A typology of semantic entities*

Jessica Rett

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1 Introduction

The goal of this paper is to discuss which basic semantic entities we should include in our formal semantic ontology, and on which principles we should include them (cf. Bach, 1986b). The vast majority of formal theories employ individuals as a basic type; they represent quantification over, modification of, and reference to individuals. But many theories include additional types or entities, including possible worlds, but also less common ones like vectors. Some papers have argued that types should be constrained or reduced; others that they should be proliferated. I'll present some representative arguments on both sides and suggest a path forward in evaluating them against one another.

Standard Montagovian semantics employs individuals as a basic type, but in practice, some theorists embrace many more basic types. Champollion (2010) uses at least five (differentiating between degrees, numbers and intervals) in just an extensional semantics; Bittner (2003) uses seven (differentiating between animate and inanimate entities); and Landman (2006) assumes nine basic entities, differentiating between kinds, events, and event-kinds. In contrast, others have taken for granted that the adoption of different types should be constrained by Ockham's Razor, and have posed and taken up the challenge of eliminating as many as mathematically possible. Thomason (1980) argued that possible worlds aren't necessary to model propositional attitudes, and Keenan (2015, 2018) addresses an issue in the semantics of adjectives by doing away with individuals as a semantic basic.

Being a semanticist, I take semantic adequacy to be the primary goal of a formal semantic theory. But a metasemantic concern about modeling the right entities – or at least the right quantity of entities – seems like a plausible secondary goal. This is highlighted by the *reductio ad absurdum* put forth in Ritchie (2016), which depends on the principle that equally semantically adequate treatments should have equal voice in determining the ontological

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commitments carried by natural language theory. If there are indeterminately many – or even multiple – semantic formalisms that postulate a distinct set of entities, we cannot hope for a principled relationship between semantic theory and ontology.

There are, as far as I can tell, three logically possible positions to take regarding basic entities in a semantic model:[1]

1. **Type Reductionism**
   Type Reductionalism assumes no basic types, or no non-functional types. This position is best instantiated historically by Henkin (1963), and more recently by Partee (2009) and Keenan (2015, 2018), whose foundational type is set-theoretic. Following Gallin's (1975) notation, a Type Reductionalist account is Ty-0, because it has no basic types.

2. **Type Ersatzism**
   A Type Ersatzist assumes one basic non-functional type – entities in general – and proposes to treat all natural-language phenomena using this type. In Gallin's notation, a Type Ersatzist account is Ty-1. Church (1932) exemplifies Type Ersatzism, as does Carlson (1977) for times and Klein (1980, 1982) for degrees.

3. **Type Proliferationalism**
   A Type Proliferationalism account is a Ty-n account, for $n > 1$ entities that pass some linguistic tests, e.g. that they have dedicated pronouns. (This test, a modern adaptation of Quine's (1948) generalization 'to be is to be the value of a variable,' is explicitly assumed as one of a few tests for entityhood in Schlenker (2006).)

The difference between Type Ersatzism and Type Proliferationalism is a subtle one, reminiscent of selectional restrictions on verbs and adjectives, illustrated in (1).

(1) a. *Jane met.   *number restriction*
     b. *She's a bachelor.   *gender restriction*
     c. *The plant tried to grow.   *animacy restriction*
     d. *Jane bounced the cloud.   *(solid-)state restriction*
     e. *The piece of paper is fat.   *(three-)dimension restriction*

The predicates are picky about what sorts of arguments they take. (1-a) is ungrammatical because intransitive *meet* requires that its subject denote a plurality; (1-b) is ungrammatical because the adjective *bachelor* can only be predicated of males. It's standardly assumed that these are all predicates of individuals; they can be modeled as denoting partial functions from the subclass of entities that satisfy the relevant selectional restriction. This is something like

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[1]The classic Montagovian semantics in Montague (1970, 1973) offers a mixed case because it employs one basic entity (individuals) but two basic types (s, for possible worlds) in addition to truth values. These approaches are equivalent to a Ty-2 logic (Kaplan, 1976; Zimmermann, 1989).

a Type Ersatz approach; it treats different kinds of entity within the same type. In contrast, a Type Proliferationalism approach might assign different types to singular and plural entities, male and female entities, etc.

(2) illustrates this difference between Type Ersatzism and Type Flexibility for the adjectival modifier *very* (and some contextually-valued standard s); the former involves individuals, type e, and requires a partial function to model the fact that *very* must modify something gradable (**very student*); the latter involves entities other than individuals – degrees of type d – and thus does not require a partial function.

(2)   a.   **Type Ersatzism:** $[\![\text{very}]\!] = \lambda P_{\langle e,t \rangle} \lambda x_e : \text{degree}(x).\ P(x) \wedge x > s$
        b.   **Type Flexibility:** $[\![\text{very}]\!] = \lambda D_{\langle d,t \rangle} \lambda d_d.D(d) \wedge d > s$

I'll end this section with some ground-clearing. First, I restrict myself to the discussion of basic types – not complex ones – because I assume that the latter come for free via type formation. This is despite the interesting empirical arguments that some complex types (e.g. quantifiers) are unavailable in some languages (e.g. St'át'imcets), which I take to be a separate discussion (Matthewson, 2014). And also despite the fact that the same arguments used to differentiate between basic and complex entities (Link, 1983) might also be useful in differentiating between two basic entities.

