

# Cocktails and Countability

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**Abstract.** Liquids (*oil, wine*) are considered to be canonical non-countable nouns. Yet nouns referring to cocktails and coffee drinks (*margarita, cappuccino*) display strongly countable behavior, which raises broader questions about the semantics of countability and the relationship between nouns and the things to which they refer. This paper investigates these mixed drink nouns and proposes the source of their countability lies in their possessing MEASURED PARTS at the subatomic level which provides a unit for individuation. This, in connection with the ratio relationship between the drink’s ingredient parts, is the source of count behavior for these nouns.

**1. Introduction.** The central question in the literature on countability is why some nouns combine directly with plural syntax while others do not. A speaker can make reference to one *dog* or multiple *dogs*, but not to one *rice* or multiple *rices*. In answering these questions, the semantics and philosophy of language literature on countability has usually focused on paradigmatic cases of individuals, like *dog* or *apple*, and substances, like *water* and *wine*, along with aggregates and granulars, like *furniture* or *rice* which behave as non-countable predicates despite existing as discrete objects in the physical world. But another puzzling subclass of nouns exists—which, as of yet, the literature has not addressed—that make reference to liquids but are countable. These are mixed drink nouns which denote cocktails, such as *martini* and *margarita*, along with many coffee drink terms like *americano* or *cappuccino*. Unlike other nouns referring to liquids—even nouns for similar drinks such as *punch* and *lemonade*—this group of mixed drink nouns are, surprisingly, countable. These are a puzzling class of nouns: a priori, there is no reason why a mixture of two or more liquids which are themselves grammatically non-countable should result in something described by a predominantly countable noun.

This paper investigates these mixed drink nouns, their grammatical behavior, and provides the first semantic analysis of these nouns. Their behavior reveals a rich structure of ingredient parts, relationships between parts, and standardized measures. I argue that the source of countability for cocktails and other mixed drink nouns is a combination of the unique ratio relationship between their parts and the existence of a MEASURED PART as part of the ingredients of the drink which provides a unit for individuation. While this measured part—often referred to colloquially as *a shot* of liquor or espresso—is only one of the ingredients making up a mixed drink, it is central to the countability of the noun. Thus, countability of the noun is rooted in the noun’s subatomic structure. This paper also shows that these nouns—though they are a small and quite specific group—are a rich ground for further semantic investigation, especially in their unique behavior in quantity judgment tests and with subatomic quantifiers—quantifiers that target ‘essential’ parts of a noun’s denotation (Wagiel 2021). Section 2 provides an overview of nominal countability behavior broadly, while section 3 outlines the grammatical behavior of mixed drink nouns and gives examples of these nouns in a number of syntactic and semantic countability criteria. In section 4, I provide an analysis of the countability of these mixed drink nouns and propose the concept of a MEASURED PART. Section 5 concludes.

**2. Nominal Countability in English.** Two facets of countability have been identified in the literature—the syntactic and semantic (Quine 1960; Bunt 1985; Chierchia 1998; Deal 2017). Separating the syntactic countability behavior of a noun from its semantic countability with dis-

tinct criteria and tests distinguishes different groups of nouns and, in many cases, helps clarify the source of countability. I will follow this approach, first examining the syntactic—and morphological—features of countability behavior, before moving to the semantics.

2.1. SYNTACTIC COUNTABILITY. The syntactic facet of countability regards whether nouns occur with plural marking or combine directly with numerals and determiners, like *many*, in (1).

(1) There are *six dogs* and *many cats* at the shelter.

Non-countable, or mass, nouns do not combine directly with numerals, but instead require a measure or container phrase to be grammatical, as in (2a). These nouns also occur with mass-specific determiners, like *much*, as in (2b).

(2) a. I'll get *one gallon of milk* and *two bottles of wine* from the store.

b. There is *so much dirt* on the floor!

While non-countable nouns do not combine directly with cardinal numbers in most uses, there is still some degree of flexibility provided by coercion phenomena. In these uses, non-countable nouns can be counted when either a standard portion or distinction between multiple types is established in context. In the literature, these functions has often been referred to as the UNIVERSAL PACKAGER or UNIVERSAL SORTER (Bach 1986). While a noun like *water* is normally ungrammatical directly combining with numerals, it can occur in a context such as ordering at a restaurant in (3a), where there's an established standard portion of *three glasses of water*. The inverse is true for count nouns in UNIVERSAL GRINDER (Pelletier 1975; Pelletier & Schuber 1989) constructions like (3b).

(3) a. Can we get *three waters* for the table?

b. There is *too much apple* in this salad.

This type of mass-to-count coercion behavior is restricted to contexts where a reference portion has already been established (Rothstein 2010; Husić 2020; Zamparelli 2020; Grimm et al. 2021) though certainly frequent and familiar uses—such as a drink being portioned in a cup or other standard drinking vessel—can be easily extended to novel coercion uses. Given that we know a noun refers to a drinkable, liquid, substance it can be felicitously used a sentence like (3a). However, coerced readings usually account for only a small percent of uses for a given noun, and thus most of the literature treats these uses as a unique sub-case of nominal countability; even though *water* can occur in a count reading as in (3a), this countability does not account for most uses of *water* and thus *water* is considered to be a non-countable noun. I will return to the issue of nominal coercion, specifically portioning, for mixed drink nouns in section 3.5.

2.2. SEMANTIC COUNTABILITY. While syntactic determiners of countability focus on the distribution of nouns with certain morphosyntax, examining the semantic facet of countability often involves placing a noun into different acceptability judgment constructions or other experimental conditions. These often help tease apart the reference of a noun from other facets of the syntax (such as the portioning or grinding coercions seen above); the underlying question is, of course, whether a noun refers to an individual or otherwise has some sort of accessible unit for counting. For example, acceptability with stubbornly distributive predicates like *large* or *big* is one test for accessibility of individuals (Schwarzschild 2011), as can be seen in the pairs in (4) and (5).

- (4) a. The *apple* is large.  
b. The *apples* are large.

