on phase space (b) relative measure of 'objective' or 'intrinsic' probability.

I have nothing to add to their suggestions. Insofar as semantics is foremost accountable to our truth-condition intuitions, any description that captures our actual proportional modal judgments will serve the semantics equally well. It would be interesting to discover that we are onto something deep in the structure of reality in these practices, but that is not of primary importance to the descriptive adequacy of the semantics.

While I sometimes worry that the problems of quantificational force threatens to render the entire Manley and Wasserman-style account vacuous, I think there are reasons to suppose that maybe it isn't such a big problem after all. In any specific case with adequately specified contextual factors in which a disposition ascription is uttered, we will have vague though substantive intuitions about which possibilities are relevant, and if we know the relevant facts, judgments about relative proportions of modal space. I am inclined to think that in specific cases, our intuitions will not diverge from the basic constraints of the (M-W-K) analysis, even if the analysis does not describe all of the potentially relevant contextual factors that determine intended quantificational force.

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[32] Manley and Wasserman 2008, p. 79
[33] Manley and Wasserman 2008, p. 81

One reason to think that such factors will not ultimately be amenable to systematic treatment is the fact that judgments about proportions of possibilities, and by extension the intended force of proportional quantification on a given context of utterance, are so strongly tied to specific 'intuitive measures' we can lean on in a specific case. When we are thinking about testing for fragility, a measure like the *degree of force* of a stress will be an indispensable guide to our modal thinking because of our ability to make inferences based on the value of the measure: e.g. that if x breaks when stressed with degree of force d, it would break when stressed with any degree of force > d. Proportions for 'fragility' ascriptions and comparisons of relative fragility will very likely be rooted in intuitive measures like degree of force. But as Manley and Wasserman observe, intuitive measures differ from case to case, and in many cases we won't have one or even a small cluster of intuitively best measures for making judgments of proportional and comparative modality.

g. The challenge of extrinsic dispositions

So far, I have suggested that supposing that dispositional modal bases characterize intrinsic properties and laws of nature is a way of making good on the thesis that dispositions are shared by intrinsic duplicates. But I didn't actually motivate the intrinsic duplicates thesis, which has recently received a significant amount of criticism in the dispositions literature.

The challenge is simple: Jennifer McKitrick and others[34] have presented numerous examples of sentences which seem to be ascribe dispositions that needn't be shared by intrinsic duplicates. Since the (M-W-K) analyses do predict that the same disposition ascriptions will be true of intrinsic duplicates subject to the same laws of nature, these cases, if they are genuine, provide straightforward counterexamples to these analyses.

The counterexamples divide into two importantly different types of cases: (a) 'is disposed' ascriptions and (b) predicates which intuitively ascribe dispositions. I distinguish these types and focus exclusively on (a)-type cases because I am tempted in most (b)-cases to respond in the obvious way – that the sentences aren't in fact disposition ascriptions.

Let's look at some type (a) cases.

(46)   This key is disposed to open my front door.
(47)   The cup of water is disposed to dissolve the contents of my pocket.
(48)   That dog is disposed to depress a properly constructed scale so as to elicit a reading of 85 pounds in its gravitational field.

Example (46) is a classic case from Sydney Shoemaker of what he calls 'a mere-Cambridge power.'[35] The disposition can be lost or gained by changing only extrinsic facts – specifically, facts about what the lock on my front door is like. Example (47) is a case in which the water's disposition changes depending on what's in my pocket. Example (48) is offered as an analysis of a weight ascription; its truth value will vary depending on the gravitational field in which the dog is located.

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[34] McKitrick 2003 is the original paper spurring the debate in the literature.
[35] Shoemaker 1984, p. 221.

To be honest, many of the examples in the literature – (47) and (48) for instance –sound quite marginal to my (admittedly biased) ear. However, I do think that there are genuine, undeniable, straightforward, natural examples of 'extrinsic disposition ascriptions' that fit the influential formula of Shoemaker's key and don't sound nearly as weird as cases like (47) and (48). What Shoemaker's key and almost every subsequent example of a purportedly extrinsic disposition have in common is that some entity or entities described in the infinitive clause form an integral part of the causal process connecting the disposition test and result, and the obviousness of this role forces us to restrict our attention to possibilities in which that entity or entities are (a) intrinsically just as they actually are and (b) related to the object ascribed the disposition in the ways they are actually related. The key's disposition to open a certain door door is unmistakeably grounded in more than the intrinsic properties of the key and the laws of nature – it crucially involves the fact that the lock on the front door is a certain way.