And while considerations of economy and parsimony are certainly relevant when it comes to evaluating theories, these considerations presume empirical equivalence (i.e., Can semantic theories that presume different basic semantic entities account for the same natural language data?). And since it is this empirical equivalence that I will be discussing, I will treat considerations of economy and parsimony as secondary to the discussion at hand.[2]

When I discuss the question of how many basic entities or types there are, I view the issue as regarding the semanticist's toolbox, rather than a given speaker's i-language. In particular, if some language were to have what we decide to be irrefutable evidence that the semantic modeling of that language requires e.g. degrees as a basic entity, then this is sufficient evidence that there are degrees in the semantic ontology, but not sufficient evidence that there are degrees in every human being's i-language. This is compatible with the possibility that some languages do not require degrees in their semantic modeling, or even should not be modeled using degrees, as has been argued for Washo (Bochnak, 2015b).

Finally, there is one diagnostic for basic semantic entities that I will not use: I will not assume that the presence of a referring expression over a particular sort of thing privileges that thing as an entity (cf. Schlenker, 2006). More

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[2]There have been impressive contributions made on this front into reducing entities in a Montagovian semantics to a single type (Liefke, 2014a,b). Liefke (2015) represents possible worlds and situations as ultrafilters, and Liefke and Werning (2018) represents individuals and propositions as parameterized partial sets of situations. This work tends not to include discussions of degrees, kinds, or vectors, but it does rely on type-raising – which seems independently motivated in all of these theories – to make some of the other distinctions discussed below. I do not review them here because they do not introduce any novel empirical arguments for type reduction.

broadly, I will focus on linguistic tests that don't involve categories of words whose inventory is potentially infinite; this is the standard lexical vs. functional distinction. It seems as though we can coin a referring expression for anything, really, at least in particular contexts – e.g. Twin Earth (Putnam, 1973) – and so it is a trivial test.

2 Metasemantic arguments

Before I turn to empirical arguments made in favor of proliferating or collapsing types, I'll briefly present two instances of semanticists directly addressing the question of how many basic entities the ontology should include, and discuss why their claims don't seem to completely settle the issue.

In his 2006 paper, Philippe Schlenker observes that "Reference to individuals, times and worlds is uniformly effected through generalized quantifiers, definite descriptions, and pronouns" (p504). He interpreted this observation as evidence that there is a single type, ξ, ranging over an ⟨individual, time, world⟩ triple.

As argued above, there is no limit on the sort of entity that can be referred to with a name or definite description, given the innovativeness of natural language. And, as we'll see below, it seems clear that there are types of entities other than individuals, times and worlds (namely degrees, events, and/or situations) that are associated with quantifiers and proforms as well. So if Schlenker's criteria are necessary and sufficient for differentiated basic entities – and he provides no arguments that they are, especially as he considers them members of a triple – they lead to a more inclusive ontology than he advocates for.

In her 2003 paper, Maria Bittner adopted a similar perspective. She advocatese for a Ty-7 formal semantics, including worlds, times, places, events, states, animate individuals, and inanimate individuals as basic entities. What's more, she meaningfully differentiates between basic types – like states and events – and derived or complex types, like processes and habits, whose types are partial functions. Bittner's criterion for a basic type (see also Bittner, 2006, 2014) is whether entities of that sort participate in anaphora in a language, and thereby whether a dynamic model of that language requires a separate discourse stack for that type.[3]

However, Bittner herself acknowledges that discourse reference can be to complex types (or, rather, to the basic components of a complex type): "In general, simple episodic discourse involves only simple types of drefs – the seven basic sorts (possibilities $\omega := \mathbf{w}t$, agentive entities α, non-agentive entities β, events ϵ, states ω, times τ, and places π) – or else simple functions (mostly processes $\epsilon\epsilon$...)" (2003: 645). She specifies, of discourse referents to processes, "Formally, these are ϵ-dependencies, mapping each stage of the process, except the last, to the next stage" (2003: 641).

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[3] "In online update anaphora resolution is primarily based on the current centering rank, restricted to the relevant type of the 7-sorted NL ontology, and only secondarily on world knowledge" (2006:6).

entity	type	conventional variables	origin(s)
individuals	e	x, y	Montague (1970, 1973)
possible worlds	s	w	Kripke (1959)
events	v	e	Davidson (1967)
times	i	t	Partee (1973, 1984)
degrees	d	d	Cresswell (1976)
kinds	k	k	Carlson (1977)
situations	s	s	Barwise (1981); Kratzer (1989)
vectors	v	u, v	Zwarts (1997)

Table 1: Basic entities: the Usual Suspects

So the ability of a proform or anaphor in a language to refer to an entity is a necessary but not sufficient condition for its being a basic type, as it could be anaphoric on a subcomponent of a complex entity. The result is a very robust and comprehensive cross-linguistic ontology, but one with no clear, reliable way of differentiating between basic and complex or derived types.

