

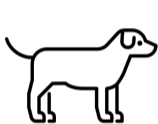
Cocktails and Countability

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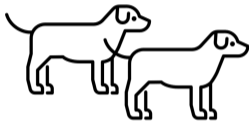
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Nominal Countability in English

Why do some nouns in English combine directly with plural syntax?



dog



dogs



rice



**rices*

Does countability derive from some real-world property?

- animacy of the referent
- conceptual distinction of objects and substances

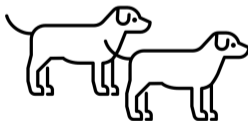
Nominal Countability in English

Two facets of countability—the **syntactic** and **semantic** (Quine 1960; Bunt 1985; Chierchia 1998; Deal 2017)

Syntactic: Does a noun occur with plural marking or combine directly with numerals and count determiners?



many books



two dogs



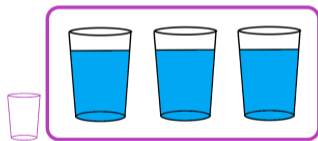
**three rices*

Nominal Countability in English

Syntactic: Mass nouns can sometimes combine with numerals in established contexts (e.g. UNIVERSAL PACKAGER (Bach 1986))



**three waters*



three waters

Nominal Countability in English

Semantic: Are countable individuals semantically accessible?

Acceptability with stubbornly distributive predicates like *large* or *big* is one test for accessibility of individuals (Schwarzschild 2011)

- (1) a. The box is large
b. The boxes are large

- (2) a. ?The milk is large
b. ?The milks are large

Nominal Countability in English

Quantity judgements (Gathercole 1985; Barner and Snedeker 2005) are another way to determine if a noun references individuals via the differing ways for comparing entities—by volume or by number



Figure: Experiment stimuli from Barner and Snedeker (2005)

Nominal Countability in English

Syntactic: Does a noun occur with count syntax?

- Though some flexibility with UNIVERSAL PACKAGER constructions

Semantic: Are countable individuals semantically accessible?

- Possibility of stubbornly distributive readings
- Metric of comparison used in quantity judgements

Nominal Countability in English

Count Nouns:

- *dog*
- *book*
- *chair*

Mass Nouns:

- *water*
- *rice*
- *oxygen*

Challenging Nouns:

- *furniture*
- *silverware*
- *fence*

Today's talk: an undiscussed group of challenging nouns!

Mixed drink nouns, which refer to liquid stuff, but are surprisingly strongly syntactically countable and make reference to individuals

Mixed Drink Nouns

- Cocktail nouns, most drawn from the International Bartender's Association official cocktail list
- Coffee drink nouns, drawn from menus of major coffee chains

Other nouns which might fall into this group (milkshakes, old-fashioned soda fountain drinks) were not considered.

Most all example data is drawn from corpora and web searches.

Standard Mass Drink Nouns

Can only combine with determiners or numerals if a measure or container phrase is also present

- (3) Please pick up *two gallons of milk* from the store.
- (4) Having *a glass of wine* with dinner could lead to better health.

Occasionally combine directly with count syntax but only in contexts where a standard portion is understood (UNIVERSAL PACKAGER)

- (5) Here is the simplest way to order *a coffee* in Italian.

Mixed Drink Nouns

Appear with plural suffix, numerals, and count determiners

- (6) I've had *three lattes* and *two americanos*, so I'm about to die or see sounds.
- (7) When I went on my honeymoon, I had *so many daiquiris* and *bellinis*!

Can only occur in bare singular constructions in 'spilled' contexts

- (8) Remember when I spilled *mimosa* all over myself at brunch?

Measure Phrases

Mass drink nouns most frequently use measure pseudopartatives

- (9) What effect would *12 pints of beer* in one night have on the body?

With mixed drink nouns, measure phrases more frequently use direct modification

- (10) *A 16 ounce cappuccino* at McDonald's contains 142 mg of caffeine per serving.

Distributivity and Divisiveness

Mixed drink nouns occur with stubbornly distributive predicates

- (11) The *margaritas are large* and not watered down, they have lots of flavors for them too.
- (12) Well, our *pineapple martini is big* and filling, we might as well call it soup!

They are, however, moderately divisive—what's left in the glass after taking a few sips of a margarita is still a margarita.

Quantity Judgements

(13) Who ordered more margaritas?

(14) Who has more margaritas?

(15) Who drank more margaritas?