The (M-W-K) modal base doesn't give the right truth-condition predictions because it fails to preserve any facts besides intrinsics and laws; I'll try to fix this by telling a story about when and why we need to be some extra facts into the modal base.

Consider an utterance of (49), which looks to me to ascribe a straightforward, unproblematic, but undeniably extrinsic disposition:

(49)   Lebron is disposed to blame Eric Spoelstra when the Heat lose.

Let's suppose (49) is true. The (M-W-K1) analysis gives the following truth condition: (49) is true just in case most possibilities preserving Lebron's intrinsics and the laws in which the Heat lose are possibilities in which Lebron blames Spoelstra. But that can't be right – most of the possibilities compatible with that modal base are possibilities in which Lebron doesn't play for the Heat and isn't coached by Spoelstra. And we don't mean to say by uttering (49) that Lebron blames Spoelstra in most of those possibilities. Rather, we intuitively want a more limited domain of modal quantification: something like the subset of the (M-W-K1) domain in which Lebron plays for the Heat and Spoelstra coaches the Heat.

If this is right, the (M-W-K) analysis finds itself in straights between Charybdis and Scylla – on the one hand, if we *don't* build additional facts (beyond intrinsics + laws) into the modal bases of disposition ascriptions, the analysis will simply generate the wrong predictions for cases like (49). This an unacceptable result; despite most of the standard examples of extrinsic dispositions being far removed from ordinary usage, extrinsic disposition ascriptions like (49) permeate our everyday talk and thought. We cannot rest content with an account that is patently incorrect for cases like these.

On the other hand, I have been repeating ad nauseum the claim that these dispositional modal bases which characterize *only* intrinsics + laws are the central pillar of the (M-W-K) account and the heart of what characterizes disposition ascriptions among modal meanings – what makes them different than conditionals, habituals, etc. If we respond to cases like (49) by building in extra non-intrinsic non-lawful facts into the modal base, we either have to suppose these facts can go into modal bases for disposition ascriptions generally – and thus lose the general notion of a dispositional modal base that was the core of the analysis – or draw a line between the extrinsic

disposition ascriptions and the ones for which are supposed to take purely intrinsic + lawful facts in the modal base.

My tentative suggestion is that we can draw a line between the disposition ascriptions which take the sort of intrinsics + laws modal base I have stomping my feet and pounding my fists about and those like (49) in terms of whether their infinitival complements specify test and response conditions *qualitatively* or not. I have in mind, for instance, the difference between

(49)   Lebron is disposed to blame Eric Spoelstra when the Heat lose.
(50)   Lebron is disposed to blame his coach when his team loses.

Sentence (50) seems to get the right results without needing any additional facts in the modal base: possibilities in which Lebron plays for the Celtics and blames Doc Rivers are intuitively relevant cases; but those cases are obviously not relevant to (49), which intuitively quantifies only over possible cases in which Lebron plays for the Heat and is coached by Spoelstra. Similarly, compare the first four qualitatively specified dispositions to their non-qualitative counterparts:

(13)   Mark is disposed to smoke when he is stressed.
(40)   Corey is disposed to play tough defense.
(41)   Zach has this obnoxious disposition to prattle on incessantly.
(42)   Audrey is disposed to oversell the merchandise.

(51)   Mark is disposed to smoke when he's around Mary.
(52)   Corey is disposed to play tough defense against the Spurs.
(53)   Zach has this obnoxious disposition to prattle on incessantly when he's talking to Miriam.
(54)   Audrey is disposed to oversell the merchandise to visiting Japanese tourists.

I think in the dispositional modal bases I have characterized in the (M-W-K) analyses line up relatively well with the intuitively relevant possibilities in the first four examples. But in the second examples, there are lots of irrelevant possibilities compatible with the dispositional modal base: cases in which Mark and Mary have never met, cases in which Corey plays for the Spurs, cases in which the behaviours of Japanese tourists are nothing like they actually are.