In the next section, I present several prominent empirical arguments that natural language semantics needs to include a given entity as basic.

3 Type proliferation arguments

Across the formal semantics literature, there have been a number of implicit and explicit arguments for a number of different non-individual entities. I have summarized the most prominent ones in Table 1.[4]

The empirical arguments for adding different types or entities to the semantic ontology have been very similar, and they fall into two broad categories. First, there is morphological evidence: arguments that a given language has functional items that seem dedicated to particular, non-individual domains. Second, there is semantic evidence in the form of arguments from semantic adequacy: phenomena that seem to be able to be modeled only in a formalism that includes non-individuals. For several familiar non-individual entities, I will review some prominent arguments in favor of their inclusion in the semantic ontology.

3.1 Possible worlds

The original Montagovian semantics (Montague, 1970, 1973) manipulated only individuals as a basic semantic entity, but included possible worlds as a restriction on the interpretation function. Explicit world variables were quickly added

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[4]I do not include a discussion of tropes, which have been proposed by Moltmann (2013), or essences, as proposed by Ramchand (2016), as these objects have been proposed to replace individuals as basic types (and cover some additional empirical ground), not in conjunction with individuals.

to Montague-inspired formalisms in part based on the empirical arguments from modal semantics in Hintikka (1957) and Kripke (1959): they allowed for a set-theoretic representation of entailment, and a treatment of weak and strong modals as dual quantifiers, in parallel with individual quantifiers.

Effectively, in arguing that possible worlds should be represented as semantic variables, these papers instantiate both of the types of arguments I outlined above. The observation that languages lexicalize (strong and weak) modals like *must* and *might* differently from (universal and existential) individual quantifiers like *all* and *some* constitutes a morphological argument for adding possible worlds to the semantic ontology. And the claim that relationships between propositions can be best modeled using set theory – and thereby that propositions must be associated with sets – constitutes a semantic adequacy argument.

Interestingly, there appears to be no language that does not have modals, although languages do seem to differ with respect to which elements they unite lexically (i.e. quantificational force; flavor; and evidential base; Matthewson, 2013). This lack of cross-linguistic variation seems in concord with the relatively uncontroversial status possible worlds enjoy in formal semantic theory (in contrast with many other entities in Table 1; although see e.g. Kaplan and Montague 1960, Fine 2012 for arguments that possible worlds shouldn't be used to model specific phenomena). But the question of how to deal with cross-linguistic variation, in cases where we do find it, will turn out to be a central one.

3.2   Times

In a series of papers, Barbara Partee (1973; 1984) argued that tense markers should be thought of as temporal proforms rather than operators. While these accounts both include times in their semantic models, they differ in whether they require the modeling of times as a basic entity. A formalism in which tense markers denote temporal operators is compatible with a formalism in which times are restrictions on the interpretation function, an analogue to Montague's treatment of modals qua possible world operators.

Partee's arguments that tense markers are temporal pronouns amount to arguments by parallel. They take for granted that there are individual pronouns, and that individual pronouns are individual pronouns by virtue of their semantic behavior. If tense markers demonstrate identical semantic behavior, then they, too, must be pronouns (only over times, not individuals). Stone (1997) made parallel arguments for the words *will* and *would*, which he assumed were modal or possible world proforms. The key data are reproduced below.

(3)   *non-linguistic antecedents*

    a.   [at a bar] She left me.   *individual*

    b.   [on a road trip] I didn't turn off the stove.   *temporal*

    c.   [at a stereo store] My neighbors would kill me.   *modal*

(4)   *definite antecedents*

    a.   Sam is married. He has three children.   *individual*
    b.   Sheila had a party last Friday. Sam got drunk.   *temporal*
    c.   The company would face bankruptcy if the merger goes through.

                modal

(5)   *indefinite antecedents*
    a.   Pedro owns a donkey. He beats it.   *individual*
    b.   Mary woke up sometime during the night. She turned on the light.

                temporal
    c.   Jane might give a presentation. She would use slides.   *modal*

(6)   *bound variable use*
    a.   Every woman believes that she is happy.   *individual*
    b.   Whenever Mary telephoned, Sam was asleep.   *temporal*
    c.   If a mathematician proves the Reimann hypothesis, they will gain
        notoriety.   *modal*

(7)   *donkey-anaphoric use*
    a.   If Pedro owns a donkey, he beats it.   *individual*
    b.   If Mary telephoned on a Friday, it was (always) Peter who answered.

                temporal
    c.   If a submarine cannot self-destruct if an enemy captures it, the en-
        emy will learn its secrets.   *modal*

These constitute morphological arguments for times and possible worlds as distinct entities, and they have been influential. But it's worthwhile noting that there are other anaphoric elements that display the same behavior which we do not tend to associate with basic types, including VP ellipsis; propositional anaphors as in *Jane believes that too*; and adjectival *such* (Landman, 2006; King and Lewis, 2018). This is a good illustration of one of the limits of morphological arguments for proliferation, at least for those semanticists who don't consider verbal properties and propositions to be basic entities.

