# Classifiers as patterns of spatial distribution

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*"No habrá una cosa que sepa que su forma es rara."*
*There won't be a single thing that is aware of its own strange shape.*
Jorge Luis Borges, 'De que nada se sabe', *La rosa profunda,* 1975.

*"Reality is an activity of the most august imagination"*
Wallace Stevens*, Opus posthumus,* 1957.


## Abstract

This paper proposes a new theoretical perspective on classifiers. The traditional perspective on classifiers can – somewhat peremptorily – be summarized as follows. Mensural classifiers are distinct from sortal classifiers. Mensural classifiers have to do with quantification, while sortal classifiers indicate the shape of the objects in their complement. The shape properties of sortal classifiers vary across languages without limits and in unpredictable ways. Only sortal classifiers are 'true' classifiers. Only languages with 'obligatory' classifiers are classifier languages.

I claim instead that classifiers do not vary across languages any more than phoneme inventories, nor are they particular to specific language groups. Their 'obligatoriness' is orthogonal to their nature. Rather, classifiers encode the result of a universal, internalist, and computational cognitive mechanism that describes the dynamic patterns of spatial distribution of the material denoted by the predicate in their complement. Classifiers do not simply denote shape, but rather the transformations into shapes that are afforded by the material in their complement. More precisely, the specific spatial distribution of classifiers can be formally analyzed in terms of Champollion's (2010) analysis of distributivity. These patterns of spatial distribution do not vary unrestrictedly: they are governed by two sets of computationally calculable parameters: Vector (force, magnitude, direction, boundedness) and Dimension (1/2/3D, axis inclusion, alignment). These predict a typology of classifiers that is both rich and constrained. These fundamental aspects of classifiers then in turn provide the grammatical scaffolding for the construal of individual and countable objects.

So-called 'mensural' classifiers are derived from 'sortal' classifiers by a process of grammaticalization. I propose a more fundamental distinction in the classifier domain between Samples and Pointers, each with distinct properties in terms of countability and spatial distribution. 'Countable' Samples (e.g. splash, drop, slice, spoonful) directly describe how specific materials distribute in space, while 'uncountable' Pointers (e.g. trace, whiff, tinge, note) indirectly encode spatial distribution. Samples operate through a mechanism of identity: a Sample is materially representative, identical to, and typical of the material sampled. Pointers operate via a mechanism of functional similarity: a Pointer does not need to be identical to the material they represent. This distinction is operationalized in some detail, and the consequences for a new understanding of collectives and the mass/ count distinction are spelled out.

# 1. Introduction[1*]

This paper is an attempt to provide a theoretical analysis of classifiers. Classifiers have not attracted much theoretical scrutiny in terms of an analysis of their intrinsic properties in terms of principled parameters that would derive their properties rather than describe them. I believe this situation is due to a set of ingrained traditional assumptions about classifiers that have hindered theoretical progress in this domain. I will briefly outline what these assumptions are, before presenting an alternative that I will elaborate on in the rest of the article.

## 1.1. Traditional assumptions

Descriptive studies on classifiers tend to focus on the semantic properties of the noun in the complement of the classifier. These properties have to do with the material shape of the object the noun refers to. These shape properties are assumed to vary widely and without restriction across languages as a function of cultural differences. This may be one of the reasons that these semantic properties have not elicited the kind of theoretical attention that is typically afforded other grammatical categories.

Classifiers are mostly used as a descriptive term for sets of poorly understood properties, and they tend to be defined in terms of other grammatical categories and discussions. This is perhaps most evident in the traditional distinction between mensural and sortal classifiers. Grinevald (2000:58ff) argues that mensural classifiers should be distinguished from sortal classifiers. Grinevald (2000, 2002) argues that sortal classifiers categorize by "some inherent characteristic of the referent such as its shape (or texture, or material etc)". Mensural classifiers provide a direct link to better understood categories such as quantification and individuation. She provides the following examples to illustrate the difference:

| | | | | |
|---|---|---|---|---|
| (1) | | *[mensural classifier]* | | *[SORTAL classifier]* |
| | a. | two [bags of] oranges | c. | two [ROUND] oranges |
| | b. | a [stack of] shirts | d. | a [FLAT.FLEXIBLE] shirt |
| | | (Grinevald 2000:59 (5); 2002:261(3)) | | |