My suggestion is that when we specify test- and response-conditions in non-qualitative terms, it is in general manifestly obvious that we're ascribing a disposition which depends to some degree on the non-qualitatively specified stuff in the condition being more-or-less as it actually is, and more-or-less related to the object ascribed the disposition in the ways they are actually related. When the disposition ascribed quite obviously involves relations or interactions with some entity or entities non-qualitatively specified in the infinitive, I propose that linking facts characterizing what the entity or entities are like, and characterizing how they relate to the object ascribed the disposition, will also go into the modal base.

Returning to the specific cases, our qualitative Lebron sentence will get the usual standard treatment.

(50)   Lebron is disposed to blame his coach when his team loses.
         Most⟨⟦Lebron's team loses⟧ ∩ B(w),⟦Lebron blames his coach⟧⟩

Because B(w) is just the standard intrinsics + laws dispositional modal base, (50) is true just in case most possibilities in which Lebron's team loses (which will include predominantly cases where he plays for teams other than the Heat) are situations in which he blames the coach (who will be someone other than Spoelstra in most possibilities). I think these truth conditions are plausible – what (50) ascribes is a disposition to blame the coach for a loss which intuitively is not grounded in specific facts about Lebron's particular team and coach.

But (49) may intuitively be grounded in specific facts about Spoelstra and the Heat – perhaps I utter (49) because of what I know about Lebron's attitudes towards Spoelstra and the particular makeup of the 2010-2011 Miami Heat organization. In such a case, the linking facts for Spoelstra and the Heat will also go into the modal base, yielding roughly the following:

(49)   Lebron is disposed to blame Spoelstra when the Heat lose.
         Most⟨⟦Heat lose⟧ ∩ B+(w),⟦Lebron blames Spoelstra⟧⟩

         where B+(w) is the modal base characterizing intrinsic properties of Lebron, the
         laws of nature, and linking facts about the Heat, Spoelstra, and the   relations they
         bear to Lebron

While I think we have a good sense of what the relevant linking facts are in the particular case – facts about the roster and history of the Miami Heat, facts about the personality of Spoelstra, and most importantly the facts that Lebron plays for the Heat and Spoelstra coaches the Heat – once again it seems unlikely that we could improve the account with a general description of which linking facts will be relevant in which cases of non-qualitatively specified conditions. Similarly, by applying this to examples (51), (52) and (53) we get something like

(51)   Mark is disposed to smoke when he's around Mary.
         Most⟨⟦Mark is around Mary⟧ ∩ B+(w),⟦Mark smokes⟧⟩

         where B+(w) characterizes (a) Mark's intrinsic properties at w, (b) laws of nature
         at w, (c) Mary's intrinsic properties at w, and (d) relations holding between Mark
         and Mary at w

(52)   Corey is disposed to play tough defense against the Spurs.
         Most⟨⟦Corey plays defense again the Spurs⟧ ∩ B+(w),⟦Corey plays tough defense⟧⟩

         where the restrictor clause is provided by implicit quantifier domain restriction

         and B+(w) characterizes (a) Corey's intrinsic properties at w, (b) laws of nature
         at w, (c) the Spurs' intrinsic properties at w, and (d) relations holding between
         Corey and the Spurs at w

(53) Zach has this obnoxious disposition to prattle on incessantly when he's talking to Miriam.

Most⟨⟦Zach is talking to Miriam⟧ ∩ B+(w),⟦Zach prattles on incessantly⟧⟩

where B+(w) characterizes (a) Zach's intrinsic properties at w, (b) laws of nature at w, (c) Miriams's intrinsic properties at w, and (d) relations holding between Zach and Miriam at w

As far as I can tell, these analyses, though quite vague, predict prima facie plausible truth-conditions, and – crucially for the (M-W-K) analyses – allow us to preserve the generalizations about dispositional modal bases with the caveat about linking facts for non-qualitative descriptions. What I have emphasized is that disposition ascriptions are insensitive to matters of overall comparative similarity, which is still true even on the amendment made to accommodate non-qualitative linking facts: ascriptions of extrinsic dispositions still have an empty ordering source, but have a slightly richer modal bases, incorporating not only facts characterizing the intrinsic properties of the object ascribed the disposition and the laws of nature, but also relevant linking facts concerning stuff non-qualitatively specified in the infinitive.