Many languages have been observed to lack tense marking of any kind: so-called 'tenseless languages'. Interestingly, these languages differ in how their tenseless clauses can be interpreted, leading to a series of proposals that constitute semantic arguments for times as a distinct entity, as well as cross-linguistic variation with respect to whether or not a language should be modeled using times.

The simple matrix clause in (8), from Lillooet (a Salish language, Matthewson, 2006) lacks any sort of overt tense marker.

(8)   Táytkan
        hungry.1sgS
        'I am/was hungry.'

In her analysis of such sentences, Matthewson (2006) observes that while they are underspecified with respect to a present- and past-oriented interpretation, they can never be future-oriented (i.e. can never mean 'I will be hungry').

She thus concludes that they must include a (morphologically null) non-future marker, effectively a covert tense operator.

However, in other tenseless languages, versions of (8) behave slightly differently, leading other researchers to offer distinct analyses of tenseless sentences (Bittner, 2005; Lin, 2005; Tonhauser, 2011; Mucha, 2013). While none of these analyses assume that times are explicitly introduced in the language, they all assume that it is nevertheless manipulated by the language, in some way. And they all argue that we can infer this from the truth conditions of these tenseless sentences.

For instance, while Hausa sentences lack overt tense markers, they do include (overt) aspectual operators. And the truth conditions of sentences that include e.g. prospective aspect do involve the manipulation of times. Mucha (2013: 203) argues that the prospective aspect should be given the analysis in (9), which involves the restriction of an event's runtime $\tau(e)$ to precede some temporal argument t.

(9) $[\![\text{prospective aspect}]\!] = \lambda P_{\langle v, \langle s,t \rangle \rangle} \lambda e \lambda t \lambda w [P(e)(w) \wedge \tau(e) > t]$
       for the runtime $\tau(e)$ of an event e

We can conclude from this body of work that times – or at least some subtype of strictly ordered entities, or some entity (like events or situations) from which runtimes can be calculated – are necessary for modeling languages universally, despite the fact that not all languages have dedicate time-introducing pronouns. Once again, we have a situation in which there seems to be no cross-linguistic variation with respect to whether languages need to be modeled using times (the semantic arguments), although we do, for the first time, see cross-linguistic variation with whether reference to times is morphologically encoded (the morphological arguments).

I'll end this section by highlighting the significant empirical and theoretical overlap between times, and some other semantic entities. While the arguments discussed here explicitly advocate for times, others have used similar arguments to instead advocate for the existence of situations (to be discussed in more detail in §4.1), events (Section 4.2), or states (Parsons, 2000; Katz, 2003; Altshuler, 2016; Stojnić and Altshuler, 2020). Insofaras they advocate for treating these or related phenomena using an entity other than individuals, the arguments in these other works are in some loose sense parallel to the arguments detailed here, but I have of course not done them justice. Section 4 discusses reference to events, situations, etc. in type-collapsing arguments.

3.3   Degrees

Based on a suggestion in Cresswell (1976), a common and intuitive way of semantically differentiating between non-gradable and gradable adjectives is in their arity; specifically, that non-gradable adjectives denote individual properties, while gradable adjectives denote relations between degrees and individuals.

(10)   a. $[\![\text{single}]\!] = \lambda x.\mathsf{single}(x)$

b. $[\![\text{tall}]\!] = \lambda d \lambda x.\text{tall}(x, d)$

Ewan Klein (1980; 1982) argued that the phenomena Cresswell focused on – specifically, positive constructions like *Jane is tall* and comparatives like *Jane is taller than Bill* – can be dealt with instead in a semantics with only individuals as basic entities. In his analysis, gradable adjective constructions manipulated comparison classes of individuals, partitioned according to metasemantic principles that assure that e.g. *a* is not both bigger and smaller than *b*.

However, since Klein's proposal (and refinements offered in Neeleman et al. 2004; Bale 2011), there have been several adjectival phenomena that, it's been argued, cannot be properly characterized using a degree-free semantics. Kennedy (1999) argued that a Kleinian degree-free semantics can't differentiate between antonyms like *tall* and *short*. He also argued that it can't account for the semantic contribution of measure phrases (MPs) like *two feet*, especially in their function as comparative differentials in e.g. *Jane is two feet taller than Bill* (Schwarzschild, 2005). And in a particularly influential paper, Kennedy and McNally (2005) argued that the different types of intervals degrees can form – closed, open, partially closed – are needed to predict the behavior of different subtypes of gradable adjectives, i.e. the difference between relative, absolute, and total/partial adjectives.

Finally, English has different comparative strategies, and it's been argued that some of them involve the comparison of degrees, while some of them involve the comparision of individuals. This argument, like the others, is a semantic adequacy argument: if there are semantic differences between two comparative strategies that are predicted by modeling one with degrees and one without, then we can conclude that degrees must be in the semantic ontology.

Three comparative strategies are listed below, although there are others, even in English (Stassen, 1985).

