English Linguistics – The mass/count distinction, applied investigations
Winter 2019-2020
Lecture Notes

Introduction:

- The mass/count distinction
    - The basic data (restricted to concrete entities):
        - *one bush, two shrubs, three plants, three pieces of vegetation, *three vegetations*
        - *one lake, two rivers, three bodies of water, *three waters*
        - Generalization
            - Terminological note: I follow Rothstein (2017) in assuming the following:
                - Numbers---e.g. 1, 2, 3
                - Numericals = words that refer to numbers---e.g. *one, two percent, three-point-five*
                - Numerals = numbers and numericals
            - Numericals are directly combined with some nouns, lets call them "count"
            - Numericals are not directly combined with other nouns, lets call them "mass"---note, some people prefer "non-count" (e.g. Grimm 2012)
                - Modification (a classifier or measure phrase) is needed for mass nouns to be counted---e.g. *pieces of, kinds of, kilos of* (can a good cover term be made for classifiers and measure phrases?)
            - In some cases, numericals are sometimes directly combined with nouns and sometimes not directly combined with nouns
                - e.g. *three stones*, *three pieces of stone*
                - These nouns are called `dual-life' () or sometimes `flexible' (rothstein2010,rothstein2017,schvarczRothstein2017).
                - It is assumed by some that these nouns have two distinct interpretations, one count and one mass (huddleston_pullum_2002,rothstein2010,erbachEtAl2018hungarian)
        - Coercion
            - *three waters = three portions of water* OR *three kinds of water*
            - ``a mismatch (cf. Francis and Michaelis 2004) between the semantic properties of a selector (be it a construction, a word class, a temporal or aspectual marker) and the inherent semantic properties of a selected element, the latter being not expected in that particular context" (Lauwers and Willems 2011)
            - Assumption: numericals are selectors with properties that mismatch with respect to the properties of mass nouns
                - *Three* is a selector that has certain properties that mismatch with respect to the properties of *vegetation* and *water*
            - `Universal sorter' (bunt1985mass) a semantic operation that is able to (c)overtly coerce a portion or kind interpretation
                - Allows numericals and nouns to be directly combined
            - `universal grinder' (pelletier1975) a semantic operation that is able to (c)overtly coerce a substance interpretation
                - Allows mass selectors and count nouns to be combined
        - **Exercise**: Explain the difference between each of the following NPs: *Three cakes, three portions of cake, three beers, three portions of beer*.
    - The main question underlying the mass/count distinction

        - What are the properties of numericals, count nouns, and mass nouns that explain the basic data---i.e. the fact that numericals are directly combined with count nouns but not mass nouns
    - Further data: the mass/count distinction is not restricted to numerals
        - In the same way that numericals like *three* can be thought of as selectors whose properties match with the properties of count nouns like *shrub* but not with the properties of mass nouns like *vegetation*, there are
        - Other selectors: count vs. mass
            - Commonly discussed selectors whose properties match with the properties of count nouns but not the properties of mass nouns (not exhaustive)
                - -(*e*)*s*, *a*(*n*), *every*, *each, both, several, many, few, these/those*
            - Commonly discussed selectors whose properties match with the properties of mass nouns but not the properties of count nouns(not exhaustive)
                - *much, little*
            - Less commonly discussed selectors
                - *Hundreds of, dozens of, couple of, pair of*
                - **Can you think of others?**
            - Determiners without restriction
                - *All, the, some, any, no*
        - Subclasses
            - Object mass nouns---e.g. *furniture, jewelry, cutlery*
                - Show crosslinguistic variation---*furniture* vs. *mobil-e/i* (`piece/s of furniture' Italian)
                - Show intralinguistic variation---*shoes* vs *footwear*
                - Are more likely to be judged according to cardinality in quantity comparison tasks than canonical mass nouns (Barner & Snedeker 2005)
                    - "Who has more?"
                - Take stubbornly distributive predicates unlike canonical mass nouns (Rothstein 2010)
                    - *The furniture is big.*
                    - **The mustard is big.*
            - Granular nouns---e.g. *sand, rice, beans, lentils*
                - Show crosslinguistic variation---*lentils* vs *čočka* (`lentil'$_{\text{mass}}$ Czech)
                - Show intralinguistic variation---*oats* vs *oatmeal*
                - The predicate generally holds over parts: If grains of rice are cut into pieces, they are still *rice* in the same sense
                    - Compare to canonical count nouns
            - Homogenous count nouns
                - Show intralinguistic variation---*shrub(s)* vs *shrubbery, fences* vs *fencing*
                - Can be subdivided and still counted unlike canonical count nouns
                    - e.g. The fencing around a piece of property can be counted as one or four fences.
                        - *I have a fence around my property.*
                        - *I have a fence on each side of my house.*
                    - Compare to canonical count nouns
        - **Exercise**: characterize the countability of the following nouns: *chair, concrete, window, glass, tile*
- Theories of the mass/count distinction