Grinevald (2002:260) suggests that lexical classifiers in English are strictly mensural, while languages with 'true' classifiers distinguish between mensural and sortal classifiers. Only sortal classifiers are 'true' classifiers. Grinevald (2000) further argues that in some systems, mensural and sortal classifiers can behave differently in agreement patterns. Only languages with 'obligatory' classifiers are classifier languages.

In the theoretical literature, more attention has been devoted to mensural classifiers than to sortal classifiers no doubt because of the relation between measures, individuation and quantification: the mass/ count distinction (Chierchia 1998ab), gender (Corbett 1991). In addition, the relative obligatoriness of classifiers in certain languages for individuation and enumeration (Aikhenvald 2000, Borer 2005, Her & Tang 2022) has retained due attention. It is generally assumed that the individuating function of sortal classifiers makes nouns

[1*] This paper would not exist without the ongoing dialogue and collaboration since 2013 between Pierre Pica and myself about Mundurucu classifiers and their French and English counterparts. Those discussions have crucially influenced the ideas expressed here, though Pierre will most likely not agree with the perspective I propose. Many thanks also go to Camil Staps, who read and commented on earlier versions of this paper.

countable, because sortal classifiers are argued to be in near complementary distribution with plurals (Borer 2005, Li & Bisang 2012, Doetjes 2012, Greenberg 2013, Csirmaz & Dekany 2014). However, why and how sortal classifiers would carry out this function is typically not examined. In fact, though, sortal classifiers often co-occur with plurals in the same language, as observed by Zhang (2013), Kim & Melchin (2018), and Her & Tang (2019, 2022).

## 1.2. New assumptions and claims

While acknowledging the results of this body of work, I will assume a very different perspective, relinquishing a number of standard assumptions about classifiers, and adopting more controversial ones. First of all, I will assume that there is no obvious relationship between the obligatoriness of classifiers in a language and the individuation or countability of nouns in that language. I believe deeper insight into the nature of classifiers themselves is required before a better understanding of their interaction with the category of Number can be achieved.

Secondly, I will reject the idea that the properties of classifiers vary without restriction as a function of cultural differences. I would like to claim that they do not vary across languages any more than phoneme inventories do. Denny (1979) for instance argues that classifiers are a reflection of the functional interactions speakers have with the objects of their environment. My argument here goes further: classifiers are the *only* way language users have to cognitively represent not only the material objects in their environment but also abstract concepts. I argue that classifiers encode the result of a universal, internalist, and computational cognitive mechanism that primarily describes the spatial distribution of materials, but can be extended to abstract concepts.[2] Classifiers express the cognitive representation of how specific materials *distribute in space* under the exertion of a force. The specific type of spatial distribution indicated by classifiers is one of separation and transformation: in *a drop of water*, the classifier *drop* indicates how water is distributed in space via a specific process of separation and transformation. This is not to say that culture has no influence on classifiers, but I take its role to be less prominent than has hitherto been assumed.

Classifiers encode spatial patterns of distribution of the material denoted by their complement.[3] This definition is in line with the Aristotelian theory of forms known as hylomorphism: the idea that every object is a combination of matter or substance with an insubstantial form (See e.g. Ainsworth 2020). For a subset of classifiers, this fundamental function of classifiers then in turn provides the grammatical scaffolding for the construal of individual and countable objects. This definition of classifiers as being primarily about materials has an important implication: the use of classifiers with abstract nouns is derived from their behavior with nouns referring to material. This important implication will be discussed in more detail in Section 7.

Third, I will assume that classifiers are not particular to specific language groups. Classifier languages are usually defined as those languages where classifiers obligatorily co-occur with

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[2] I will be using the term 'material' here in the sense of Adelson's (2001) 'stuff' and 'material', in order to avoid what Adelson (2001) calls the prejudice for 'things' in perception. I also want to avoid cumbersome reference to 'objects and substances'.

