A typology of semantic entities[*]

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1 introduction

- very little discussion about the sorts of semantic entities we should include in our semantic ontology

    - standard Montague-inspired semantic analyses employ individuals and possible worlds;

    - but in practice, some take a 'the more the merrier' approach:

        * Landman (2006) uses 9 basic entities, differentiating between kinds, events, event-kinds (p2)
        * Champollion (2010) uses 5 basic entities, differentiating between degrees, numbers, and intervals (p8-9) *before* considering intensional constructions

    - while others take for granted that these decisions should be guided principally by Ockham's Razor, posing and taking up the challenge of eliminating as many as possible

        * Thomason (1980) argues possible worlds aren't necessary to model propositional attitudes;
        * Keenan (2015, 2018) addresses an issue in adjectival semantics by doing away with individuals

- the big question: how can we differentiate between types (in a principled way)?[1]

    1. **Type Reductionalism**: Ty-0, no basic types (Keenan, 2015, 2018)

    2. **Type Minimalism**: Ty-1, no ersatz types (original Montague; Klein 1980, 1982)

    3. **Type Ersatzism**: Ty-1, with the domain of entities sorted into different groups at the sub-type level via lexicalized selectional or domain restrictions (Carlson, 1977, for times)

    4. **Type Flexibility**: Ty-n, for n types that pass some tests (Landman, 2006; Champollion, 2010)

        (a) **Global**: calculated language-universally
        (b) **Local**: calculated language-specifically

- a little more on Type Ersatzism:

    (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*

    - standardly, these are predicates of individuals; they can be modeled as partial functions from the subclass of individuals that satisfies the selectional restriction

    - Type Ersatzism does this with different flavors of entities (Schlenker, 2006; Moltmann, 2007)

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

[1]I borrow this notation from Gallin (1975), who argued that Montague's use of possible worlds is more appropriately characterized as a two-sorted variant of Russell's type theory.

- some ground-clearing

  - a model of what?

    * a given speaker's i-language
    * the semanticist's toolbox

  - basic vs. complex

    * I'm interested in adjudicating about the former because the latter come for free[2]
    * although arguments that differentiate between basic and complex entities might also be useful in differentiating between basic entities, e.g. Link (1983)[3]

  - a non-starter diagnostic: the existence of referring expressions over entities (cf. Schlenker 2006)

    * we can coin a referring expression for anything, really – e.g. Twin Earth – this is why the lexical/functional distinction is used as a weapon against Whorfianism
    * but there might still be functional systematicity to pay attention to, e.g. the ability of definite noun phrases and bare plural noun phrases to refer to kinds (Carlson, 1977)

2   type proliferation

The empirical arguments for different types, across the literature, have been very similar: there are lexical items that seem dedicated to particular domains (**morphological cues**), and semantic phenomena that seem to only be explainable by appeal to non-individuals (**semantic adequacy**)

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

2.1   possible worlds

- possible world semantics (Hintikka, 1957; Kripke, 1959)

- in stark contrast to Montague (1970, 1973), explicit world variables

  - set-theoretic representation of entailment

  - modals as duals, a parallel with individual quantifiers

- interestingly, there appears to be no language without modals, although they differ with respect to which elements they unite lexically (flavor, force, evidentiality; Matthewson, 2013)

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[2]Although see Matthewson (2014) for arguments that some languages (e.g. St'át'imcets) lack quantifiers.

[3]Link's (1983) two criteria for assimilating plurals with mass nouns (as opposed to sets) are a) that they're selected by the same predicate (e.g. *The children/water gathered in pools*); and b) they both exhibit the property of cumulative reference.