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

The predicate *large* distributes over the apples in (4b)—each apple is itself large, not the apples collectively—which is possible since count nouns like *apple* pick out individuals. Non-countable nouns like *milk* have no clear individual for *large* to distribute over (again, setting aside cases of coercion where a container reading like *bottle of milk* would be understood).

In a similar vein, quantity judgments (Gathercole 1985; ?) are another way to determine if a noun references semantic individuals. Quantity judgment tests accomplish this by creating contexts where two portions of some noun are compared, a participant is asked “who has more?” and the judgment given—more in volume or more in number—reflects whether the participant is quantifying over individual entities or the total volume. Nouns which have no semantically accessible units for individuation are unable to be compared on the basis of number, but only on total volume. For example, in experiments by ? participants were asked to judge who had more between two larger units or portions and six smaller units or portions. Count and object-mass nouns like *shoes* and *silverware* are examples of nouns that are judged to be more on the basis of number and non-countable nouns like *toothpaste* are examples of nouns judged to be more based on volume.

When we look at the behavior of English nouns relative to these facets of countability, two main groups emerge: countable nouns like *dog* or *book* and non-countable nouns like *water* and *rice*.<sup>1</sup> Given the diagnostics provided in this two-part summary of countability, one might expect mixed drink nouns like *martini* and *cappuccino* to behave similarly to other drink nouns, like *wine* or *coffee*. Mixed drink nouns refer to liquid substances, which usually lack semantically accessible units for individuation. Mixed drinks are composed of other liquid substances, which themselves are referred to with non-countable nouns, such as *tequila*, *whiskey*, or *simple syrup*. These mixed drink nouns should be expected to occur as countable only when coerced into UNIVERSAL PACKAGER constructions, especially given that many of them have a standardized portion in restaurant contexts. But the predominantly count behavior of mixed drinks—much more frequent occurrence in countable readings than non-countable, reference to units or parts, and behavior with distributive predicates or in comparative quantity judgments—would be unexpected. However, despite these predictions, mixed drinks are countable, as the next section lays out.

**3. Mixed Drink Nouns.** First, which nouns exactly qualify as ‘mixed drink’ nouns? This paper will look at two main groups—nouns which refer to cocktails and coffee drinks—but other nouns might also fall into this category. I will take cocktails to be the paradigmatic case. In its most common sense, *cocktail* refers to a drink made from some combination of liquors, liqueurs, juices, syrups, or other ingredients. While many combinations of these ingredients can be a cocktail, this paper will limit the set of cocktail nouns to the 89 drinks recognized by the International Bartenders Association as of 2021. A number of coffee drinks, such as *cappuccino*, *latte*, *americano* and *mocha*, will also be included. These are all drinks where the base component consists of a shot or shots of espresso, with additional ingredients like milk or flavorings. While there does not exist an industry-standard list of coffee drinks like for cocktails, the menus of major

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<sup>1</sup> However, note that not all nouns fit neatly into this binary. A third group, object-mass nouns like *furniture*, are syntactically non-countable but make reference to individual objects. Other nouns like *stone* or *fence* seem to be flexible between countability classes. I will not discuss these nouns here.

coffee shop chains provide a good reference for this group of nouns.

3.1. MIXED DRINKS AND PROPER NAMES. Before getting into the mixed drink noun data, I would like to briefly discuss the common noun status of mixed drinks. The terms used to refer to different mixed drinks come from a wide range of sources. Some cocktail nouns reference the base alcohol and method of preparation, such as *gin fizz* or *whiskey sour* but most are either unique coinages using common nouns, like *old fashioned* or *tuxedo*, named after places or people, like *manhattan* or *mary pickford*, or some combination of the two, like with *cuba libre* or *hemingway special*. Most coffee drink nouns, and a number of cocktail nouns as well, are loanwords, such as Italian *cappuccino* or Cuban Spanish *mojito*. And in modern usage, we see semi-productive affixes like *-tini* for anything served in a martini glass or *-ccino* for any drink with espresso and milk. Etymology is not the focus of this paper, but the data raises some questions as to whether mixed drink nouns are proper names or common nouns.<sup>2</sup> I take the view that despite the origins of some mixed drink terms, they are common nouns and not names.

Unlike familiar examples of proper names such as *France* or *Taylor Swift*, mixed drink nouns do not make unique reference to a single object or individual. Instead, mixed drink nouns have particular conditions under which some substance is or is not a particular drink. I can't mix whiskey and blackberry liqueur together, garnish it with an orange wedge, and call it a *margarita*. This clearly points towards a common noun interpretation of mixed drink names, despite the fact that some originate from proper names. Thus, we should treat *macchiato* or *long island iced tea* like any other predicates which pick out certain portions of matter in the world falling under their extension.

3.2. A CORPUS OF MIXED DRINK NOUNS. If mixed drink nouns are common nouns, not proper names, the next question is how they behave syntactically and semantically with regards to countability—are they similar to or different from other common nouns for drinks like *water*, *beer*, or *lemonade*? To gather data relevant to these questions, I created a small corpus using mixed drink nouns which were the most well-known and distinctive, to avoid confusion with other word senses (excluding nouns like *cosmopolitan* or *aviation*). The corpus contained 10 cocktail and 7 coffee drink nouns (*bellini*, *bloody mary*, *daiquiri*, *margarita*, *martini*, *mimosa*, *mojito*, *negroni*, *pina colada*, *whiskey sour*, *americano*, *cappuccino*, *cortado*, *frappe*, *latte*, *macchiato*, *mocha*) along with 9 other drinks that are non-countable nouns (*beer*, *cider*, *coffee*, *juice*, *lemonade*, *milk*, *tea*, *water*, *wine*).