[3] This definition resolves, I believe, an interesting tension present in early descriptive and theoretical work on classifiers (Berlin 1968, Denny 1979, Allan 1977) between 'actions' associated with classifiers on the one hand, and the material shapes involved in and resulting from those actions on the other.

the nouns they modify (e.g. Lyons 1977:430, Allan 1977). Since Indo-European languages do not require overt classifiers, they are said to lack the category altogether. Instead, I argue that all languages have functional morphemes with largely identical classifier properties. Note that even Lyons (1977:462) admitted that English *lump* and *sheet* function like classifiers (see also Toyota 2009).

Coming back to Grinevald's (2000:58-59, 2002:260-261) argument about mensural and sortal classifiers, I would like to point out some problems with this distinction. First of all, English certainly possesses lexical sortal classifiers that refer to the shape of an object: *a kernel of corn, a beam of light*. In addition, a radical separation between sortal and mensural classifiers is deeply misguided. I argue that *all* classifiers refer to the way in which the material denoted in their complement noun distributes in space in a not strictly quantificational way, but in a manner that refers to shape or another physical manifestation.

Examining Grinevald's examples in (1), the mensural classifier *bag* in *a bag of oranges*, includes a flexible aspect that is lacking in more 'inflexible' mensural classifiers such as *a crate of oranges*. Note that flexibility is typically seen as a sortal property. Similarly, analyzing *stack* in *a stack of shirts* as a simple measure for shirts ignores the fact that *stack* refers to a dynamic upward oriented vector, again a typically sortal property. In other words, the mensural classifiers *bag* and *stack* can be sortally reinterpreted as follows:

(2) a. two [bags of] oranges
    two [FLEXIBLE.CONTAINER-PL of] oranges
  b. a [stack of] shirts
    an [UPWARD.ALIGNED.SET of] shirts

I will argue that all mensural classifiers include a dynamic dimension that reflects distribution in space. More concretely, I will argue that mensural classifiers and quantifiers can derive from a subset of sortal classifiers via a process of grammaticalization. What is called 'shape' is most often just the end result of this dynamic spatial distribution. Mensural classifiers often turn out to refer to the final, static representation of that dynamic process. So I agree with Grinevald (2000, 2002) that sortal classifiers are more elementary than mensural classifiers, but I disagree with her assessment that mensural classifiers are not 'true' classifiers, and with her all too radical separation between both types of classifiers.

Of course, the interaction of classifiers with other grammatical categories may vary from language to language. In addition, some languages may obligatorily express sortal classifiers expressing shape with specific nouns, while other languages do not. I will attribute the obligatory or optional nature of classifiers across languages to independent and poorly understood factors that I will not discuss here.[4] In this article, I will mostly use examples from English and French for the sake of simplicity. Obviously, not all languages exhaustively express all possible classifier distinctions discussed here, in the same way that not all languages have the same phoneme inventory. Nevertheless, nearly all English or French classifying nouns discussed here have morphologically recognizable counterparts in e.g. Mundurucu (Tupi), Tzeltal, or Mandarin.

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[4] Similarly, it was long assumed that the category of evidentiality was specific to certain language families. This was in fact largely because their nature as bound morphemes made them appear obligatorily in such languages. Rooryck (2001ab) shows that many if not most evidential meanings can be expressed by parentheticals in languages like English and French. In the same way, the fact that classifiers appear obligatorily for individuation and enumeration in specific languages should be viewed as a property that is independent of their existence.

Please note that this paper is more of an initial sketch laying the groundwork for a research program rather than a fully worked out formal analysis. It should be read and evaluated as such. The structure of the paper is as follows. In section 2, I will define two main types of classifiers, Samples and Pointers, in terms of the relation between the classifiers and its complement in terms of *similarity* or *identity*. In section 3, I will discuss the relation between classifiers, quantification, and distributivity. Section 4 is dedicated to a discussion of the parameters of Vector and Dimension that define classifiers. Section 5 explores the consequences of the defining notions of *similarity* and *identity* for a novel understanding of mass and count in particular, and collectives more in general. Section 6 examines Pointers in more detail, and Section 7 analyzes how classifiers extend from concrete to abstract nouns. Section 8 provides a brief conclusion.