(11) a. Jane exceeds Bill in height.   *'exceed' comparative*
      b. Jane is tall compared to Bill.   *implicit degree comparative*
      c. Jane is taller than Bill.   *explicit degree comparative*

Explicit degree comparatives, formed with the English *-er* or *more*, exhibit subtly different semantic behavior than other comparative strategies (Beck et al., 2004, 2009; Kennedy, 2005). They: i) don't require a 'crisp judgment' scenario, in which the difference in values is significant; ii) are non-evaluative when formed with positive relative adjectives like *tall*; iii) can be modified by a differential; and iv) can be formed with absolute adjectives. These differences are illustrated in (12)-(15).

(12)   *context: Jane is 1mm taller than Bill.*

        a. Jane is taller than Bill.   *explicit*
        b. #Jane is tall compared to Bill.   *implicit*

(13)   a. Jane is taller than Bill. $\nrightarrow$ Jane is tall.   *explicit*
        b. Jane is tall compared to Bill. $\rightarrow$ Jane is tall.   *implicit*

(14)   a.   Jane is six inches taller than Bill.   *explicit*
       b.   Jane is (#six inches) tall (#six inches) compared to Bill. *implicit*

(15)   a.   This pole is more bent than that one.   *explicit*
       b.   ?This pole is bent compared to that one.   *implicit*

A broad consensus is that the best way of accounting for these semantic differences is by treating the explicit comparative *-er, more* as denoting a degree quantifier, or a relation between a set of degrees corresponding to the matrix argument and a set of degrees corresponding to the embedded argument (Beck et al., 2004, 2009; Kennedy, 2005). For example, a Kleinian account of comparative constructions – in which the embedded argument forms a comparison class restrictor for evaluating the matrix argument – predicts the 'crisp judgment' requirement we see in (12-b), and cannot account for the acceptability of the explicit comparative in (12-a).

Even more compelling, there seems to be variation with respect to whether a language's comparison strategies behave like explicit comparatives, and thereby must be modeled using degrees. A series of languages have been identified as 'degree-free' languages, meaning they lack any sort of construction that has been argued to require degrees to be adequately semantically modeled: Motu (Beck et al., 2009); Fijian (Pearson, 2010); Washo (Bochnak, 2015a,b; Beltrama and Bochnak, 2015); Navajo (Bochnak and Bogal-Allbritten, 2015);[5] Walpiri (Bowler, 2016). These languages do not have explicit comparatives (or superlatives), but they also do not have measure phrases or measure phrase constructions (e.g. *five feet tall*), and they do not have degree modifiers like *very.*

In conclusion, there have been attempts to model English adjectival constructions without the use of degrees as basic semantic entities (Klein, 1980, 1982; Neeleman et al., 2004). These accounts have been argued to fail on empirical grounds, because they cannot account for the semantic behavior of many constructions, including explicit comparatives. Furthermore, there seem to be languages for which an entire class of constructions are not available, and this class is very naturally characterized as constructions that must be modeled using degrees.

3.4   Interim summary

There are, roughly, two types of arguments made in favor of adding basic entities to the semantic ontology: morphological and semantic ones. The morphological arguments pertain to the language's inventory of functional morphemes. They assume (generally implicitly, as in Partee 1973, 1984), that a language differentiates between entity x and entity y if: i) it lexicalizes different **proforms** for x and y; ii) it lexicalizes different **modifiers** for x and y; and iii) it lexicalizes different **quantifiers** for x and y. These arguments have all been extended – implicitly or explicitly – to possible worlds, times, and degrees.

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[5]Cf. Bogal-Albritten and Coppock *to appear*, who argue not only that Navajo has degrees, but that it has degrees and degree quantifiers (but not individual quantifiers).

The other arguments for type proliferation pertain to semantic adequacy: in the case of times, there was the argument that, even in the absence of a dedicated temporal proform or quantifier in Hausa, aspectual markers need to reference times in order to impose strict enough truth conditions. And in the case of degrees, there was the argument that a semantic model that does not include degrees can adequately model implicit comparatives in English, but not explicit comparatives.

In the case of degrees – but not, as far as I know, any other putative basic entities – there has also been a robust research project arguing that languages can differ with respect to whether they must be modeled using degrees. Evidence for this distinction comes in the different inventory of constructions or morphological strategies for expressing certain situations, so they constitute a sort of comparative morphological argument.

These criteria – imposed by the morphological and semantic arguments – are arguably not necessary conditions, as we can imagine a language with a relatively impoverished lexicon and accidental homophony in e.g. its proform inventory, but not its quantifier inventory. This sort of thing happens all the time, and I'll return to discuss it in more detail in §5.

They are also arguably not sufficient conditions for basic entities, which is a very unsatisfying result. *Wh*-phrases could be construed as either proforms or quantifiers, depending on one's semantic theory, but they do not perfectly track what is generally thought of as being a plausible basic entitity. On the one hand, English and several other languages co-opt the same *wh*-phrase to range over degrees and manners (*how*), prompting some to argue that these are the same sort of entity (see §4.3). On the other hand, English has a dedicated *wh*-phrase *where* for locations and vectors (it has a locative and a directional interpretation); and two distinct ones, *why* and *how come*, for reasons.

However, it's worthwhile noting the consistency of these morphological and semantic arguments across different, unrelated theoretical projects and empirical phenomena. The idea that e.g. distinct proforms belie distinct basic entities seems to be a common and thereby intuitive assumption.