For each of these 26 nouns I performed web searches of noun phrases containing a given mixed drink noun in count singular with the indefinite article (*a margarita*), a numeral quantifier (*two cappuccinos*), a count quantifier (*many lattes*), and with a mass quantifier (*much mimosa*). I gathered example sentences from the first page of search results, excluding incomplete sentences, cases where the noun was not the head noun (*there's so much mimosa magic to be had*), and cases of marginal grammaticality. I used context, credibility of the website, and the apparent level of bartending or barista knowledge of the writer, if discernible, to judge whether a sentence should be included. Given that discussions of food and drink are viewed as largely informal topics, the examples collected ranged from a handful of more formal print sources (cocktail handbooks, news articles, legal proceedings) to less formal (internet forums, blogs, tweets). While

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<sup>2</sup> This is also an issue for editors and style guides, who have to make the call whether to capitalize all words within a mixed drink name, lowercase all, or capitalize only the proper nouns within the names, e.g. *Singapore sling* or *rum and Coke*. For consistency throughout this paper, I will write all mixed drink terms in lowercase.

further work remains to create a full-scale corpus of mixed drink nouns, this initial work provides enough data to categorize the general behavior of these nouns. The examples in (6) are taken from the corpus, while additional natural-language examples are from supplemental web searches of these mixed drink nouns in specific noun phrase constructions.<sup>3</sup>

3.3. SYNTACTIC COUNTABILITY OF MIXED DRINKS. The mixed drink corpus demonstrates that all of these nouns occur with strongly countable morphosyntax, including occurrence with count determiners and numerals. The examples in (6) provide a summary of these contexts.

- (6) a. I haven't had *a mojito* this good in a while.  
b. In college, I would get inspired and work at the most oddball hours fueled by too *many Americanos*.  
c. I had *two piña coladas* back to back and could not feel anything.  
d. It's hard to speculate exactly how *many martinis* I'd knock back in one evening, but three sounds about right.

This syntactic countability of mixed drink nouns even appears in unique situations, such as with phrase cocktail names like *sex on the beach* or for drinks that end in *y* like *bloody mary* in (7).

- (7) a. Also, when the bachelorette party bus unloads in front of your bar, whipping up *a dozen Sex on the Beaches* is an easy task.  
b. We serve *a hundred to a hundred and fifty Bloody Marys* a day.

This syntactic behavior differs sharply from other drink terms like *beer* or *coffee*, which are paradigmatic cases of non-countable nouns—only occurring in count noun phrase constructions when coerced into portion or type readings. In the results of web searches I performed, both mixed drink and other non-countable drink nouns occur in volume measure phrases, but in slightly different ways. Non-countable nouns most frequently use measure pseudopartitives, where a measure noun like *pints* combines with the pseudopartitive *of beer*, as in (8a). With mixed drink nouns, measure phrases more frequently use direct modification, as in (8b).

- (8) a. What effect would *12 pints of beer* in one night have on the body?  
b. *A 16 ounce cappuccino* at McDonald's contains 142 mg of caffeine per serving.

In the cases where mixed drink nouns do occur in non-countable uses, the focus is often on the total volume consumed and subsequent impact of the alcohol or caffeine in the drink, such as in the examples in (9).

- (9) a. I feel hungover just thinking of having that *much negroni*.  
b. Had a good time, I think but definitely had too *much daiquiri*.  
c. Drinking too *much latte* can cause the same side effects as drinking too much coffee, such as jitters, insomnia, and headaches.

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<sup>3</sup> For access to a copy of the corpus and sources for the supplemental examples, email [ellise.moon@rochester.edu](mailto:ellise.moon@rochester.edu).

The other context where mixed drink nouns occur with non-countable syntax is in spilled readings. This behavior parallels other count nouns in UNIVERSAL GRINDER readings.

- (10) a. Remember when I spilled *mimosa* all over myself at brunch?  
b. No one should cry over investors' spilled *macchiato* in the Luckin saga.

When it comes to syntactic features, mixed drink nouns behave as count nouns. This distributional difference is odd unless we assume mixed drink nouns have an underlying unit for individuation, unlike non-countable drink nouns.

3.4. SEMANTIC COUNTABILITY OF MIXED DRINKS. When it comes to semantic countability tests, mixed drinks—for the most part—act like count nouns. First, mixed drink nouns are felicitous with stubbornly distributive predicates, unlike their non-countable drink counterparts.

- (11) a. The *margaritas are large* and not watered down.  
b. Well, our *pineapple martini is big* and filling, we might as well call it soup!  
c. The *lattes are big*, beautiful and of course delicious.

The mixed drinks in (11) are perfectly acceptable with these distributive predicates—the drink behaves as an individual for the predicate to distribute over. However, the comparable constructions with non-countable drinks in (12), sound odd, and the only interpretations possible have to do with portion size or a very esoteric type comparison, such as a sense of *big* in (12c) as a descriptor of bold flavor. And these readings seem only possible in restricted contexts where relative portion sizes or type comparisons have been established via coercion to type readings or with the UNIVERSAL PACKAGER.

- (12) a. ?The *lemonades are large* and not watered down.  
b. ?Our *beer is big* and filling.  
c. ?The *wines are big*, beautiful and of course delicious.

While portioning and type readings complicate things somewhat for comparison with these non-countable drink examples, the mixed drink nouns in (11) have a straightforward reading with distributive predicates just like count nouns do. And just like with the syntactic countability behavior discussed in the section above, this status is surprising.

The questions raised by the apparent count noun behavior of mixed drinks with the distributivity tests also carries over to other semantic countability tests like quantity judgment tests (?Gathercole 1985). Given the data so far, it might seem straightforward to assume that mixed drink nouns must be both syntactically countable and semantically make reference to individual units of some sort—that they behave as count nouns all the way through, with just the exception of UNIVERSAL GRINDER readings where the noun has a substance reading when spilled or scattered. The assumption with these tests is that for count nouns it is natural to compare on the basis of number, where the entire unit is quantified. Consider the following:

- (13) a. Who has *more margaritas*?  
b. Who ordered *more margaritas*?  
c. Who drank *more margaritas*?

To get a better sense of how a mixed drink noun like *margarita* would behave, I not only took into account my own readings of the sentences in (13), but also informally canvassed a number of colleagues. The responses, surprisingly, varied widely, and most of the people I spoke with said that multiple readings were, in fact, possible for them.