## 2. Two types of classifiers

### 2.1. Samples and Pointers

From the perspective I adopt here, classifiers include understudied expressions in English like *splash*, *drop, lump, slice, spoonful, whiff, trace* and *hint*. I distinguish two types of classifiers: *Samples* and *Pointers*. *Samples* are classifiers like *splash*, *drop, slice, lump* or *spoonful* that refer to materials whose spatial distribution can be *directly* perceived. By contrast, *Pointers* include classifiers like *hint, trace, whiff, inkling, tinge,* and *note*, that refer to materials whose spatial distribution can only be *indirectly* perceived. I will henceforth capitalize *Samples* and *Pointers* to indicate their technical use.

Samples and Pointers can be formally distinguished by the fact that Samples can be quantified by numerals, while Pointers can never be quantified by numerals, as shown by the contrast between the examples in (3) and (4):

| | | | |
|---|---|---|---|
| (3) | a. Three splashes/ drops of water | b. Two lumps of sugar |
| | c. Four slices of cake | d. Five spoonfuls of sugar |
| (4) | a. A hint/(*two) hints of cognac | b. A whiff/ (*two) whiffs of perfume |
| | c. A tinge/(*three) tinges of green | d. A note/ (*four) notes of cinnamon |

I will discuss this property later on in this paper, but use it here simply as a diagnostic for the distinction. Samples can be seen as those classifiers that pave the way for further individuation and quantification. However, in and by themselves, Samples (e.g. *splash*, *drop, slice, spoonful*) describe how specific materials distribute in space or time: *a splash of water* refers to a small amount of liquid that is forced to separate from a larger mass of water through the application of an external force. As a result, classifiers also represent specific *material and mechanical properties of consistency* (e.g., plasticity, density, viscosity, texture, or cohesion of matter). However, the properties of consistency should be viewed as a corollary of the more fundamental property of spatial distribution, as I will argue throughout this paper. Samples operate through a mechanism of *identity*: the Sample is materially representative, identical to, and typical of the material sampled. I will show in Section 3 that this perspective can be fruitfully extended to the mass/ count distinction, and to collective nouns that refer to particular spatial configurations, such as *swarms, herds,* and *stacks*.

Pointers (*hint, trace, inkling, tinge, note, taste*) only indirectly refer to material properties of distribution in space. They provide an indirect representation of material by referring to a property of distribution that is hard to perceive, vague, or imprecise. This is probably why they do not combine well with individuation and quantification: I will make a more precise proposal in Section 7. Pointers represent a range of materials and properties whose spatial outline cannot or can barely be visually perceived. Pointers like *whiff* and *taste* in *a whiff of perfume, a taste of cinnamon* can be perceived by the senses of smell and taste, but are not visually perceptible. They can also refer to the *spatial effect* of a particular material that is no longer fully visually present: *a spot of oil, a trace of blood*. Importantly, Pointers need not be identical to the material they represent. It is sufficient that Pointers have a relation of *functional similarity* with the material they represent: a *taste* of cinnamon is not identical to cinnamon in the sense that it is not a sample – in the regular, non-technical sense – of cinnamon, but it is functionally similar to cinnamon in that it evokes its presence. A taste of cinnamon may even refer to a material that has no cinnamon in it whatsoever. This is not always clear cut: one could debate whether a whiff of perfume represents a unit that is identical to the perfume or not. Finally, since Pointers do not directly represent material properties, they can occur more freely with abstract nouns than Samples: *a hint of cinnamon/ surprise, a trace of garlic/ an accent, a tinge of pink/ regret, a note of chocolate/ optimism*.[5, 6] I will discuss Pointers in more detail in Section 6, once the parameters defining classifiers have been put in place in Section 4.