Results from a pilot experiment suggest that some readings of (13) could allow for comparison on number via *glasses of margarita*, but most participants compared quantity on the basis of total volume.

Multiplier Phrases

Some uses of multiplier phrases like *double* and *triple* do not count entities, but modify **parts** of entities (Wągiel 2021)



hamburger



double hamburger

This kind of multiplier phrase is a unique indicator that an entity has distinct and semantically salient parts

Multiplier Phrases

While cardinal numerals like *two* modify the whole entity, multipliers change the number of some part of the entity

Where both numerals and multipliers are present, the multiplier phrases are necessarily the part-modifying sense

(16) I accidentally purchased *two double hamburgers*.

(17) I've seen *three double rainbows* in the past 12 months.

Multiplier Phrases

Some mixed drink nouns also undergo *double* modification, where reference to parts is made

- (18) If you're the kind of person who orders *a 16 oz. double Americano* from your local barista, then this will probably be the right strength.
- (19) I have *four double Americanos* a day during the week.

This is evidence that a noun like *americano* makes reference to an individual unit that has distinct parts in its denotation

Multiplier Phrases

Only a handful of mixed drink nouns occur with the part-modifying sense of multiplier phrases

Other mixed drinks do not seem to permit multiplier modification as there is no clear 'base part' to modify the amount of

(20) ?I'll have a *double negroni*.

Multiplier phrases are a good way to group these mixed drink nouns

- BASE AND MIXER DRINKS: *americano, mimosa, gin and tonic, etc.*
- FIXED RATIO DRINKS: *negroni, margarita, cappuccino, etc.*

Mixed Drink Nouns

Syntactic

- occur with numerals and other count syntax
- always occur with a determiner except in ‘spilled’ contexts

Semantic

- refer to liquids, but which are treated as individuals
- quantity judgements generally based on volume, not number
- reference to salient parts for some types of mixed drink nouns in multiplier constructions

Why are Mixed Drinks Countable?

Why do we count mimosas but not wine?



Why are Mixed Drinks Countable?

Mixed drink nouns differ from mass drink nouns in two ways

- semantically salient parts
- ratio relationship between parts

For mixed drink nouns, the whole is structured by specific parts and the relationship between those parts.

Additionally, some mixed drink nouns have a single semantically salient base part, while others have a more fixed ratio between the parts the drink is composed of.

Modeling Parthood

Classical extensional mereology models part-whole relationships

$$(21) \quad y \sqsubseteq x$$

(y is a part of x)

$$(22) \quad y \oplus z = x$$

(x is composed of y and z)

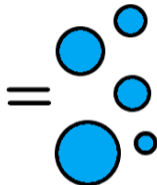
However, mereology only provides an unstructured parthood relationship while a model for mixed drink nouns relies on specific parts and the relationships that hold among them

Modeling Parthood

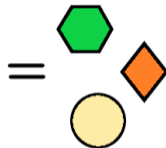
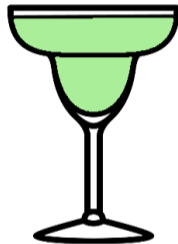
Enriching mereology with topological notions of spatial continuity, **mereotopology** (Casati and Varzi 1999) is able to model the parts of an entity and their relationship to the whole.

Mereotopology is an increasingly-used framework for modeling linguistic countability behavior (Grimm 2012a,b; Lima 2014; Scontras 2014; Wągiel 2021).

Modeling Parthood



water
same parts



margarita
semantically salient different parts

A Mereotopological Semantics for Mixed Drinks

For *margarita* we want to account for three ingredient parts, and we want to specify what those three parts are

A first pass at a denotation would be something like (23)

$$(23) \quad \llbracket \text{margarita} \rrbracket = \lambda x [x = y_0 \oplus y_1 \oplus y_2 \wedge \text{TEQUILA}(y_0) \wedge \text{TRIPLE SEC}(y_1) \wedge \text{LIME JUICE}(y_2)]$$

(an entity is a margarita if it is composed of three parts—tequila, triple sec, and lime juice)

A Mereotopological Semantics for Mixed Drinks

We also need to represent the relationship between the parts

$$(24) \quad \llbracket \text{margarita} \rrbracket = \lambda x [x = y_0 \oplus y_1 \oplus y_2 \wedge \text{TEQUILA}(y_0) \wedge \text{TRIPLE SEC}(y_1) \wedge \text{LIME JUICE}(y_2) \wedge \mu(y_0) = 2 \text{ ounces} \wedge \mu(y_1) = 1 \text{ ounce} \wedge \mu(y_2) = 1 \text{ ounce}]$$