In a sentence like (13a), most people said *margarita* seems to be compared based on volume, which is a result more consistent with a non-countable reading of *margarita*. Others said the sentence was just odd, or mentioned that their first reading of it was in a type sense—which restaurant or bar could offer more types of margaritas. I can get both a comparison-by-volume and a comparison-by-number-of-glasses reading for (13a), as well as the type reading; in any case it seems like a somewhat odd or vague sentence. Changing the verb in the comparative constructions has a major effect on the judgment as well. In ordering contexts like (13b) it seems more intuitive, to me at least, to compare drinks by number—for example, judge three smaller margaritas to be more than two larger ones, even if the latter is more total volume of beverage, since the context of ordering individuates drink by drink. In a context like (13c), the number of glasses that the margaritas were drunk from seems less relevant, so the focus returns to the total volume of margaritas. Despite my own intuitions for these sentences, when talking with colleagues judgments seem to vary widely, and in many of these instances both comparison by number and comparison by volume readings are possible.

Complicating matters further, I would argue that another dimension of judgment exists for cocktail nouns specifically—the total volume of alcohol, not total volume of liquid, consumed. If one person is drinking big frozen margaritas that are watered down with ice and mixer while another person is drinking smaller margaritas on the rocks with a higher percent of alcohol by volume, a reading is possible where the second person is drinking more in terms of volume of alcohol, regardless of the total volume of liquid for each drinker. Should this dimension of quantity be considered quantity based on volume (total volume of alcohol, regardless of the amount of mixers), quantity based on number (total number of shots of alcohol, regardless of the number of drinks those shots were in), or something else entirely? In the case of mixed drink nouns, more than just straightforward volume and number are at play, and I feel that the results of quantity judgment tests are thus only helpful in that they raise questions about countability, portioning, and the role of the alcohol part for cocktail drinks. I will set aside the complicated results, if they can even be called that, of the quantity judgment tests for now, but I will return to some of these questions in section 4.4 below.

3.5. STANDARD PORTIONS AND COERCION. In the data presented so far, these mixed drink nouns behave more like count nouns than non-countable nouns despite referring to fluid substances. Given this, one might suggest that the ideal way to account for the behavior of these nouns is by treating them as non-countable nouns which nearly always invoke the UNIVERSAL PACKAGER: in all uses of these nouns a ‘standard portion’ *glass of* interpretation is applied, generating a count reading. This seems plausible at first glance. Mixed drinks are liquids, and made from liquids that are referenced by non-countable terms—such as *tequila*, *triple sec*, and *lime juice*—but are so commonly ordered, mixed up, and served as individual, single-portion drinks

that one could argue speakers only think of a portioned, and thus countable, version. However, upon further investigation, this approach runs into a few difficulties.

First, given what we know about nominal coercion by portioning or type readings and the distributional behavior of nouns relative to it (Zamparelli 2020; Grimm et al. 2021), positing that the countability behavior of an entire group of nouns is the result of near-universal coercion seems tenuous. If the main motivation for this approach is the physical fluidity of the objects the nouns refer to, rather than the grammatical behavior of those nouns, positing that all mixed drink countability is the result of portioning interpretations is a difficult fit. Examples of mixed drink nouns behaving in a clearly non-countable way are incredibly few and far between, with these few examples being uses of the UNIVERSAL GRINDER construction as in (10), and this is a phenomena well-established in the literature to apply to count nouns with only a handful of exceptions.

Second, if mixed drink nouns are non-countable but always occur in a coerced portioning reading, they should behave like other portioned non-countable nouns do when placed into a different container than their standard serving glass. Instead, mixed drink nouns behave generally like count nouns when placed in a container larger than their standard serving glass. Recipes for pitchers of a drink, such as in (14a), occur with mixed drink nouns in count plural form,<sup>4</sup> as do phrases like *bottomless* applied to cocktails in (14b) in contrast with *bottomless* applied to non-countable drink terms like in (14c), where the noun does not take on count plural syntax.

- (14) a. Here’s how to make an extra-cold *pitcher of Martinis* like Ernest Hemingway.  
b. *Bottomless mimosas and bloody marys* are considered a “loss leader,” an item sold at a loss with the goal of getting diners to spend more on other items.  
c. The theater offers treats for your dog, as well as *bottomless wine and whiskey* for you.

The fact that mixed drink nouns retain their countability even when poured into pitchers or when they are in a *bottomless*, constantly-refilled context demonstrates that they are more strongly conceptualized and spoken about as whole entities, unlike non-countable drink nouns such as *wine* or *whiskey*. This seems to be strong evidence against a UNIVERSAL PACKAGER coercion being the source of mixed drink countability. Instead, mixed drink nouns should be treated as count nouns.

**4. Mixed Drink Countability: Parts, Ratios, and Subatomic Structure.** A satisfactory account of the mixed drink noun countability behavior, given in the previous section, needs to explain the source of mixed drink countability—and how this differs from other non-countable drink nouns. Ideally, the puzzling behavior of mixed drink nouns in quantity judgment tests can also be accounted for. I will accomplish both of these by proposing that mixed drinks have a unique parthood structure, including a central MEASURED PART, in specific ratio relationships, which differs somewhat from previous theories of part-whole relationships in the semantics literature. Since Quine (1960), many approaches to the semantics of countability involve some notion of mereological structure, especially following the formal lattice-theoretic framework of

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<sup>4</sup> Note that while count plural constructions like (14a) were the most frequent in the searches I conducted for examples, non-countable constructions like *pitcher of margarita* also occur. In discussion with colleagues, many felt that both constructions were grammatical, with a few only accepting *pitcher of* with the count use and one only accepting it with the non-countable use; this difference might also be impacted by factors including age and dialect of English.



Link (1983). The analysis presented in this section anchors mixed drink countability in the existence of one or more MEASURED PARTS, not at the level of the drink as a whole but at the level of the drink's ingredient parts. This proposal relies on subatomic structure that is semantically accessible and relevant to quantification and the count-mass distinction. This is modeled using a mereotopological framework, which involves both parthood relationships and spatial configurations, such as overlap and connectedness.