The binary distinction between classifiers in terms of direct and indirect perception of their spatial distribution places them in the realm of other functional categories with similar distinctions. The Sample/ Pointer distinction is reminiscent of the proximal/ distal opposition in demonstratives, or the direct/ indirect distinction in evidentiality.

## 2.2. Samples in more detail

Samples indicate how the material referred to by their complement noun materially behaves when it distributes in a space or volume under the influence of an internal or external force. For example, a *drop of water* typically is a sample of water that distributes in space in the shape of a small, roughly spherical, liquid, globular volume that is circumscribed by its surface tension. A *drop* is seen as originating in and separating from a larger volume of liquid under the influence of an external force that pulls on it, i.e. gravity. In this respect, *drop* is minimally different from *splash* in that *drop* implies an external force slowly *pulling* on the

[5] The distinction between Samples and Pointers is reminiscent of Peirce's (1955) distinction between iconic and indexical signs. Recall that iconic signs reflect qualitative features of the object (similar to Samples), while indexical signs only require some existential or physical connection between the index and the object (like Pointers). I have refrained from using these terms because Peirce's terms are part of a trichotomy between icons, indexes, and symbols, and couched in a much more general theory of semiotics. Instead, the distinction I wish to establish here is a more particular and grammatical one in terms of material consistency and spatial distribution of the classifier 'signs'. I would have been remiss not to note the striking resemblance, but must leave it for later enquiry.

[6] The distinction between Samples and Pointers in terms of resp. identity and similarity is probably the most important one, as will become clear in the discussion of mass and count below. Note that identity can be formally described as universal quantification over compared properties between individuals, while similarity can be analyzed as existential quantification over compared properties. This accounts for the fact that *almost identical* is on a par with *almost all*, while **very identical* and **very all* are ungrammatical. Similarly, *very similar* is on a par with *very many*.

material, while *splash* requires an external force that *pushes* on the material.[7] Other minimal pairs of classifiers also show this opposition between internal and external force: the difference between the Pointers *a whiff of perfume* and *a sniff of perfume* is that *sniff* refers to an external force applied to the perfume (inhaling via the nose), while *whiff* refers to an internal force that spreads the perfume, involuntarily picked up by the nose. These systematic differences between internal and external forces suggest that a taxonomy of classifiers using such variables is in order.

As a corollary, the specific spatial distribution indicated by the Sample is associated with a specific type of consistency of that material. For example, *drop* indicates that the material has a low enough viscosity to separate into a *drop*, and that the density of the material is such that it is liquid rather than solid or a gas. A material is interpreted with a liquid consistency only because it is spatially distributed as flexible units (*drops, streams, drizzles, sprays*) under the exertion of a force. Other samples may refer to other types of consistency: hardness, malleability, breakability, flexibility, viscosity, granularity, density, or brightness.[8] This list of types of consistency is not meant to be exhaustive. However, I will take the consistency of material to be a corollary of more basic parameters such as Force (see Section 4).

Finally, Samples indicate *identity* with the material in their complement. For example, *drop* indicates that any other unit of the larger volume of water in the complement of the Sample possesses that same capacity to distribute in space in the shape of drops: it is *typical* for the material under discussion. Informally, there is again an implication that there are more drops where the Sample drop came from. Sampling thus not only provides the scaffolding for units, measures, and quantities, but it also implies the potential for a sequence of such units and quantities.

The term 'Sample' is in part chosen for this property of identity: in the usual meaning of the term, samples are defined as small parts or quantities that are intended to show what the whole is like. A sample of cloth or cake allows the sampler to appreciate the qualities of the product, and provides an impression of the type of spatial distribution that the material from which the sample was taken is capable of.

Sample classifiers can be syntactically implemented as SamplePs in the derivation:

(5) $[_{DP}$ a $[_{SampleP}$ drop (of) $[_{NP}$ water $]]]$

I will assume that Sample classifiers in e.g. English and French are a subset of relational nouns that function both as lexical and as functional items (similar to the way in which a verb like *have* can be either a main verb or an auxiliary). As functional/ semi-lexical elements, Samples represent the material properties of spatial distribution of their complement. Like many other functional categories, Samples can be optional in particular languages and obligatory in so-called classifier languages, where they often appear as bound morphemes.