Schematically, here is the proposal:

(M-W-K3) $\llbracket$N is disposed to ψ when $\varphi\rrbracket^{w,\tau} = 1$ iff $\tau\langle\llbracket\varphi\rrbracket \cap B+(w),\llbracket\psi\rrbracket\rangle^w = 1$

where τ is a contextually provided proportion relation

B+(w) characterizes the intrinsic properties of the referent of 'N' at w and laws of nature at w, and for any non-qualitative descriptions in ψ and φ, relevant linking facts about the properties of the non-qualitatively specified elements and their relations to the referent of 'N' at w

I have applied two revisions to (M-W-K1) – from 'most' to proportional quantification, and from modal base B(w) to B+(w) – and have flagged another not explicitly articulated in (M-W-K3), namely the need to account for implicit quantifier domain restriction (most notably in cases of 'absent stimulus conditions.') I propose that these resources are adequate to characterize the truth conditions of disposition ascriptions. In particular this means that all restrictions on the possibilities quantified over besides compatibility with propositions characterizing intrinsic properties and laws will be due either to either to non-qualitative linking facts in the modal base or

implicit domain restriction of the sort we saw in the case of 'absent stimulus conditions.' I had originally hoped that we would only need to appeal to domain restriction phenomena in cases in which there simply is no 'when'-clause, but I now think it must be involved in other cases which neither have non-qualitative descriptions nor 'absent stimulus conditions.' Take for example sentence (12) which I have leaned on heavily in the analyses – 'Mark is disposed to smoke when he is stressed.' If we consider how it fares with respect to the constraint that possibilities quantified over in the semantics should be the same ones we take to be intuitively relevant, I think it becomes clear that it may not be doing so well. In particular, should it count against Mark being so disposed that he doesn't smoke in possible cases compatible with the dispositional modal base in which he is stressed but cigarettes are unavailable? Even if those cases are relevant, by some conceivable intuitive measures of modal space, a significant proportion of possibilities among those preserving only Mark's intrinsic properties and the laws of nature may be one's in which cigarettes aren't available. And we don't want (12) coming out false because of the preponderance of those cases.

In this and many other cases, it seems that the best available answer is to plead implicit quantifier domain restriction. I think the ascription of behavioural dispositions to persons – one of several loci of disposition-talk in natural language – almost always involves implicit restriction to cases in which the person ascribed the disposition *can* give the response or not give the response. Of course to say they *can* is only to restate the problem: that there are some possibilities we want to exclude beyond the ones the account has so far told us we can. In summary, reserving the right to plead implicit quantifier domain restriction does seem motivated by specific examples, but presents the major methodological problem of allowing the account so much flexibility from case-to-case that testable predictions are hard to generate.

8.   Situation theory for frequency adverbs

At this point it is time to try to deliver on the promissory note in (7e): to try to reformulate the (M-W-K) analysis in terms of *modal quantification* in Portner's sense – as '[incorporating] the semantics of an adverb of quantification together with some sort of additional, more properly 'modal' meaning.'[36]   The reason is simple: for the treatment of disposition ascriptions as quantifiers over possibilities to have any plausibility, the possibilities quantified over must be individuated and counted in a plausible way. In particular, quantification over *maximal* ways things could be is not adequate to intuitive individuation and counting. We need to leave behind possible worlds for less-than-maximal possibilities.

I already mentioned that Fara adopts the Lewisian approach to modal quantification and treats generics as unselective binders ranging over admissible assignments to variables in the scope. I have every reason to think that the bound-variable approach is well-suited to the required reformulation of the (M-W-K) analysis, but for no particularly good reason I focus on a different approach to modal quantification, Angelika Kratzer's situation theory.[37]

In the possible worlds framework we've been working with until this point, propositions are identified with sets of possible worlds and modal relations are understood as semantic relations

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[36] Portner 2009, p. 213
[37] Kratzer 1989 / forthcoming

between sets of propositions (or equivalently, given the identification of propositions with sets of worlds, as set relations between sets of sets of worlds). On the situation theoretic approach, propositions are more fine-grained – they are identified with sets of *situations*, where situations are understood as (possible non-maximal) *parts of possible worlds*. There are a number of variations on the basic Kraterian approach that have been pursued in the literature; I will first discuss the basic elements of any Kratzer-style situation theoretic framework, then discuss the basic 'counting' problem for situational quantification, and finally reproduce a version of Kai von Fintel's semantics for adverbial quantification in a situation theoretic language.