- Link (1983)
  - Main observations:
    - Plurals and mass nouns have collective reference
      - *The students gathered (in a circle).*
      - *The water gathered (in a puddle).*
      - **The student gathered (in a circle).*
    - Plurals and mass nouns have cumulative reference
      - *students + students = students*
      - *water + water = water*
      - *student + student =/= student*
    - Count and mass nouns can refer to the same objects and take contradictory predicates
      - *The rings are new, but the gold is old.*
  - Hypothesis
    - Count nouns refer to atoms, entities that cannot be divided and still counted under a predicate, mass nouns do not
      - This accounts for the third observation
    - Plurals and mass nouns both refer to semi-lattices (entities and sums thereof)
      - This accounts for the first and second observations
    - (Can be skipped) Individual entities and sums thereof are of the same semantic type
      - Introduces mereology into formal linguistic theory
        - Assumes that the sum operation is primitive and available to make two entities into one
        - a, b, c, a⊔b, a⊔c, b⊔c, a⊔b⊔c
          - A chair and a desk count as a single entity in this sense
      - This is an alternative to the set-theoretic approach where individual entities and sums thereof are of different types
        - a, b, c, {a, b}, {a,c}, {b, c}, {a, b, c}
          - A chair and a desk are a set of two entities in this sense
      - Mereology is the most widely adopted
        - Many philosophers prefer plural logic, though has been shown to not really be better or worse per se (Florio and Nicholas)
          - Individuals: a, b, c
          - Sums: aa, bb, cc
  - Criticisms: Bach (1986)
    - Main contribution: extending Link's analysis to eventualities
      - There are noted parallels between the mass/count distinction and the a-telic/telic distinction
      - *running + running = running*
      - *run to the store + run to the store =/= run to the store*
      - Interesting theoretical point, but not our concern
    - What matters for us: Two things referred to with contradictory properties cannot be identical
      - Two mass nouns can refer to the same entity and take contradictory predicates
        - *The snow is new, but the H_20 it is made of is old*.
        - The snow and the water making it up cannot be identical

- Solutions
  - Don't interpret things like *is made of* as the constitution relation or equivalences
  - Remove the mass domain
- Krifka (1989)
  - Model-theoretic formalization of a one-domain approach using predicate-specific quantization to determine countability
  - There is no reason to commit to an atomic or a non-atomic domain
    - Atomicity is not necessary or sufficient for countability
      - Fences are count but not atomic (they and their parts can sometimes be counted)
      - Furniture is mass but (presumably) atomic (if chairs and desks are atomic as count nouns, then presumably they would remain so under a mass predicate)
    - Non-atomicity is hard to commit to for concrete objects
      - Is anything concrete infinitely subdivisible? The material of canonical mass nouns is not---e.g. water, mud, etc.
  - Countability is whether or not a "natural unit" function is part of the meaning of a noun and applied to the denotation of the predicate
    - The natural unit function counts the number of entities referred to by the predicate
    - *cow* = $\lambda n \lambda x[\mathrm{COW}'(x) \wedge \mathrm{NU}(\mathrm{COW}')(x) = n]$
      - where COW is a nominal predicate which underlies the meaning of cow but has no surface representation in English
    - Implication: for homogenous entities---e.g. fence---then the total number is always the highest
      - If the fence around a property can be counted as one, and each of the four sides can be counted as one, then the total number of fences is five.
      - **Discussion**: Does this seem like a good idea?
    - **Discussion**: If the difference between count nouns and mass nouns is the presence of a natural unit function, then what explains why some nouns get a natural unit function and why some don't?
- Formal Semantics
  - Assumption: Language can be explained with mathematical tools
  - Theories about reference
    - Finding the meaning in the relations of symbols and configurations thereof to objects of various kinds
  - Basic assumptions and type theory
    - Assumption: names denote (refer to) individuals
      - e.g. *Beyonce* denotes the singer
      - Because names are assumed to denote individuals, we can call them type *e*, where *e* can be understood as referring to an entity
    - Assumption: referential sentences have truth values: T, F; 1, 0
      - e.g. *Beyonce sings* has the truth value 1 or `true'
      - Because sentences have truth values, we can call them type *t*, where *t* can be understood as having a truth value
    - Decomposition: if *Beyonce* is type *e,* and *Beyonce sings* is type *t,* then *sings* is a function that takes an entity--e.g. Beyonce--and returns a truth value--1.