2.2   times

- Partee (1973, 1984): tense markers are temporal proforms (Stone 1997: modals are world proforms)

  1. non-linguistic antecedents

     (3)   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*

  2. definite antecedents

     (4)   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*

  3. indefinite antecedents

     (5)   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*

  4. bound variable use

     (6)   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*

  5. donkey-anaphoric use

     (7)   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 enemy will learn its
                secrets.   *modal*

- (some other anaphors we tend not to associate with (basic) types: VP, propositional, adjectival; Landman 2006, King and Lewis 2018)

- many languages observed to lack tense marking of any kind (e.g. Bittner, 2005, 2011)

  - Lillooet (Salish) (Matthewson, 2006):

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

    * these untensed sentences are not future-oriented
    * so Matthewson concludes they have a null non-past marker

  - broad consensus from other languages whose versions of (8) behave slightly differently: nothing in the language specifies or refers to time, but aspect modifies it
    * Chinese (Lin, 2005)
    * Guaraní (Tonhauser, 2011)
    * Hausa (Mucha, 2013)

  - e.g. Hausa prospective aspect, which introduces the function $\lambda P_{\langle v,\langle s,t\rangle\rangle}\lambda e\lambda t\lambda w[P(e)(w)\wedge\tau(e)>t]$ for the runtime $\tau(e)$ of an event e (Mucha 2013:203)

- conclusion: times are necessary for modeling languages universally, but not all languages have dedicated time-introducing pronouns

2.3 degrees

- Cresswell (1976): non-gradable adjectives and gradable adjectives differ in arity[4]

    (9)   a.   Jane is single.
                b.   Jane is 6ft tall.

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

- several adjectival phenomena that can't be properly characterized using a degree-free semantics (as originally proposed in Klein 1980, 1982)

    - antonymy writ large (*tall* vs. *short*, Kennedy 1999);
    - the semantic contribution of measure phrases (MPs) like *2ft*, especially as differentials (e.g. *Chris is 2ft taller than Karen*; Kennedy 1999; Schwarzschild 2005);
    - the behavior of subclasses of gradable adjectives (Kennedy and McNally, 2005)
    - the meaning of (some) comparatives

        * comparative strategies differ in whether the involve degree quantification ('explicit comparatives,' as in *-er/more* in English, Beck et al. 2004, 2009; Kennedy 2005)[5]

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

        * explicit comparatives, formed with degree quantifiers (*-er, more* in English) exhibit subtly different semantic effects from other comparative strategies (Kennedy, 2005):
            · explicit comparatives don't require a 'crisp judgment' scenario, in which there is a minimal difference between the two values;
            · explicit comparatives are non-evaluative (i.e. don't entail the corresponding positive construction) when formed with positive relative adjectives;
            · explicit comparatives can be modified by a differential (e.g. *by 2 inches* or *2 inches taller*);
            · explicit comparatives can be formed with absolute adjectives (e.g. *bent*)

- however, in contrast to possible worlds and to some extent times, there are compelling arguments that while languages like English need to be modeled using degrees, other languages do not

    - 'degree-less' languages: Motu (Beck et al., 2009); Fijian (Pearson, 2010); Washo (Bochnak, 2015a,b; Beltrama and Bochnak, 2015); Navajo (Bochnak and Bogal-Allbritten, 2015);[6] Walpiri (Bowler, 2016)
    - these languages do not have:
        * measure phrases
        * degree modifiers (e.g. *very*)
        * explicit comparatives, superlatives

- conclusion: degrees are necessary for modeling some languages; other languages would be mischaracterized if their analyses involved degrees

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[4]Despite these origins, MPs are almost certainly adjectival modifiers rather than degree proper names (Schwarzschild, 2005). That, of course, does not preclude the need for degrees to model adjectival constructions.

[5]A parallel argument can be made for equative strategies, Rett *to appear*.

[6]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).

2.4   trends in type proliferation

- direct evidence

    (12)   a language differentiates between entity x and entity y if:
    - a.   **proform**: it lexicalizes different proforms for x and y
    - b.   **modifier**: it lexicalizes different modifiers of x and y
    - c.   **quantifier**: it lexicalizes different quantifiers over x and y

- indirect evidence

    - non-dedicated restrictors or semantic dependence (e.g. aspectual markers in Hausa)

    - semantic precision (e.g. implicit vs. explicit comparatives)

- these are arguably not necessary conditions, we can imagine a relatively impoverished lexicon with accidental homophony (although see §3)

- but are they sufficient? (jointly sufficient?)