Given that the ingredient parts making up a mixed drink both stand in a ratio relationship to one another and are strongly self-connected due to their physical arrangement—being shaken or stirred together—the accessibility of one or more units for counting at the part level provides a basis for the countability for the whole. In a sense, mixed drinks are a specific plurality of ingredient parts, and form a whole entity. Unlike substances—even those which are mixtures—mixed drink nouns crucially contain one or more countable units, which I will refer to as MEASURED PARTS, at the subatomic level. Since one or more elements making up a mixed drink noun is individuable there is criterion for counting the whole, whereas a standard treatment of them as non-countable nouns modeled as semi-lattices with no bottom elements fails.

Section 4.1 introduces the part-whole structure of mixed drinks, along with the appropriate formal mereotopological definitions. Section 4.2 gives a detailed overview of the measured parts proposal, and the relationship between countable unit parts and the countability of the mixed drink noun as a whole. Sections 4.3 and 4.4 explore the implications of this proposal for subatomic modification and for comparative quantity judgments, respectively.

4.1. PARTS AND RATIOS. What differences are there between mixed drinks and other drinks? Consider *wine* and *mimosa*. One is a non-countable noun, one is a count noun. Both are found in similar contexts, spoken about in similar ways, and both are materially similar—they are alcoholic drinks composed of fruit juices, some of which have been fermented. What difference is there between the two that would lead to a speaker talking about *a glass of wine* on the one hand and *a mimosa* on the other? I argue that this difference is due to a speaker's knowledge of the world and knowledge of the inherent structure in a mimosa which is lacking in wine. Wine, while made up of different ingredients, is bottled, uncorked, poured, and drunk as a singular substance whereas a mimosa is a mixture of two things—sparkling wine and orange juice—in a particular ratio. Considering the entire class of mixed drinks it is apparent that they all share the feature of being some mixture of ingredient parts. What it means to be a margarita—the thing picked out by the noun *margarita*—is not so much to be some singular margarita-substance but instead to be a mixture of other substances—tequila, triple sec, and lime juice.

Since Quine (1960) and Link (1983), much of the discussion on the representation of count and mass nouns has focused on atomicity, using mereological approaches to model semantics: count nouns are atomic, and have no proper parts, whereas mass nouns are non-atomic. While this approach works well for many nouns, there are a number of cases it does not capture, including our group of mixed drink nouns, which are count but seem to crucially involve semantically accessible parts. Thus, I will build my semantics for mixed drink nouns, starting with the same basic mereological building blocks. Classical Extensional Mereology proposes a framework with a domain,  $U$ , the parthood relation,  $\sqsubseteq$ , and the sum operator  $\oplus$ . I will follow the formal definitions given by Simons (1987), though my notation differs slightly (see also Casati & Varzi (1999) and Varzi (2019)).

For a mixed drink noun like *margarita*, the denotation should be the sum of the drink's ingre-

dient parts, and specify what those parts are, such as in (15).

$$(15) \quad \llbracket \text{margarita} \rrbracket = \lambda x [x = y_0 \oplus y_1 \oplus y_2 \wedge \text{TEQUILA}(y_0) \wedge \text{TRIPLE SEC}(y_1) \wedge \text{LIME JUICE}(y_2)]$$

Per this formula, an entity is a *margarita* if it is composed of three parts—tequila, triple sec, and lime juice. But the existence of ingredient parts is not the only factor in play. Given the current proposal in (15), if a drink contains 6 ounces of tequila, a half ounce of triple sec, and a gallon of lime juice, it satisfies the reference of *margarita*. But that would be a mildly alcoholic limeade, not a margarita. So the denotation needs to make reference to the amounts of each part, otherwise it will over-generate. The International Bartender’s Association specifies that a margarita is 2 ounces of tequila, 1 ounce of triple sec, and 1 ounce of lime juice, so this could be included in the formula in something along the lines of (16).

$$(16) \quad \llbracket \text{margarita} \rrbracket = \lambda x [x = y_0 \oplus y_1 \oplus y_2 \wedge \text{TEQUILA}(y_0) \wedge \text{TRIPLE SEC}(y_1) \wedge \text{LIME JUICE}(y_2) \\ \wedge \mu(y_0) = 2 \text{ ounces} \wedge \mu(y_1) = 1 \text{ ounce} \wedge \mu(y_2) = 1 \text{ ounce}]$$

Now, formally, 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. Note that nothing in my proposal hinges on the specifics of the measure function  $\mu$ , though I treat it as an extensive function on an entity following Champollion (2010) (see also Krifka (1998) and Schwarzschild (2002)). But any measure semantics could work here, the main issue is that there is some specification of volume.

But (16) isn’t quite right. What matters for mixed drinks is not only the measurements of the parts, but the ratio between those measurements. Otherwise, only margaritas made with exact ounce measurements would be described by this formula, so it now under-generates. The formula should account for jumbo margaritas, mini margaritas, and margaritas made with any system of volume measurement like teaspoons or centiliters. What is needed is not a specific measurement but something that can fix the ratio relationship between the parts that make up the drink. This can be achieved by instead setting the measurements, divided by a ratio constant of sorts, equal to one another, as in (17).

$$(17) \quad \frac{\mu(y_0)}{2} = \frac{\mu(y_1)}{1} = \frac{\mu(y_2)}{1}$$

This captures the ratio relationship for a margarita as 2:1:1 without specifying any particular volume measurements; the measure of each part can be increased or decreased, but since it must stay in the same ratio relationship the measure of the other parts must increase or decrease accordingly, or the mixture is not a margarita. Now the formula for the denotation of *margarita* can be modified to include this relationship between parts, rather than a specific measurement for each part.

$$(18) \quad \llbracket \text{margarita} \rrbracket = \lambda x [x = y_0 \oplus y_1 \oplus y_2 \wedge \text{TEQUILA}(y_0) \wedge \text{TRIPLE SEC}(y_1) \wedge \text{LIME JUICE}(y_2) \\ \wedge \frac{\mu(y_0)}{2} = \frac{\mu(y_1)}{1} = \frac{\mu(y_2)}{1}]$$

However, this still has a major flaw: it says nothing about the physical arrangement of the ingredient parts. Classical Extensional Mereology is incredibly flexible in its definition of a M(ereological)-INDIVIDUAL—any group of objects can be an M-INDIVIDUAL, and sum formation is unrestricted.