- The shorthand for this type of function is type ⟨*e,t*⟩
- One step further: If *Beyonce sings Single Ladies* is type *t,* and *Beyonce* and *Single Ladies* are both type *e,* then transitive *sings* is type ⟨*e,*⟨*e,t*⟩⟩
- Basic lambda expressions and sets
  - Since Beyonce is an entity that sings, we can abstract away from this statement and say that she belongs in the set of all entities that sing
  - Draw, D, our domain of entities, and draw a circle for the set of entities that sing
  - Set theoretic definition:
    - $[\![\text{sing}]\!]^{v} = x \in \{x : x \text{ sings in } v\}$
    - semantic operators: interpretation $[\![\,]\!]$, situation variable ^{v}, =, entity variable *x,* set membership ∈, set { }, such that :
    - The interpretation of sing in the situation *v* is that x is a member of the set of xs such that x sings in v
  - Lambda expression:
    - $[\![\text{sing}]\!]^{v} = \lambda x[\text{sing}(x)]$
    - The expression λx[P] is called a λ-abstract (or λ-expression) and can be read as "the property of being an x such that P." We say that x in λx[P] is bound by λ and that P is the scope of that occurrence of the λ-operator.
- Formal logic
  - Rules and operators for formulating truth
    - negation ¬, and ∧, or ∨, implication →, bicondition ↔
  - $[\![\text{does not sing}]\!]^{v} = \lambda x[\neg\text{sing}(x)]$
    -

P	¬P
1	0
0	1

  - $[\![\text{sings and dances}]\!]^{v} = \lambda x[\text{sing}(x) \wedge \text{dance}(x)]$
    -

P	Q	P ∧ Q
1	1	1
1	0	0
0	1	0
0	0	0

  - $[\![\text{sings or dances}]\!]^{v} = \lambda x[\text{sing}(x) \vee \text{dance}(x)]$
    -

P	Q	P ∨ Q
1	1	1
1	0	1
0	1	1

0	0	0

- ⟦if sings, then dances⟧^{v} = λx[sing(x) → dance(x)]
  -

P	Q	P → Q
1	1	1
1	0	0
0	1	1
0	0	1

- ⟦sings iff dances⟧^{v} = λx[sing(x) ↔ dance(x)]
  -

P	Q	P ↔ Q
1	1	1
1	0	0
0	1	0
0	0	1

- Applying these predicates to *Beyonce*, *b*, we get the following:
  - ⟦Beyonce does not sing⟧^{v} = λx[¬sing(*b*)]
  - ⟦Beyonce sings and dances⟧^{v} = λx[sing(*b*) ∧ dance(*b*)]
  - ⟦Beyonce sings or dances⟧^{v} = λx[sing(*b*) ∨ dance(*b*)]
  - ⟦If Beyonce sings, then she dances⟧^{v} = λx[sing(*b*) → dance(*b*)]
  - ⟦Beyonce sings iff dances⟧^{v} = λx[sing(*b*) ↔ dance(*b*)]
- Formal quantifiers: Abstracting away from Beyonce
  - NL quantifiers: *all, every, each, some, many, much,* etc
  - Formal quantifiers: universal quantifier ∀, existential quantifier ∃
    - universal quantifier ∀ often corresponds to *all, every, each*
      - ⟦*Every person sings*⟧ = ∀*x*[person(*x*) → sing(*x*)]
      - In words: for all entities, if that entity is a person, then that entity sings
    - existential quantifier ∃
      - ⟦*Some person sings*⟧ = ∃*x*[person(*x*) ∧ sing(*x*)]
      - In words: Some entity is a person and sings
- Why are these used, why do we care? Working with the underlying assumption that language use and meaning can be explained with logical rules, these rules and operators are the tools of the semanticist.
  - A hypothesis is written as a logical formula, and that formula is tested against data
    - Circularity: a formula is informed by available data, so of course it will not be found to be invalid
- Relevant example:
  - PL(table)({*a*,*c*}) → table(*a*) ∧ table(*c*) (Chierchia 1998)