(Berman 1987) and (Heim 1990) are two classic situation-theoretic accounts of adverbs of quantification from which the account I'll discuss below derives. The central element of models for situation theoretic language is a SITUATION STRUCTURE $\langle S, \sqsubseteq \rangle$ where S is a set of situations partially ordered by the parthood relation $\sqsubseteq$. Every situation is stipulated to be related by $\sqsubseteq$ to a *unique maximal element* – that is, for any $s_1 \in S$, there exists a *unique* situation $s_2 \in S$ such that (i) $s_1 \sqsubseteq s_2$ [RELATEDNESS] and (ii) for any $s_3 \in S$, if $s_2 \sqsubseteq s_3$ then $s_2 = s_3$ [$\sqsubseteq$-MAXIMALITY]. The unique $\sqsubseteq$-maximal element related to situation s is intuitively *the world of s*. For shorthand, we'll designate the unique $\sqsubseteq$-maximal element related to s as w_s (the world of s). Call two situations s_1, s_2 WORLDMATES just in case $w_{s1} = w_{s2}$. Only worldmates will be related by $\sqsubseteq$.[38]

These basic elements constraining situation structures together with the persistence assumption form the core of a Kratzerian situation semantics. There are other important elements that appear in specific implementations of situation theory. Kratzer's situation theory is closely tied to a picture of situations inherited from D.M. Armstrong – she takes situations to be composed from a stock of 'thin particulars' (individuals minus all their properties) together with properties or relations. Other authors have heavily leaned on mereological constraints on situation structures. For instance, it is often assumed that any non-empty set of situations will compose a situation that is the *mereological sum* of all the elements: that is, for any $A \subseteq S$ there exists a situation s_1 such that (i) for every $s \in A$, $s \sqsubseteq s_1$ and (ii) for any $s_2 \in S$, if $s \sqsubseteq s_2$ for all $s \in A$, then $s_1 \sqsubseteq s_2$. Paul Dekker[39] has pointed out an obviously bad feature of assuming universal mereological summation: namely that in any situation structure there exists only a single world.[40] Dekker points out the obvious solution – restrict summation to *worldmates* – and that is exactly what Kratzer does.[41]

The main problem for quantification over situations in the framework is that counting situations up in an unreflective way goes badly. We can't treat (55) as follows

(55)   I've gone snorkeling twice.
         $(\exists_2 s)(\llbracket \text{Alex goes snorkeling} \rrbracket^s = 1)$

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[38] Proof: Assume $s_1 \sqsubseteq s_2$. By unique maximal relatedness, $s_1 \sqsubseteq w_{s1}$ and $s_2 \sqsubseteq w_{s2}$. Since $\sqsubseteq$ is a partial order it is transitive; by transitivity $s_1 \sqsubseteq w_{s2}$. But since each situation is related to a single *unique* $\sqsubseteq$-maximal element and s_1 is related to $\sqsubseteq$-maximal elements w_{s2} and w_{s1}, $w_{s2} = w_{s1}$.

[39] Dekker 1995, p. 387

[40] Proof: According to universal summation, any set of situations composes a situation satisfying (i) and (ii) above. Let s be the sum composed of S – that is, the situation such that every situation in the structure is related by $\sqsubseteq$ to it, and $s \sqsubseteq s^*$ for any situation s^* such that $s^{**} \sqsubseteq s^*$ for every $s^{**} \sqsubseteq S$. Since every situations in S bears $\sqsubseteq$ to s and $\sqsubseteq$ is antisymmetric (because it's a partial order), if $s \sqsubseteq s^{***}$ then $s^{***} = s$. By the definition of $\sqsubseteq$-maximality, s is a $\sqsubseteq$-maximal element; by the uniqueness of $\sqsubseteq$-maximality, s is the unique $\sqsubseteq$-maximal element for every member of S – that is, the world of every situation in the structure.