A semantics textbook on my shelf and a particular cluster of grapes growing in a French vineyard can compose a M-INDIVIDUAL, despite the distance between them. In the case of mixed drinks, consider a scenario where a person walks into a bar, orders two shots of tequila, a shot of triple sec, and a shot of lime juice, drinks each of them, and then says they enjoyed drinking a *margarita*. The correct ingredients in the correct ratio were present, but calling those shots a *margarita* would be incorrect. The referents of mixed drink nouns consist of ingredient parts in ratios that also are mixed together in particular ways.

This presents a problem formally, since the proposal needs a way to handle spatial arrangement as well as parthood to rule out these separate-shots cases. While unrestricted sum formation allows mereology to model many types of part-whole relations, it has a downside, since there's no way for mereology to distinguish M-INDIVIDUALS that correspond to our intuitions and experiences—such as a delicious margarita in my hand—from M-INDIVIDUALS that do not—such as the scattered group of margarita ingredients behind the counter at a bar. So a formal approach is needed that accounts not only for parts of a drink but also the arrangement of and relationships that hold between them. Frameworks such as mereotopology (Casati & Varzi 1999) extend classical mereological frameworks with topological notions of spatial arrangement. The inclusion of topology has allowed for formal semantic proposals to model the different metaphysical and grammatical behavior of whole objects, granulars and aggregates, and mass substances (Grimm 2012; Lima 2014; Scontras 2014; Krifka 2021; Wągiel 2021). Key topological axioms added to mereology include overlap, connectedness, and touch. From these, formal representations of entities as consisting of parts that are self-connected can be defined.

It may at first seem odd to put a liquid substance in the category of individuals, but as seen in section 3 cocktail nouns behave as strongly count predicates, and thus my proposal will be that they are individuals which are maximally strongly self-connected. To do this, a few key mereotopological notions are needed. The following definitions are adapted from Grimm (2012). The connection relation,  $C$ , is taken as primitive; this relation is both reflexive and symmetrical. Any two entities are connected if they share a boundary, which includes cases where two things are only touching, such as the wine and the bottle it is in. Two things overlap (19a) if and only if they share a part. An entity is self-connected (19b) if and only if any two parts that form the whole of that entity overlap. Strong self-connection (19c) is possible if an entity is self-connected and its interior is also self-connected, which prevents cases of tangential overlap.

- (19) a.  $O(x,y) := \exists z[z \sqsubseteq x \wedge z \sqsubseteq y]$   
 b.  $SC(x) := \forall y \forall z[\forall w (O(w, x) \longleftrightarrow (O(w, y) \vee (O(w, z))) \rightarrow C(y, z)]$   
 c.  $SSC(x) := SC(x) \wedge SC(INT(x))$

These can be used to then define a MAXIMALLY STRONGLY SELF-CONNECTED (MSSC) entity relative to a given property,  $P$ .

- (20)  $MSSC(P)(x) := P(x) \wedge SSC(x) \wedge \forall y [P(y) \wedge SSC(y) \wedge O(y, x) \rightarrow y \sqsubseteq x]$

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. Adding this to the proposed denotation for *margarita* creates the following.

$$(21) \quad \llbracket \text{margarita} \rrbracket = \lambda x [x = y_0 \oplus y_1 \oplus y_2 \wedge \text{TEQUILA}(y_0) \wedge \text{TRIPLE SEC}(y_1) \wedge \text{LIME JUICE}(y_2) \\ \wedge \frac{\mu(y_0)}{2} = \frac{\mu(y_1)}{1} = \frac{\mu(y_2)}{1} \wedge \text{MSSC}(\text{MARGARITA})(x)]$$

Since this now specifies both what parts make up a margarita and that they are maximally strongly self-connected, the formula captures the cases intuitively understood to be margaritas while excluding fringe cases such as separate shots of margarita ingredients.

Now that this has been worked out for *margarita*, it can also be generalized for the semantics of any mixed drink noun by giving a sequence of variables for the parts and the predicates, as in (22). The parts of the drink are represented as a series of indexed variables,  $\vec{y}_0^n$ , given that some mixed drinks only have two parts while others have three or more. For each part,  $y$ , there exists a corresponding ratio constant,  $r$ , and the parts are set in a ratio relationship with each other. The specifics of this depend on the particular drink, but the formula allows for a flexible number of ingredients in any ratio relationship, which can account for everything from americanos to zombies.

$$(22) \quad \llbracket \text{mixed drink} \rrbracket = \lambda x \exists \vec{y}_0^n \exists \vec{P}_0^n [x = \oplus \vec{y} \wedge \forall y_i \forall P_i [P_i(y_i)] \wedge \exists \vec{r}_0^n \forall \vec{y}_0^n [\frac{\mu(y_i)}{r_i} = \frac{\mu(y_j)}{r_j}] \wedge \\ \text{MSSC}(\text{P})(x)]$$

Thus, an entity is a mixed drink if it is composed of two or more parts which are all an 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.

4.2. MEASURED PARTS. The formal parthood structure worked out in the above section provides a framework to introduce the concept of a MEASURED PART. This, I argue, is the source of the countability of these mixed drink nouns, and what provides the distinction between mixed drinks and other, non-countable drinks that are made from ingredients in specific ratios. These include nouns referring to non-alcoholic drinks like *lemonade* as well as alcoholic, punch-format drinks like *sangria*. If the semantics given above was the only criteria for mixed drink countability, this would be a case of over-generation as it would predict that, based on their structure as liquid substances composed of parts in ratios, that these would also be countable nouns, but the data only shows count uses in UNIVERSAL PACKAGER contexts. Consider (23) below.

(23) Melanie is making *lemonade* and finds a recipe that calls for 1 part lemon juice, 2 parts sugar, and 8 parts water.

Per the formula in (22), *lemonade* should be a countable mixed drink noun, as should similar drinks as well as a number of non-drink substances including chemical compounds and alloys.<sup>5</sup>

An initial response might be to return to the discussion of flexibility in the ratio relationship in (22). Cases such as lemonade might allow a much higher degree of flexibility of the ratio between parts than cocktails or countable coffee drinks do. However, this would still include cases of chemical compounds, such as *citric acid*, and exclude some number of mixed drinks which

<sup>5</sup> Thanks to Chris Kennedy for pointing out this case.

allow for some variation of the ratio between a more standard ‘base’ and the ‘mixer’ part, like *americano* or *cuba libre*. The existence of a measured part, then, is what separates these lemonade cases from mixed-drink nouns.