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7 The external force acting on water can cause a splash by either pushing on it or resisting it, as when water makes a splash when falling on the ground. A splash is also faster than a drop. It is unclear to me whether this is part of the lexical information of these classifiers or if it can be derived from independent factors.

8 Research in vision (Sharan et al. 2009) has shown that material perception (matte/glossy, opaque/translucent, rigid/non-rigid, soft/rough, warm/cool) is as fast and flexible as object recognition and scene perception. Properties of materials (mechanical properties like viscosity, but also texture, hardness, roughness, transparency) are effortlessly recognized visually without even touching them (Ritchie et al. 2021).

The observation that Samples encode the distribution in space of the material in their complement, and hence its consistency, can be tested. *Drops* require a complement that is liquid: drops of wood, rock, or air are either infelicitous or create a poetic effect. Similarly, one can have a *slice* of salami but not of water or rock: salami is soft enough to be cut up into thin but materially coherent units, pieces, or chunks. A *whiff* of fresh air refers to a change in air density, smell, and temperature as a result of a relevant portion of air moving. *Spoonfuls* and *drizzles* refer to material that possesses either granular or liquid plasticity: a *spoonful of granite* refers to granite powder or granulate rather than to solid rock. A *dollop* of something requires a higher degree of viscosity than water. Their reference to spatial distribution enables Samples to evoke a semantic implication of the consistency of material: its plasticity, density, viscosity, texture, and cohesion. Both *stream* and *string* restrict their complements in terms of orientation, but *stream* requires the fluidity of a material that may or may not be discrete (*cars, water*), while *string* implies a connected succession of discrete elements (*beads, words, cars*). Samples can also refer to the way in which a material behaves when it loses cohesion as the result of an external force: *slice, piece, chunk*.

Samples can be very specific in restrictions they impose on a material. Take French *nuage* 'cloud' in its use as a Sample. The aTILF (http://atilf.atilf.fr) notes "*nuage de poudre, de crème, de lait.* Petite quantité se répandant en évoquant un peu la légèreté d'un nuage."[9] In other words, French *nuage* 'cloud' selects powdery or liquid materials that, despite being heavier than water, move in water in a manner that seemingly defies gravity. This shows that *nuage* encodes *relative* viscosity: the liquid that moves is slightly heavier than the liquid in which it is spatially distributed. This in turn provides an argument that distribution in space is a more important property of Samples than viscosity *per se*. Such Samples represent a remarkable attention to the detail of material integrity and dispersal.

The question arises as to why and how language encodes the property of a material's distribution in space. After all, it is easy to imagine a language that would only refer to mere quantities of material, without paying attention to its spatial distribution. A drop could be referred to as 'the smallest subset of a liquid', a stream as 'a longitudinal subset of a liquid', a dollop to 'a subset of a thick liquid'. In fact, this is more or less the way in which such Samples have been considered in semantics: as mere expressions of quantity. However, drops and streams in fact primarily refer to fine-grained changes in the spatial distribution of liquids, and I will argue in Section 3 that their quantificational use derives from their primary use as classifiers. I will assume that this vocabulary of Samples is generated by a computational system in an internally represented conceptual space. For the examples in the present paper, I will also need to assume that this computational system uses geometrical coordinates and vectors in an internally represented conceptual space, but I leave further specifications of this level of representation open (also see Gärdenfors 2004).[10] The study of

[9] '*Cloud of powder, cream, milk*. Small quantity that disperses by evoking, to some extent, the low density of a cloud.' [my translation]

[10] There is a nontrivial relationship between Samples and signs in sign languages, which also often stand for the way in which an object is distributed in space. For example, the sign for *book* in ASL is made by putting both hands together, palm-to-palm, and opening up the hands as if opening up a book, keeping the pinky fingers together. One could say that the spatial distribution associated with Samples allows us to identify materials in a similar way. But this misses the more general point. Rather, human cognitive abilities seem to be particularly attuned to capturing and distinguishing the smallest movements, whether they involve acoustic or visual cues, and making these representative for the thing that moves in this way. Human fine motor skills seem to go hand in hand with fine-grained perception of movement (with acoustic vibrations a particular subcase of movement).