(an entity is a margarita if it is composed of three parts—tequila, triple sec, and lime juice—and the measure of tequila is 2 ounces, the measure of triple sec is 1 ounce, and the measure of lime juice is 1 ounce)

A Mereotopological Semantics for Mixed Drinks

However, what matters for mixed drinks is not the measurements of the parts, but the **ratio** between those measurements

$$(25) \quad \frac{\mu(y_0)}{2} = \frac{\mu(y_1)}{1} = \frac{\mu(y_2)}{1}$$

This allows us to capture the ratio relationship for a margarita as 2:1:1 without specifying any volume measurements

$$(26) \quad \llbracket \text{margarita} \rrbracket = \lambda x [x = y_0 \oplus y_1 \oplus y_2 \wedge \text{TEQUILA}(y_0) \wedge \text{TRIPLE SEC}(y_1) \wedge \text{LIME JUICE}(y_2) \wedge \frac{\mu(y_0)}{2} = \frac{\mu(y_1)}{1} = \frac{\mu(y_2)}{1}]$$

A Mereotopological Semantics for Mixed Drinks

Using a ratio relationship rather than just specifying measurements also allows us to handle part or ratio modifiers

(27) One of the most popular styles of this cocktail, however, is the *dry martini*.

(change in ratio between parts)

(28) The *jumbo margarita* is so appropriately named and it's definitely what you're going to want to order.

(change in measurements, ratio remains the same)

A Mereotopological Semantics for Mixed Drinks

So far the mixed drink semantics has parts and the relationship between them, but how can this be the source of mixed drink countability?

There also needs to be a way to show that the parts making up a drink **form a whole** in a particular and non-arbitrary way.

Currently, the semantics for this is still too weak and separate shots of tequila, triple sec, and lime juice would count as a *margarita*.

Modeling Parthood

$$(29) \quad o(x,y) := \exists z[z \sqsubseteq x \wedge z \sqsubseteq y]$$

(Two things overlap if and only if they share a part)

$$(30) \quad sc(x) := \forall y \forall z[\forall w (o(w, x) \rightarrow (o(w, y) \vee o(w, z))) \rightarrow c(y, z)]$$

(An entity is self-connected if and only if any two parts that form the whole of that entity overlap)

$$(31) \quad ssc(x) := sc(x) \wedge sc(int(x))$$

(An entity is strongly self-connected if it is self-connected and its interior is also self-connected)

Modeling Parthood

We can use these to define a **MAXIMALLY STRONGLY SELF-CONNECTED (MSSC)** entity relative to a given property

$$(32) \quad \text{mssc}(P)(x) := P(x) \wedge \text{ssc}(x) \wedge \forall y [P(y) \wedge \text{ssc}(y) \wedge o(y, x) \rightarrow y \sqsubseteq x]$$

(An entity is a maximally strongly self-connected whole if every part is strongly self-connected, overlaps the whole, and anything else which has the same property is also maximally strongly self-connected)

These mereotopological definitions distinguish arbitrary or unstructured mereological sums from entities which are physically self-connected

A Mereotopological Semantics for Mixed Drinks

Even though mixed drinks have semantically salient parts, those parts are maximally strongly self-connected

$$(33) \quad \llbracket \text{margarita} \rrbracket = \lambda x [x = y_0 \oplus y_1 \oplus y_2 \wedge \text{TEQUILA}(y_0) \wedge \text{TRIPLE} \\ \text{SEC}(y_1) \wedge \text{LIME JUICE}(y_2) \wedge \frac{\mu(y_0)}{2} = \frac{\mu(y_1)}{1} = \frac{\mu(y_2)}{1} \wedge \\ \text{MSSC}(\text{MARGARITA})(x)]$$

Since there is a clear criteria for what parts make up a mixed drink and for being maximally strongly self-connected, there is a criteria for what is a countable mixed drink ‘unit’

A Mereotopological Semantics for Mixed Drinks

Now to generalize this semantics to any mixed drink (*martini*, *latte*) by giving a sequence of variables for the parts and the predicates

$$(34) \quad \llbracket \text{mixed drink} \rrbracket = \lambda x \exists \vec{y}_0^n \exists \vec{P}_0^n [x = \oplus \vec{y} \wedge \forall y_i \forall P_i [P_i(y_i)] \wedge \exists \vec{r}_0^n \forall \vec{y}_0^n [\frac{\mu(y_i)}{r_i} = \frac{\mu(y_j)}{r_j}] \wedge \text{mSSC}(\mathbf{P})(x)]$$