The existence of measured parts is not only needed to explain why mixed drink nouns are countable while other, similar drink nouns are not, but some of the data presented in section 3.5 shows that mixed drink nouns retain their countability even when the drink-stuff the noun refers to is mixed with multiple other individual drink-stuffs. In (14a) the referent of the noun phrase *pitcher of martinis* is one large vessel filled with un-individuated martini-liquid. I used these examples to argue that the countability behavior of mixed drink nouns is not simply a case of a standard portion coercion such as the UNIVERSAL PACKAGER. However, these examples also raise an interesting question—for a sentence like (14a), a semantics using the notion of maximal strong self-connection would be unable to account for the ‘units’ of martini that seem to be conceptually relevant for a count plural construction. In a comparable example, like *bucket of apples*, a mereotopological approach would be able to describe *apple* in a way where it can make contact with other apples while still maintaining its borders. But with *pitcher of martinis* there are no clear borders that touch but not overlap, all the martini-liquid in the pitcher is intermingled. The source of countability must lie somewhere else.

So what makes the referent of *a martini* a margarita, regardless of its physical arrangement? If one consumes multiple portions of liquid from a *pitcher of martinis* over the course of an evening, how many martinis have been drunk? One could argue that the number of ‘standard portions’ of martini-stuff is the number of martinis drunk. What about cases with highball or long drinks like *cuba libres*? It still seems like the number of drinks drunk corresponds to the number of ‘standard portions’ even if the drink is not served, glass-at-a-time, corresponding to these portions. And the volume measurements differ from drink to drink—a ‘standard portion’ of a dry martini, stirred, following the IBA specifications, is about 84 milliliters while a *cuba libre* would be around 198 milliliters. But in both cases, there seems to be an established ‘standard portion’ for the drink, independent of the total volume. This also seems to be reflected by cultural awareness regarding ‘a standard drink’ or ‘unit of alcohol’ where a 250 milliliter glass of beer and a 25 milliliter shot of whiskey both count as one drink. In the case of *martini* and *cuba libre*, both contain around 50 milliliters of hard liquor as the base spirit.

Without straying further into details about legislation surrounding alcohol, I argue that the notion of ‘a standard drink’ is very much intertwined with semantically relevant ideas of what counts as *one*. However, I don’t think the solution is as simple as equating the countability of mixed drinks to concept of a standard drink. First of all, that approach would incorrectly predict that nouns like *beer* and *wine*, which can also be individuated by number of standard drinks, would have the same countability behaviour as nouns for cocktails, which is not what the data shows. Secondly, it would leave out the similar grammatical behavior of certain non-alcoholic coffee drink nouns, which also seem to have a type of ‘standard unit’ but in a slightly different manner based on the number of espresso shots in a drink. While many coffee drinks, such as an *americano*, are portioned by total volume, such as 12 or 16 ounces, when considering a case of comparison, it seems odd to say that one person who drank two single-shot 16 ounce americanos drank *more americano* than the person who drank two quadruple-shot 12 ounce americanos. This highlights what’s really the unit for individuation in the case of both coffee drinks and cocktails—shots of liquor or espresso.

A mixed drink’s MEASURED PART is the ingredient part foundational to the identity of the

drink. While the volume of the MEASURED PART is flexible, that volume measurement serves as the determining quantity for the rest of the drink’s components. Despite being a portion of liquid, it is conceptualized as and spoken about as a unit—a unique part that can be individuated. I argue that these measured parts provide a mechanism for individuation at the subatomic level. Since the ingredient parts of a mixed drink stand in a ratio relationship, the accessibility of one or more of these parts for counting serves as the basis for the countability of the whole. Not only does this analysis fit with the mixed drink data, it dovetails with the ways in which their creation and consumption differs from other beverages.

4.3. MEASURED PARTS AND MULTIPLIER MODIFICATION. The measured part proposal shares some similarities with recent work by Marcin Wągiel (2021) which has shown that a certain class of multiplier phrases give insight into the semantic accessibility of parts of entities. Wągiel uses multiplier phrase data to argue for a semantics that moves beyond the idea of countability as corresponding to atomic units, and focuses his work on cases of subatomic quantification. In these cases, multiplier phrases like *double* and *triple* do not count entities, but instead modify parts of entities, such as in (24), where *double* modifies the number of patties in the hamburger, not the overall quantity of hamburgers, which can be shown by the felicity with *two*.

(24) a. I accidentally purchased *two double hamburgers*.

A central observation in Wągiel work is that multipliers like *double* are picking out what he calls the ESSENTIAL PARTS of an object, such as the patty in a double hamburger. Formally, Wągiel introduces a measure function  $\boxplus P(x)$  which counts the essential parts. His analysis shares some similarities with my proposal for the MEASURED PART in mixed drinks, though I argue that the latter is restricted to certain types of liquid substance mixtures, while essential parthood is a more broad property.

Wągiel’s analysis of multiplier modification is also interesting in the case of mixed drinks. Consider the following examples with *double*.

(25) a. I have *four double Americanos* a day during the week.  
b. We started with *three double mimosas* and a bellini.

It seems that in similar behavior to *double hamburger*, the multiplier in (25a) modifies the number of shots of espresso in the americano, not the total volume or number of americanos, while in (25b) it modifies the amount of champagne in the cocktail. Following Wągiel’s proposal, the espresso is the ESSENTIAL PART of the americano and the champagne is the ESSENTIAL PART of the mimosa, making them accessible for counting via the multiplier phrase; meanwhile the cardinal numerals *four* or *three* count the total number of double americanos or double mimosas.