Samples provides us with a window into the way i-semantics organizes and analyses matter. In Section 3, I will look in further detail at the relation between classifiers, quantification and distributivity, before moving on to the parameters of geometrical coordinates and vectors that define classifiers in Section 4.

# 3. Classifiers, quantification, and distributivity

## 3.1. Classifiers and quantification

Both Sample classifiers like *drop, slice, spoonful* and Pointer classifiers like *whiff, touch,* or *taste* at first sight often seem to refer to a *small quantity* of material:

(6) a. a splash/drop/ drizzle/ trickle of water
b. a sprinkle of sugar
c. a whiff of fresh air
d. a dollop of whipped cream
e. a kernel of corn
f. a stream of water/ cars/ air
g. a string of beads/ words/ letters/ sausages
h. a slice/ piece/ chunk of salami
i. a spoonful of salt/ butter
j. a taste of cinnamon
k. a grain of sand
l. a touch of ginger
m. a glimmer/ glint/ twinkle/ flicker of gold/ light

Samples and Pointers are indeed invariably described in the dictionary as referring to small quantities, but this is not an inherent property of classifiers. The examples in (6fg) show that the quantity need not always be small. Samples are often small because they provide information about how a fraction of material compares against the rest of it in terms of its spatial and temporal distribution. Pointers are small because their spatial distribution is hard to perceive visually: a pointer is a perceptual anchor referring to materials whose spatial extent is hard to pin down. Classifiers tend to be small because they are *representative* of material properties of distribution.

I would like to argue that the use of Samples and Pointers as quantificational measures is secondary, and derives from their more fundamental nature as elements that evaluate the spatial distribution of material. In other words, as mentioned before, there is no radical division between mensural and sortal classifiers: all classifiers are sortal to begin with, and their use as quantificational measures is a derived one. Classifiers are not quantifiers in and by themselves, but they are made compatible with a quantificational interpretation thanks to the higher individuating functional categories (DP, QP) that turn SamplePs into units and/ or quantities, as in (7):

(7) [$_{DP}$ a [$_{QP}$ Ø$_{Q}$ [$_{SampleP}$ drop (of) [$_{NP}$ water ]]]

This relation between classifiers and quantifiers allows for an explanation why Samples that receive a quantificational interpretation so often refer to an approximate quantity. In a sentence like *Sue had a drop of wine at dinner*, *drop* refers to an undefined small quantity of wine, and certainly not to a quantity that refers to the volume corresponding to a drop in its

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I cannot do full justice to this idea, which may have far-reaching implications for our understanding of the primitives of language. Phonology and i-semantics might be more closely related than generally assumed.

lexical sense, nor to its spatial distribution in the form of a drop. Now recall that as a Sample, *drop* does not refer at all to the exact volume of a drop, but rather evaluates the specific spatial distribution of *wine* in its complement. A (covert) Q selecting the SampleP *drop* will combinatorially yield the interpretation of a quantity of wine that is presented as approximating the volume of a drop.

The quantificational interpretation can be viewed as a grammaticalized use of the classifier, where its original meaning in terms of spatial distribution has been entirely bleached away to leave the interpretation of 'approximate small quantity'. We will examine similar cases in section 7 below.

This grammaticalized 'approximate small quantity' interpretation allows for context-sensitive euphemistic and ironic interpretations of *a drop of wine*. Note that in their approximate interpretation, Samples are not easily modified by numerals, and prefer paucal quantifiers:

(8) Sue had a few/ *?many/ *six drops of wine at dinner.

This suggests that the covert Q in *Sue had a drop of wine at dinner* is likewise a paucal. Under this analysis, it is the covert Q that provides the interpretation of small quantity, not the Sample *drop*, which only indicates a particular shape and volume that just happens to be small.