[41] Kratzer 1989 / forthcoming, p. 8

because the occasions of snorkeling I intuitively intend to be counting are much more course-grained than situations are intended to be in the semantic framework. Suppose (55) is false – I've only gone snorkeling once. Consider the situation which intuitively *just* consists of my going snorkeling that one time. That's one situation s s.t. ⟦Alex goes snorkeling⟧^{s} = 1. But it isn't the only one! Consider the situation which is just a little bit bigger – it consists of my snorkeling and my eating watermelon on the beach afterwards. That's also a situation in the denotation of 'Alex goes snorkeling' – and we can see the problem – there are many, many situations in the denotation of 'Alex goes snorkeling' that I didn't mean to count in saying that I've gone snorkeling twice.

The simplest solution is to introduce the notion of a 'counting situation' – that is, the sort of situations that we intend to quantify over in cases like (55). However, it'd be ideal if we could identify the counting situations in terms of features of our situation structures, and Kratzer has proposed a way of doing that – by defining an *exemplifying situation*.

(Exemplification)   If A is a set of situations then
                          the elements exemplifying A

$$X(A) = \{s \in A: \quad \neg(\exists s^*: s^* \in A)(s^* \sqsubseteq s) \ \vee$$
$$(\forall s^{**}: s^{**} \sqsubseteq s)(s^{**} \in A)\}$$

Informally, for $A \subseteq S$, the situations exemplifying A are those which either have no parts in A or have all of their parts in A. The first disjunct characterizes the 'minimal situations' and is adequate for most situation counting.[42] Sometimes, however, we don't want to count minimal situations. Here's an example from von Fintel:

(56)   Often, when John runs, he wears his old tennis shoes.[43]

All of the situations which are a part of John's running – his first step, his second step, and so on – are themselves situations in which John is running. For this kind of case, the second disjunct kicks in: we want to count the *maximal* situations in which John runs which have as parts *only* situations which are themselves situations of John running.

That concludes the discussion of the basic elements of situation theoretic framework for quantification. Here is a first-pass reconstruction of Kai von Fintel's semantics for frequency adverbs:

(KVF GEN1)   ⟦Q(when P, R)⟧   =   ⟦Q⟧⟨X(⟦P⟧), {s*: (∃s**)(s* ⊑ s** ∧ s** ∈ ⟦R⟧)}⟩

'Q' is a quantifier, X(⟦P⟧) is the set of situations exemplifying P, and the set {s*: (∃s**)(s* ⊑ s** ∧ s**∈ ⟦R⟧)} is the set of situations which 'grow into' (i.e. are part of) a situation satisfying ⟦R⟧.

Suppose we're looking at 'always'-quantification: the intuitive gloss is that 'Always(when P, R)' is true just in case all 'P'-exemplifying situations are situations that grow into 'R'-satisfying

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[42] Minimality governs counting in (Berman 1987) and (Heim 1990).
[43] von Fintel 1995 p. 140

situations. The reason we need to specify that they are *part of* R-satisfying situations rather than just *are* R-situations is that we are talking about situations exemplifying P, which will for the most part make P true and nothing else besides. von Fintel doesn't put any restrictions on the 'growing into' relation but I think in general we need to restrict it to something more restrictive than mere parthood. Let me illustrate the problem with an example:

(KVF1) $[\![$Always(when Alex snorkels, he has fun)$]\!]$ =

$$[\![\text{All}]\!] \quad \langle \text{ X}([\![\text{Alex snorkels}]\!]),$$
$$\{s^*: (\exists s^{**})(s^* \sqsubseteq s^{**} \wedge s^{**} \in [\![\text{Alex has fun}]\!])\}\rangle$$

(KVF1) tells us that the quantified sentence is true just in case all the situations exemplifying 'Alex snorkels' grow into situations satisfying 'Alex has fun.' Suppose I've snorkeled twice and only enjoyed it once; intuitive truth-value of the statement is *false*. Call the two snorkeling-exemplifying situations s_1 and s_2. Since both cases are actual, $w_{s1} = w_{s2}$. By the persistence assumption and the fact that $[\![\text{Alex has fun}]\!]^{s2} = 1$, we get that $[\![\text{Alex has fun}]\!]^{ws2}$. But since $w_{s1} = w_{s2}$, s_1 *does* grow into a situation satisfying 'Alex has fun' – it's world w_{s1}. So it appears that we need to understand the 'grows into a situation $\in [\![R]\!]$' bit of the second argument in a more restricted sense than mere $\sqsubseteq$-relatedness. (That said, I have no suggestion how to do it.)