Phrases like *double americano* in (25a) are possible because there is some ingredient part of *americano* accessible for modification—the MEASURED PART. Contrast this with the unacceptability of a phrase like *four double milks*. What is being doubled in this case? Milk has no semantically accessible subatomic parts that would provide a basis for a ‘double of some ingredient part’ reading. However, note that only some mixed drink nouns seem to freely combine with these multiplier phases—drinks that consist of one measured part as a ‘base shot’ and then some flexible amount of a ‘mixer’ like soda, juice, or water. In the case of *americano*, for example, the espresso is the semantically salient ESSENTIAL PART for doubling, and the ‘mixer’ ingredient is

the amount of hot water needed to bring the total volume to whatever specified. While the number of espresso shots can be modified by *double*, *triple*, and so forth, there does not seem to be a similar way to refer to the ‘mixer’ part of the drink. This makes sense, as only the MEASURED PARTS of a drink are countable.

For mixed drink nouns with multiple MEASURED PARTS—so-called ‘equal parts’ drinks like *negroni* or *last word*—a more fixed ratio relationship exists between the ingredient parts. Thus, multiplier modification is less explicitly available, since there is no single ESSENTIAL PART but instead multiple measured parts making up the drink. For these equal parts cocktails, a modifier like *double* usually can only mean one thing—twice the total volume of drink. In web searches I conducted, phrases like *double negroni* only turned up on cocktail forums as a tongue-in-cheek description of a negroni made to twice standard volume—or when discussing the fact that you can’t actually order a *double negroni*, as in (26). These cases highlight the difference between my proposal of MEASURED PART and Wągiel’s ESSENTIAL PART.

(26) Most bartenders will flat-out say no if you request a *double negroni*.

There is also a third group of mixed drinks that are not specifically equal parts but still maintain a somewhat standard balance between the measured part and other mixers. These drinks, such as *margarita* or *martini*, have rather infrequent uses of *double* modifiers. However, some other interesting and rather idiosyncratic modifiers, akin to multipliers like *double*, exist. Consider the following uses of *jumbo* and *dry*.

- (27) a. The *jumbo margarita* is so appropriately named and it’s definitely what you’re going to want to order.
- b. One of the most popular styles of this cocktail, however, is the *dry martini*.

In the mixed drinks in these examples, if any one measurement changes, the measures of the other ingredients must be adjusted or the ratio is changed. In (27a), *jumbo* increases the total number of the measured part—the shots of tequila—but as this drink has a fixed ratio between the tequila, triple sec, and lime, the volume of the other parts must correspondingly increase so that the the relationship between parts remains the same. If this ratio is not maintained, the drink could be described as *watered-down*—compare with (11a) from the discussion of distributivity above. What *jumbo* does is clarify that the drink is larger than a standard portion with the assumption that the balance between ingredient parts is maintained.

However, a modifier like *dry* in (27b) means there has been a change the ratio relationship between parts. A *dry martini* has less vermouth relative to the gin, so even if the total volume of the drink is the same as a standard *martini*, the different ratio relationship of the parts can be modeled. Interestingly, *dry* is a modifier pretty restricted to martinis, though I was able to find occasional tongue-in-cheek use of it with other two-part drinks like mimosas. These examples show just how fine-tuned the reference to measured parts and, by extension, the other ingredient parts, of a mixed drink can be. Collecting other examples of idiosyncratic subatomic-sensitive modifiers like these would be an avenue for further research.

4.4. MEASURED PARTS AND QUANTITY JUDGMENTS. The measured parts proposal also accounts for the complicated behavior of mixed drink nouns in quantity judgment tests, as discussed in 3.4. Traditional approaches to these tests assume only two dimensions for quantity

comparison—more in terms of volume and more in terms of units or portions. The data with the mixed drink noun *margarita* in (13) above, however, seemed less conclusive than the data in many established studies. Judgments can be given both in terms of total volume and for number of portions, usually glasses, of the drink, and in some cases additional judgments for cocktail nouns seem to be instead primarily informed by the total volume of alcohol or the number of ‘standard drinks’ of alcohol consumed, regardless of volume or portioning.

I believe the measured parts in mixed drink nouns are the source of this puzzling data. If mixed drinks have units accessible for counting at the subatomic level, not only can mixed drinks be measured by total volume and individuated standard portions, they can also be quantified by the number of measured parts. This reading is possible for both mixed drinks with shots of alcohol as the measured part and for some coffee drinks as well. As discussed above, compare one person who drinks two single-shot 16 ounce americanos with one who drinks two quadruple-shot 12 ounce americanos. The number of portions is the same, two in both cases. The total volume is greater for the first americano-drinker. But the total number of shots—measured parts of the drink—are greater for the second americano-drinker. Who drank more? The answer is less clear than with other paradigmatic countable or non-countable nouns. Ambiguity arises between ‘total volume of liquid’ and ‘number of measured parts’ readings in addition to ‘number of portions’ readings. Because of this ambiguity, quantity judgment tests—at least in their current format—are not very informative for mixed drink nouns semantics and further experimental conditions controlling for all possible dimensions of quantity judgment would need to be constructed.

**5. Conclusion.** This paper discussed the countability of a set of nouns which, despite referencing liquid substances, are count nouns. After providing a survey of the syntactic and semantic behavior of these mixed drink nouns, I proposed an analysis of the source of their countability as due to the presence of a MEASURED PART among the mixed drink’s ingredient components. This measured part—colloquially called a *shot* for both cocktails and coffee drinks—provides a unit for individuation for the mixed drink noun. This analysis differs from one where a standard portion reading provides the source of the countability via a nominal coercion such as the UNIVERSAL PACKAGER, which is shown by countability being preserved in pitcher-of constructions like *pitcher of martinis*. This analysis also suggests that units for individuation in count nouns can occur as a special type of part at the subatomic level of the noun, which implies that countability cannot simply be reduced to atomicity or the lack thereof. This proposal thus expands on previous work on subatomic quantification, particularly work by Wągiel (2021) on subatomic modifiers like *double*. Additionally, the proposed analysis raises questions as to the efficacy for mixed drink nouns of some semantic tests for countability, such as quantity judgment tests, when these tests only compare quantity by number versus total volume. In summary, mixed drink nouns demonstrate unique countability behavior that suggests a more nuanced and complex picture that the role of parts have in nominal countability.



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