TYPE	PROFORM	MODIFIER	QUANTIFIER
individuals	*she*	*spotted*	*everyone*
possible worlds	*would*	*actually*	*must*
events	*it*	*quickly*	*always*
times	*then, -ed*	*before*	*always*
degrees	*yea*	*6ft, very*	*more*
kinds	*so, such*	*endangered*	*(how)*
vectors (?)	*there*	*far?*	*everywhere*

Table 2: Evidence for types of entities in English

- *wh*-words could be construed as pronouns or quantifiers, but they aren't perfect diagnostics (either)

    - *who, what, which* for individuals

    - *when* for times

    - *how, how many/much/etc.* for degrees (and also *what*, sometimes)

    - *how* for manners

    - *where* for vectors

    - *why, how come* for... reasons?

- it's worthwhile noting the consistency of these arguments across different, unrelated theoretical projects and empirical phenomena

- a final consideration: the appearance of a robust universal typology (à la Greenberg's Universals)[7]

    - every language must be modeled with individuals, possible worlds, and times

    - languages differ with respect to whether they must be modeled with degrees

3   type-collapsing arguments

Empirical arguments for collapsing, merging, or eliminating different types also evoke lexicalization (**morphological cues**) but semantically they focus on cross-domain parallels (**semantic convergence**)

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[7]E.g. "If a language is exclusively suffixing, it is postpositional; if it is exclusively prefixing, it is prepositional" and "If the pronominal object follows the verb, so does the nominal object."

3.1   situations

- possible worlds, times, and locations are collectively too blunt, they covary in a predictable way (Barwise, 1981; Barwise and Perry, 1983; Kratzer, 1989)

  (13)   a.   Beryl saw Meryl feed the animals.
          b.   Beryl saw that Meryl fed the animals.

- situations are spatio-temporally specified partial worlds ('particulars')

- argued to be a type that effectively collapses worlds, times, and locations into one

- Kratzer (2017) argues that situations can be used to define Davidsonian events: from this perspective, $\lambda e[P(a)(e)]$ 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

  - this approach might explain the synonymy of *when* and *if* clauses (cf. Rothstein 1995)[8]...

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

  - ...but requires an explanation of the different lexical entries

3.2   individuals and events (and degrees)

- Bach (1986): individuals and events have the same mereology

  - extending Link (1983) and his Boolean join semi-lattice to events as well as individuals
  - the mass/count distinction is equivalent to the atelic/telic one re: Link's cumulativity of reference

- Krifka (1990): some sentences are ambiguous between individual and event readings

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

  - Krifka treats this polysemy as a homomorphism from 'concrete entities to abstract entities' (p494), but assigns individuals and events distinct types
  - the cardinality operator that allows for the semantic composition of the numeral and the NP is polysemous between measuring individuals, events, or sets of events
  - (some) quantifiers seem to be domain-general, too: *Most ships passed through the lock at night.*

- still more work on this individual/event parallel: Doetjes (2007); Nakanishi (2007); Burnett (2012)

- an aside: Rett (2014) observes a similar DP polysemy between individuals and degrees:

  (16)   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.

  - observation: degree interpretations are restricted to dimensions of measurement that are monotonic on the part-whole structure of the plural individual (Schwarzschild, 2005)
  - analysis: there is a freely available meaning-preserving homomorphism from individuals to degrees (bound by 'equality of measure')

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[8]Which is arguably empirically distinct from domain-unspecified quantification, Lewis (1975)...

3.3   Schlenker's ontological symmetry

- Schlenker (2006: 504): "Reference to individuals, times and worlds is uniformly effected through generalized quantifiers, definite descriptions, and pronouns."

- Schlenker suggests that there is a single type ξ ranging over an $\langle$individual, time, world$\rangle$ triple

- our question: why stop there? (Or, perhaps, why start there?)