Finally, the introduction of the possibility that languages can differ with respect to their basic entity inventory predicts the existence of a robust and theoretically attractive universal typology, reminiscent of Greenberg's (1963) Universals (e.g. "If a language is exclusively suffixing, it is postpositional; if it is exclusively prefixing, it is prepositional"). The claim that arises from this discussion of type-proliferation arguments is that if a language has morphemes and constructions that must be semantically modeled using degrees, it also has morphemes and constructions that must be modeled with individuals, possible worlds, and times, but not vice-versa. However, there is arguably more work to do in replicating the detailed study of degrees in other domains, including times.

4 Type collapsing arguments

In contrast to those who have advocated for adding basic entities to the semantic ontology are those who have argued that basic entities should be collapsed or eliminated. These arguments, too, come in two forms: those from morphological cues and those from semantic convergence.

4.1 Situations

In a several prominent papers written in the 1980s, it was claimed that the putative basic entities possible worlds, times, and locations, were collectively too blunt to model natural-language semantics (Barwise, 1981; Barwise and Perry, 1983; Kratzer, 1989). These papers highlighted a number of constructions that seemed to restrict all of these things, but in a dependent way. Since these modal/temporal/spatial restrictions covary in a predictable way, they argued, a semantics that modeled them independently can't be restrictive enough.

There are many sentences that can illustrate this point, I focus on one (from Cresswell, 1990; Kratzer, 2007):

(16)   If, whenever it snowed, it had snowed much more than it actually did, the town plow would have removed the snow for us.

The point is that the putative anaphor *would* can't range just over possible snowing events (cf. Cresswell, 1990; Stone, 1997), but it must range over possible snowing events indexed to a particular location (the town in question) and a particular time (the reference time, prior to the time of utterance). As Kratzer (2007) explains, "we have to be able to consider for each actual snowfall s a set of counterfactual alternatives and compare the amount of snow in each of them to the actual amount of snow in s. This means that we have to be able to 'go back' to the actual snowfall situations after considering corresponding counterfactual situations".

The proposed solution involves situations: spatio-temporally specified partial worlds, or particulars. They are a basic entity that effectively collapses possible worlds, times, and locations into one. Incidentally, Kratzer (2007) argues that situations can be used to define Davidsonian events, so the use of situations actually obviates four distinct putative basic types:

(17) $\lambda e[P(a)(e)]$ is an abbreviation of $\lambda s[P(a)(s) \wedge \mathsf{exemplify}(P(a), s)]$, where $[\![\mathsf{exemplify}(p, s)]\!] = \mathsf{T}$ iff p exemplifies s

It's been assumed that situations have corresponding proforms, although it's not clear that these proforms have a single common morphology in English.[6] On the one hand, assuming situations as basic entities – instead of worlds,

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[6]Schwarz (2012) ostensibly addresses the distribution and interpretation of 'situation pronouns,' but he uses the term to refer to (null) situation indices or arguments in noun phrases, so his discussion doesn't amount to a morphological argument for situations as a basic entity.

times, and locations – seems to explain the synonymy of *when* and *if* clauses (cf. Rothstein, 2009), as in (18).

(18)   a.   Mary opens the door when(ever) the bell rings.
        b.   Mary opens the door if the bell rings.

But if *when* and *if* do both range over situations in this assumed way, it would be nice to have an explanation of why English has more than one situation proform (or quantifier, as the case may be). Such arguments are reminiscent of Lewis' (1975) arguments about domain-unspecified quantification, which highlights the challenge of empirically differentiating between a theory that assumes a single basic type with dedicated quantifiers or one that assumes a variety of different types with unspecified quantifiers (i.e. a Type Ersatz theory and a Type Flexible theory).

4.2   Individuals and events (and degrees)

A distinct but simultaneous semantic tradition has blurred the lines between individuals and events, beginning with Bach (1986a), who argued that individuals and events have the same mereology.

Bach was inspired by Link's (1983) observation that plural count nouns and mass nouns behave similarly, and his consequent conclusion that both should be analyzed as denoting join semi-lattices (individuals whose plurality is modeled in their internal Boolean structure). Bach extended the empirical parallels to events, arguing that Link's 'cumulativity of reference' property extends to atelic events – which are like mass nouns and plural count nouns – but not to telic events, which are like singular count nouns.

The empirical parallels between individuals and events have been strengthened further by the observation that some sentences are ambiguous between individual and event readings (Krifka, 1989, 1990, 1992; Lasersohn, 1995).

(19)   a.   Four thousand ships passed through the lock last year.
        b.   The library lent out 23,000 books in 1987.

In (19-a), the numeral *four thousand* could be counting distinct ships or events of passage; in (19-b) the numeral could be counting distinct books or events of lending.

Krifka treats this polysemy as a homomorphism from "concrete entities to abstract entities" (1990: 194), but assigns individuals (the concrete entities) and events (the abstract ones) different types. In his compositional analysis, the cardinality operator that allows for the semantic composition of the numeral and the NP – associating the nominal property with an argument corresponding to its cardinality – is polysemous between measuring individuals, events, or sets of events.