(An entity is a mixed drink if it is composed of two or more parts which are all some ingredient of the drink and where the measure of each part divided by its ratio value is equal to the measure of every other part divided by its ratio value and the whole is maximally strongly self-connected)

A Mereotopological Semantics for Mixed Drinks

For *americano*, the ratio relationship between the espresso and water changes when combined with a multiplier like *double* or *triple*



16 oz. double americano



16 oz. triple americano

A Mereotopological Semantics for Mixed Drinks

The semantics for any base and mixer drink (*americano*, *mimosa*, *gin and tonic*) needs to account for the flexible ratio relationship between the two parts and the salience of the base part

$$(35) \quad \llbracket \text{base and mixer drink} \rrbracket = \lambda x [\exists yz [P(y) \wedge P(z) \wedge \oplus yz = x \wedge \exists r [r = \mu(y) \wedge \mu(z) = \mu(\oplus yz) - r]] \wedge \text{mssc}(P)(x)]$$

(An entity is a base and mixer drink if there exist two ingredient parts which stand in a relationship such that the base part is some standard portion of the base ingredient and the mixer part takes up the remaining volume, and the whole is maximally strongly self-connected)

Conclusion

Mixed drink nouns

- Strongly countable
- Refer to liquid substances
- Articulated parthood structure

We can treat these nouns as structured wholes built out of ingredient parts in particular ratio relationships granting them countable, non-arbitrary structure.

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let's talk about drinks! ellise.moon@rochester.edu; twitter: @eclairmoon

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Appendix: Additional Data

Though a few mass drink nouns occur with multipliers, they only use the counting sense and only if there is an established portion

- (36) Drinking a *double espresso* after dinner keeps you up at night.
- (37) So hide your undereye circles behind these pilot-frame sunglasses from Gucci Eyewear and order a *double coffee*.

Appendix: Additional Data

Mixed drink retain their countability in durative constructions

- (38) a. He *drank tea* all afternoon.
b. We ate burgers and hot dogs and *sipped on wine* all night.
- (39) a. They have beer on tap, but I *drank margaritas* all night.
b. If you're a cocktail connoisseur, chances are you've *sipped on a margarita, martini, or mojito* in the past.

The individual drinks are referenced in (39), pointing to a strong degree of non-cumulativity for mixed drink nouns.

Appendix: Cumulativity and Pitcher Cases

Mass nouns are always cumulative in ‘pitcher’ constructions

- (40) The lawsuit says he drank *a pitcher of beer* before leaving the bar.
- (41) We each had *a pot of tea* and a scone.

Appendix: Cumulativity and Pitcher Cases

Mixed drink nouns allow both cumulative and non-cumulative readings in ‘pitcher’ constructions

- (42) Hemingway supposedly filled himself *a pitcher of martini* every morning.
- (43) There always seemed to be *a pitcher of martinis* on the bar.

Some degree of cumulativity is still possible in these ‘pitcher’ constructions as these ingredient parts are not physically discrete, but themselves mass substances.

Appendix: Quantity Judgement Pilot Experiment

Quantity judgement experiment of 16 nouns

- 4 mass drink (*wine, beer, milk, tea*)
- 4 mixed drink (*margarita, mimosa, latte, cappuccino*)
- mass food nouns (*honey, tomato soup, mustard, macaroni and cheese*)
- count food nouns (*apple, onion, cracker, cookie*)

Appendix: Quantity Judgement Pilot Experiment

Each of the noun stimuli had three variations

- Images, a story scenario contextualizing the images, specific measurements
- Images, a story scenario, and no specified measurements
- Images with no scenario

33 undergraduate participants saw one version of the stimuli for each noun (16 stimuli total, randomized for each participant) and were asked “who has more?”

Two people are enjoying a wine tasting. Person A has 3 smaller glasses of wine. Person B has two larger glasses of wine. Who has more?



Person A



Person B

Two people are enjoying a wine tasting. Person A has 3 smaller glasses of wine. Person B has two larger glasses of wine. Who has more?



Person A



Person B

Who has more?



Person A



Person B

Appendix: Quantity Judgement Pilot Experiment

Percent of quantity judgements based on number of objects, rather than volume

- mixed drink nouns: 20%
- mass drink nouns: 14%
- countable food nouns: 32%
- mass food nouns: 27%