Von Fintel hasn't said anything so far about modality. In the above example I assumed that we were just quantifying over actual situations – in order to make that explicit, von Fintel suggests that we can restrict our quantification to situations which are parts of the world of evaluation. (Since our parameters of evaluation are situations rather than worlds, I take it that he means the world the situation of evaluation is a part of.)

(KVF GEN2) $[\![\text{Q(when P, R)}]\!]^s$ = $[\![\text{Q}]\!]\langle \text{X}([\![P]\!]) \cap w_{s,,} \{s^*: (\exists s^{**})(s^* \sqsubseteq s^{**} \wedge s^{**} \in [\![R]\!])\}\rangle$

But von Fintel mentions that we may want to use these semantics for *modal* situation quantifiers as well. For this case, we want to trade in the world of the parameter of evaluation for the accessible worlds:

(KVF GEN3) $[\![\text{Q(when P, R)}]\!]^s$ = $[\![\text{Q}]\!]\langle \text{X}([\![P]\!]) \cap f(s), \{s^*: (\exists s^{**})(s^* \sqsubseteq s^{**} \wedge s^{**} \in [\![R]\!])\}\rangle$

All we did here was substitute 'f(s)' for w_s. Here's what von Fintel says above the move to modal quantification:

> *A more generally applicable move would follow the results of work on modals and say that adverbs quantify only over accessible p-situations... In this formalization* [(KVF GEN3)], *f is a function from (evaluation) situations to sets of (accessible) situations. It plays a role very similar to Kripke's accessibility relations or Kratzer's*

> *conversational backgrounds. Its identity is largely contextually determined.*[44]

There are a number of non-equivalent ways we might specify accessibility-like relations in situation theory; as the final element in the semantics for dispositions let me suggest a particular way of specifying a dispositional modal base in situation theory that simply uses the possible worlds that we do have in the situation structures (the ⊑-maximal elements) just as they were used in the possible worlds semantics.

9. A situation theoretic semantics for disposition ascriptions

In the possible worlds semantics, $B(w)$ was a set of premises characterizing some object's intrinsic properties at w and the laws of nature at w. Problem for situation theory: instead of having a world w as our parameter of evaluation, we now our evaluating relative to a situation. What situation counts as the relevant parameter of evaluation for a given utterance is not entirely clear; but we can sidestep the issue by using only world-related properties of a situation in the characterization of the modal base. In particular, take our dispositional modal base $B(s)$ to be a function from s to the set of propositions (set of sets of situations) characterizing the intrinsic properties of the object ascribed the disposition and the laws *at the unique ⊑-maximal element s is related to* – that is, at the world of s.

(M-W-K3S) $[\![N \text{ is disposed to } \psi \text{ when } \varphi]\!]^{s,\tau} = 1$ iff $[\![\tau\langle X([\![\varphi]\!]) \cap B+(w_s),$
$\{s^*: (\exists s^{**})(s^* \sqsubseteq s^{**} \wedge s^{**} \in [\![\psi]\!])\}\rangle]\!]^s = 1$

Gloss: true just in case proportional relation τ holds between the set of 'φ'-exemplifying situations compatible with the dispositional modal base (including non-qualitative linking facts) and the set of situations which grow into 'ψ'-satisfying situations.

Besides the modal base and evaluation relative to a situation rather than world, the significant differences between (M-W-K3S) and its possible-worlds antecedent are that $[\![\varphi]\!]$ and $[\![\psi]\!]$ denote sets of situations rather than sets of worlds, the restriction to *φ-exemplifying* situations rather than φ-satisfying worlds, and the condition of being ⊑-related to a 'ψ'-satisfying situation rather than being a 'ψ'-satisfying world. In each of these respects, the situation theoretic treatment seems to more adequately approximate the intuitively relevant possibilities than the possible worlds treatment.

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[44] von Fintel 1995, p. 143

Works Cited

Anderson, Alan Ross. (1951) 'A Note on Subjunctive and Counterfactual Conditionals.'
    Analysis 11, 35-38.