Some quantifiers seem to be domain-general in just this way, too; *most* in (20) can range over ships or events of passage.

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(20)   Most ships passed through the lock at night.

A number of recent articles have examined this polysemy in much more detail, for e.g. French *beaucoup* (Doetjes, 2007; Nakanishi, 2007; Burnett, 2012).

There seems to be a directly parallel DP polysemy between individuals and degrees (and events). Some examples are illustrated in (21) (from Rett, 2014).

(21)   a.   Four pizzas are vegetarian / is enough.
        b.   Four feet of the plywood are warped / is more than Betty had asked for.
        c.   French fries were eaten by the senators / is not enough, the senators will need protein.

In each example, the DP can denote a plural individual, in which case it is modified by an individual predicate (*be vegetarian, be warped, be eaten*) and triggers plural agreement on the predicate. But it can also denote a singular degree, in which case it is modified by a degree predicate (*be enough, be more than*) and triggers singular agreement on the predicate. Note that this is not a polysemy triggered by the numeral or measure phrase (cf. Landman, 2000; Rothstein, 2009), as bare plurals are polysemous in the same way (21-c).

In Rett (2014) I observe that the degree interpretations of DPs are restricted to dimensions of measurement that are monotonic on the part-whole structure of the plural individual, in the sense documented by Schwarzschild (2005). I conclude that the polysemy is the result of a homomorphism from individuals to degrees (not in the other direction, cf. Brasoveanu, 2009) that is bound by a restriction that requires the homomorphism be meaning preserving in a particular way.

4.3   Degrees, kinds, and manners

There also seems to be a morphological kinship between degrees, kinds, and manners. Landman and Morzycki (2003) and Anderson (2016) (see also Haspelmath and Buchholz, 1998) note cross-linguistic evidence for the assimilation of degrees, kinds, and manners. This is shown in (22), in which the same morpheme *as* ranges over manners in the similative in (22-a) and over degrees in the equative in (22-b).[7]

(22)   a.   Jane danced **as** Maria danced.   *manner*
        b.   Jane is as tall **as** Maria is.   *degree*

The polysemy is more expansive in Polish (23), in which the proform *tak* ranges over manners, kinds, or degrees.[8]

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[7]Rett (2013) discusses the cross-linguistic universality of the morphological similarity between equatives and similatives.

[8]There is a similar kind/degree polysemy in sentences like *It's amazing the cars he owns!* (Castroviejo Miró and Schwager, 2008).

(23) a. On tańczyl **tak**.
          he danced thus
          'He danced like that.'   *manner*
      b. **Taki**   pies   uciekł wczoraj w   nocy.
          such.MASC.SG.NOM dog.NOM ran.away   yesterday in.night
          'Such a dog ran away last night.'   *kind*
      c. **tak** wysoki
          such tall
          'that tall'   *degree*

To account for these data, Anderson (2016) explicitly argues for a particular version of 'enriched degrees' (Grosu and Landman, 1998), in which degrees are modeled as kinds of Davidsonian states. And model manners as event kinds. Formally, the approach is similar to situation semantics, in that it treats words like *tak* and *as* as involving abstraction over degree state-kinds.

4.4 Degrees and vectors

Schwarzschild (2012) notices another cross-linguistic trend: in Hindi and Navajo, there is polysemy between spatial prepositions and comparative standard markers (equivalent to *than* in English comparatives). This is illustrated in (24) for Hindi.

(24) a. anu raaj **se**   lambii   hai
          Anu Raj FROM tall.FEM PRES.SG
          'Anu is taller than Raj.'
      b. anu us   baRe   kamre   **se**   niklii
          Anu that.OBL big.OBL room.OBL FROM come.out.PERF.FEM
          'Anu came out of that big room.'

Schwarzschild (2012) uses data like these to argue for an analysis of an entity he calls a 'directed segment,' essentially a two-dimensional interval. Schwarzschild (2013) expands on this analysis, drawing on semantic arguments regarding comparison classes (Kennedy, 2007; Bale, 2011). In the analysis, segments σ are shorthand for ordered quadruplets $\langle u, v, >, \mu \rangle$, with u, v individuals representing endpoints; $>$ a total ordering; and μ a dimension of measurement (e.g. height). It is effectively a relational version of the triples Bartsch and Vennemann (1972) interpret degrees to represent. The result is a semantics for a comparative (25) formalized as (25-a) and informally summarized in (25-b).

(25) Tom is taller than Susan.
      a. $\exists \sigma [\nearrow (\sigma) \wedge \text{START}(\sigma) = \mu_\sigma(\mathbf{s}) \wedge \text{END}(\sigma) = \mu_\sigma(\mathbf{t}) \wedge \mu_\sigma = \text{HEIGHT}]$
      b. 'There is a rising directed scale segment: it starts with Susan's measurement on the scale, it ends with Tom's measurement on the scale, and it is a segment of the height scale.'