        - **Exercise:** put it in words: If a and c are tables, then a is a table and c is a table.
    - $[\![*P]\!] = \{x \in D : \exists X \subseteq [\![P]\!]\ X \neq 0 : x = \sqcup X\}$
        - Where D is the domain of entities
- Mereological operators
    - Sum, $\sqcup$, is an idempotent, commutative and associative relation.
        - Idempotent: an operation that can be applied without changing what it is applied to:
            - for any finite set A,
                - $A \sqcup A = A$,
                - $A \cap A = A$
        - Commutative: an operation that is the same regardless of the order of the elements
            - For any two finite sets A and B,
                - $A \sqcup B = B \sqcup A$,
                - $A \cap B = A \cap B$
        - Associative: an operation on elements that occurs twice or more in a row is equal regardless of order
            - For any three finite sets A, B, C
                - $(A \sqcup B) \sqcup C = A \sqcup (B \sqcup C)$,
                - $(A \cap B) \cap C = A \cap (B \cap C)$
        - Examples
            - Beyonce ⊔ Jay-Z = Beyonce⊔Jay-Z
            - $a \sqcup b = a{\sqcup}b$
            - $\sqcup\{a, b, c, d\} = a{\sqcup}b{\sqcup}c{\sqcup}d$
    - Part, $\leq$ or $\sqsubseteq$, & proper part, $<$, $\sqsubset$
        - Correspond to subset, $\subseteq$, and proper subset $\subset$
        - The subset operator identifies subsets of a set
            - e.g. $\{a\} \subseteq \{a, b, c\}$, $\{a, b, c\} \subseteq \{a, b, c\}$
        - The proper subset operator $\subset$ identifies a proper subset--i.e. a subset that is not equal to the set itself
            - e.g. $\{a\} \subset \{a, b, c\}$, but it is not true that $\{a, b, c\} \subset \{a, b, c\}$
        - The part and proper part operators work the same way but for mereological sums
            - e.g. $a \sqsubseteq a{\sqcup}b{\sqcup}c$, $a{\sqcup}b{\sqcup}c \sqsubseteq a{\sqcup}b{\sqcup}c$
            - e.g. $a \sqsubset a{\sqcup}b{\sqcup}c$ but it is not true that $a{\sqcup}b{\sqcup}c \sqsubset a{\sqcup}b{\sqcup}c$
        - Examples
            - Beyonce ⊑ Beyonce⊔Jay-Z
        - Note: thought it is called the "part" operator, it should not be assumed to always correspond to the natural language phrase *part of*
    - Relevant example: $[\![*P]\!] = \{x \in D : \exists P \subseteq [\![P]\!] \wedge P \neq \emptyset : x = \sqcup P\}$
        - The interpretation of a plural predicate is the set containing x which is a member of the domain of entities such that, there is some predicate *P* that is part of the interpretation of the word P, and the predicate is not null, such that *x* is the supremum of *P*
        - $[\![$singer$]\!]$ = {ariana_grande, beyonce, christina_aguilera…}
            - $[\![P]\!] = \{a, b, c\}$,
        - $P = \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}$

- ⟦singers⟧ = {ariana_grande ⊔ beyonce ⊔ christina_aguilera, ariana_grande ⊔ beyonce, ariana_grande ⊔ christina_aguilera, beyonce ⊔ christina_aguilera,…}
  - ⟦*P⟧ = {a, b, c, a⊔b, a⊔c, b⊔c, a⊔b⊔c}