Anthony, Alexander. (2010) <u>Dispositional predicates in context</u>.   Unpublished B.A. thesis,
    Wesleyan University. Available at <u>http://wesscholar.wesleyan.edu/etd_hon_theses/456/</u>

Berman, S. (1990) 'Situation-Based Semantics for Adverbs of Quantification.' In J. Blevins and
    A. Ainikka, eds. <u>University of Masachussets Occasional Papers 12.</u> 45 – 68.

Bonevac, D., Dever. J., and Sosa, D. (forthcoming in *Mind*) 'The Counterexample Fallacy.'
    Citations to version available at
    <u>https://webspace.utexas.edu/deverj/personal/papers/counterexample.pdf</u>

Carnap, R. (1936–7) 'Testability and Meaning', *Philosophy of Science* III: 419–471 and IV: 1–40.

Choi, S. (2006) 'The Simple vs. Reformed Conditional Analysis of Dispositions.' *Synthese* 148: 369–
    379.

Dekker, P. (1995) 'Cases, adverbs, situations, and events.' In H. Kamp and B.H. Partee, (eds.)
    Current Research in the Semantics/Pragmatics Interface, Volume 11.
    Oxford: Elsevier. Chapter 22, 383 – 404.

Fara, M. (2001) <u>Dispositions and their ascriptions.</u> Unpublished Ph.D. thesis, Princeton University.

— (2005) 'Dispositions and Habituals.' *Noûs* 39: 43–82.

von Fintel, Kai. (1995) 'A minimal theory of adverbial quantification.' In H. Kamp and
    B.H. Partee (eds.) *Current Research in the Semantics/Pragmatics Interface, Volume 11.*
    Oxford: Elsevier. Chapter 7, 137 – 175.

Goodman, N. (1954) *Fact, Fiction and Forecast*. Cambridge, Mass.: Harvard University Press.

Gundersen, L. (2002) 'In Defence of the Conditional Account of Dispositions.' *Synthese* 130: 389–
    411.

Heim, I. (1990) 'E-type Pronouns and Donkey Anaphora.' *Linguistics and Philosophy* 13: 137 – 177.

Johnston, M. (1992) 'How to Speak of the Colors.' *Philosophical Studies* 68: 221–263.

Kratzer, A. (1977 / forthcoming) 'What 'must' and 'can' must and can mean.' Original printing:
    Linguistics and Philosophy 1: 337 – 355. Citations to Kratzer forthcoming, Chapter 1.

— (1981 / forthcoming) 'The notional category of modality.' Original printing: in H.J Eikmeyer and
     H. Rieser (eds.) *Words, Worlds and Contexts*. Berlin: de Gruyter, 38 – 74. Citations to
     Kratzer forthcoming, Chapter 2.

— (1989 / forthcoming) 'An Investigation of the Lumps of Thought.' Original printing: *Linguistics
     and Philosophy* 12: 607 – 653. Citations to Kratzer forthcoming, Chapter 5.

— (forthcoming) *Papers on Modals and Conditionals*. Draft dated 'September 2010' from
     semanticsarchive.net

Lewis, D. (1973) *Counterfactuals*. Cambridge: Harvard University Press.

— (1975) 'Adverbs of Quantification.' In E. Keenan (ed.) *Formal Semantics of Natural Language*,
     3-15.

'Finkish Dispositions.' *The Philosophical Quarterly* 47: 143–158.

— (1997) 'Finkish Dispositions.' *The Philosophical Quarterly* 47: 143–158.

Manley, D. and Wasserman, R. (2008) 'On Linking Dispositions and Conditionals.' *Mind* 117
     pp. 59 – 84.

Martin, C. B. (1994) 'Dispositions and Conditionals.' *The Philosophical Quarterly* 44: 1–8.

McKitrick, J. (2003) 'A Case for Extrinsic Dispositions.' *Australasian Journal of Philosophy* 81: 155–
     174.

Portner, P. (2009) *Modality*. Oxford: OUP.

Quine, W.V.O. (1960) *Word and Object*. Cambridge, MA: MIT Press.

Ryle, G. (1949) *The Concept of Mind*. London: Hutchinson & Co.

Shoemaker, S. (1984) *Identity, Cause, and Mind.* Cambridge: CUP.

Yli-Vakkuri, J. (2010) 'Conditional and habitual analyses of disposition ascriptions.'
     The Philosophical Quarterly 60: 624 – 630.