4.5 Lattice vs. interval plurals

Finally, in Rett (2015), I argue that there are two different sorts of plural entities, intervals and lattices. Interval plurals (Schwarzschild and Wilkinson, 2002; Dotlacil and Nouwen, 2016) have strictly linearly ordered atomic members, e.g. degree scales, temporal intervals, and spatial vectors. Lattice plurals (Link, 1983) have atomic members that form a (semi-)lattice structure.

I argue that relations between interval plurals – like comparatives, temporal relations like *before* and *after*, and spatial prepositions – are interpreted with respect to the same general principle: the matrix argument is related to the most informative closed bound of the embedded argument. In contrast, relations between lattice plurals are interpreted with respect to the maximal plural entity (see Malamud, 2012, for discussion). In addition to explaining parallel semantic behavior between degree, temporal, and spatial relations, it predicts that only interval plural relations have antonyms, and that antonymic constructions are associated with reverse orderings.

4.6 Interim summary

In sum, just like arguments in favor of expanding the ontology, type collapsing or eliminating arguments tend to take one of two forms. First, there are morphological arguments that we should collapse two or more types together because there is a tendency for (unrelated) languages to use the same functional word or morpheme to range over them. These include degrees, manners, and kinds on the one hand (Anderson, 2016), and sets of degrees and vectors on the other (Schwarzschild, 2012). They also include the observation that operators like *many* and *most* range over individuals and events (Doetjes, 2007; Nakanishi, 2007; Burnett, 2012), and that operators like *when* and *if* range over worlds, times, and locations.

Second, there are semantic arguments in favor of collapsing or eliminating types. Whereas semantic type proliferation arguments deal with the issue of semantic adequacy – a model *needs* a different sort of entity to properly characterize a construction or language – type collapsing arguments deal with semantic convergence. Situation semanticists (Barwise, 1981; Barwise and Perry, 1983; Kratzer, 1989) have argued that restricting and quantifying over worlds, times, and locations independently predicts more truth-conditional variation than we see. Bach (1986a) and Krifka (1990) were the first to observe a wide-spread polysemy between individuals and events in constructions with numerals and quantifiers; in Rett (2014) I argued that the polysemy extends to degrees as well. And in Rett (2015), I argued that there is a real semantic difference between the way relations are calculated between interval plurals and between lattice plurals.

	Old High German	Modern German
infinitive	*neman*	*nehman*
1PL	*neměm*	*nehman*
3PL	*nemant*	*nehman*

Table 2: Syncretism in German verbs

5 Concluding summary and discussion

Proponents of both proliferating types and collapsing them seem to care about the same sorts of things, which makes it easy at least in principle to compare the two perspectives. They care about capturing truth conditions (either making the theory sufficiently fine-grained or preventing it from being too fine-grained). And they take seriously the morphological cues of the language (explaining either the use of the same functional morpheme for more than one putative type, or two different functional morphemes for a single putative type).

Luckily, linguistic theory has something to say about the morphological arguments; specifically, it seems to have principled answers to the question: What's more compelling, differentiated morphology or co-opted morphology? Loosely speaking, studies of grammatical change have suggested that it's more likely natural language would co-opt function words for different entities than it would innovate different function words for the same entity. First, when languages add morphemes, especially via borrowing, they either tend not to be, or cannot be, functional morphemes (Thomason, 2001). So the typical process by which we see lexical growth in a language generally does not extend to functional items, which has been the focus of the morphological arguments discussed here.

Second, functional items like proforms are more likely to converge over time (cf. Norde, 2009), via processes like analogical change (Hock, 2005) or syncretism (Baerman et al., 2005). Bußmann (1996) characterizes the former as the "diachronic process by which conceptually related linguistic units are made similar (or identical) in form... often regarded as the result of the move towards economy of form" (p.21). Syncretism is a term for this sort of process when it affects inflectional paradigms, exemplified in Table 2.

In terms of semantic arguments, the question of what is more important, a powerful theory or a restrictive one, transcends discussions of semantic ontology and even linguistics. But there is an important difference between the two approaches in the consistency of their conclusions. The arguments for proliferating types seem to lead to consistent conclusions, cross-linguistically, possibly trivally. And they also result in an attractive (albeit incomplete) universal typology: {individuals, times, worlds} < {degrees}.

The arguments for collapsing types, on the other hand, seem more inconsistent. Consider events: should they be type-assimilated with individuals, as suggested by individual/event polysemy (Bach, 1986a; Krifka, 1990)? Or should they be associated with possible worlds and locations, as the situation

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semanticists have argued? And consider degrees: are they more like vectors (Schwarzschild, 2013; Rett, 2015), or are they more like manners and kinds (Anderson, 2016)? While these empirical arguments are compelling in isolation, amalgamating them in a single semantic theory seems problematic.

I'll close by reiterating that none of these arguments appear to be able to differentiate between Type Flexibility – a semantics with numerous basic types – and Type Ersatzism, with a single type that differentiates between e.g. individuals and events at some sub-type level. I know of no empirical argument that can do this. Instead, I hope to have presented a wide variety of existing arguments for leaning towards Type Reductionalism and for leaning towards Type Flexibility/Ersatzism, and I have tentatively argued that the latter are more morphologically plausible and semantically consistent.

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