3.4   degrees, kinds, and manners

- Landman and Morzycki (2003); Anderson and Morzycki (2015): strong cross-linguistic evidence for the assimilation of degrees, kinds, and manners (see also Haspelmath and Buchholz, 1998):

  (17)   a.   Jane danced **as** Maria danced.[9]   *manner*
         b.   Jane is as tall **as** Maria is.   *degree*

  (18)   a.   On tańczył **tak**.
              he danced thus
              'He danced like that.'   *manner*
         b.   **Taki**   pies   uciekłwczoraj 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*

- also: a kind/degree ambiguity in *It's amazing the cars he owns* (Castroviejo Miró and Schwager, 2008)

- Anderson and Morzycki (2015) explicitly argue for a particular version of 'enriched degrees' in which they're modeled as kinds of Davidsonian states (and in which manners are modeled as event kinds)

3.5   lattice- vs. interval-plurals

- Rett (2015): parallels within the treatment of interval-plurals (cf. lattice-plurals)

  - intervals (Schwarzschild and Wilkinson, 2002; Dotlacil and Nouwen, 2016): plural entities whose atomic members are linearly ordered: degrees, temporal intervals, spatial vectors

  - lattices (Link, 1983): plural entities whose atomic members form a (semi-)lattice structure

  - relations between interval-plurals are interpreted with respect to the same (pragmatic) principle: the matrix argument is related to the most informative closed bound of the embedded argument

    (19)   a.   Lucinda is driving faster than is allowed on this highway.   (Rullmann, 1995)
           b.   Lucinda is driving slower than is allowed on this highway.

    (20)   NEW YORK CONTEXT: a maximum (70mph) and a minimum (40mph) speed limit

    (21)   CALIFORNIA CONTEXT: a maximum (70mph) speed limit only

  - in contrast, relations between lattice-plurals are interpreted with respect to the maximal plural entity (for discussion see Malamud, 2012)

- conclusion: there are two types of relations between plurals: those oriented to the most informative closed bound, and those oriented to the maximal plural entity

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

3.6   trends in the collapsing of types

- morphological arguments: shared pronominal forms across domains

  – times and possible worlds (in situation semantics, with *when* and *if*)

  – degrees, manners, and to a lesser extent kinds (Anderson and Morzycki, 2015)

- referential polysemy

  – DPs like *four thousand ships* can denote (plural) individuals or (plural) events...

  – ...or a degree corresponding to some measure of that individual

- cross-domain semantic parallels:

  – the co-dependence or co-variation of times, worlds, and locations (situations)

  – the cross-domain similarities of strictly-ordered vs. lattice-theoretic domains

4   conclusions

- the arguments for proliferating types seem consistent across domains, both language-internal and -external:

  – morphological arguments (distinct functional words)

  – semantic arguments (empirical adequacy)

- they also seem to lead to consistent conclusions, cross-linguistically, and an attractive universal typology: {individuals, times, worlds} < {degrees, (?)kinds...}

- the arguments for collapsing types seem more variable and contradictory

  – events: more like individuals (Bach/Krifka) or possible worlds (situation semantics)?

  – degrees: more like vectors (Rett) or manners/kinds (Morzycki et al.)?

- what's more compelling, postulating differentiated morphology or co-opted morphology?

  – diachronically, functional items like proforms more likely to converge (cf. Norde, 2009)

    * analogy: 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" (Bußmann, 1996, 21), see also Hock (2005)

	Old English	Modern English
present tense	ceosan	choose
past sg.	ceas	chose
past pl.	curon	chose
past participle	coren	chosen

    * whereas languages add things, especially via borrowing, these things either tend not to, or cannot, be functional words (Thomason, 2001)

  – good tests to differentiate polysemy from accidental homophony:

    * cross-linguistic variation

    * processing, acquisition

    * copredication (though it doesn't work for every type; Copestake and Briscoe, 1995)

  – but there isn't a cross-domain proform (in English), making it hard to conduct copredication tests

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