The difference between a strict Sample interpretation as opposed to a quantificational interpretation can be further illustrated by the somewhat unusual case of the Sample *grain*. In (9a), the direct sensory perception properties of *grain* include that it is hard, granular, and resistant to pressure. It is interpreted as a single unit thanks to the D *the*. But (9b) shows that this individuation is not always present. In (9b) *grain* refers to the granular texture of wood: there is not a singular grain being referred to here, but a plurality of them.

(9) a. the grain of sand/ corn/ wheat
b. the grain of oak/ beech/ maple/ granite

In (9b), *grain* refers to a mass-like graininess of the texture of wood and stone, the pattern of fibers specific to each type of wood, or speckles in stone. I would like to argue that this is due to a quantificational interpretation of the Sample, perhaps via an empty collective Q: *grain* in (9b) refers to a set of grain-like elements that together form a 'grainy' pattern, thus identifying the way in which wood patterns are perceived in their spatial distribution.

## 3.2. Classifiers and distributivity

To further clarify the idea that classifiers encode patterns of material distribution, I will adopt and modify Champollion's (2010) analysis of distributivity. This analysis has a wider application than just the nominal domain, but for the purposes of my argument, I will just concentrate on that aspect. Champollion (2010) analyzes distributivity in the DP *three liters of water* in terms of the three semantic notions defined in (10a). Under this analysis, *water* is viewed as the Share that is distributed over the Key *three liters* via a Map that refers to 'volume', as in (10b):

(10) a. *Key:* the entity about whose parts entailments are licensed
*Share:* the "thing being distributed" over the parts of the Key

*Map:* the function (e.g. thematic role, measure function) from Share to Key

b. Three liters of water
Three liters ... is the volume ... of water
*Key* *Map* *Share*

I will adopt the idea of Share without further ado. I expand the notion of Map to include all types of spatial distribution – understood in terms of material separation – expressed by classifiers. I decompose the notion of Key into a Classifier corresponding to the capacity of a *liter*, and a quantifier like *three* defined in terms of multiplication. The interpretation of *three liters of water* in (10) then is rephrased as in (11):

(11)

| | | | |
|---|---|---|---|
| water... | is spatially distributed into ... | …a bounded capacity of a liter... | …multiplied by three |
| *Share* | *Map* | *Classifier* | *Quantifier* |

Note that I have changed Champollion's (2010) notion of Volume to that of Capacity. This is crucial for a proper understanding of classifiers. The notion of Volume refers to the amount of space occupied by a hollow or solid object in three-dimensional space. By contrast, Capacity strictly refers to the amount of fluids that hollow objects can hold, absorb or receive. Fluids are not limited to liquids, but can refer to any substance whose particles are able to change their relative position under the influence of a force without fully separating. Fluids thus include gas and liquids, but also granular and powdery substances like beans, rice, gravel, flour, or dust. A liter is therefore a unit of capacity that measures the distribution of a fluid in a spatially bounded hollow space. This definition should not be taken literally, in the sense that there need not be an actual hollow space out in the world that is filled with liquid. Rather, *liter* is an i-semantic representation of such a space. This then allows us to use *liter* for just the quantity of fluid contained in that represented space, so we can say things like *There is half a liter of chicken bouillon in that soup*.

The reason that this change from Volume to Capacity is important is that it directly relates *liter* to classifiers: many languages have specific classifiers for hollow objects, from hollow tubes and gourds to holes and windows. Hollow objects can serve as recipients for fluids, and their classifiers often evolve into mensural classifiers. Just like the fluids that fill them – *filling* being a form of spatial distribution of material, as I will show in Section 5 – classifiers for hollow objects that can function as recipients also refer to a material that distributes in space, i.e. resists, in reaction to the material that fills them. Classifiers that indicate recipients can be elastic, and swell when being filled, like nets or pockets; or they can be inflexible and hard, resisting the fluid that fills them. Note that the unit of capacity *liter* does not specify the physical nature of its boundaries. *Liter* can assume any three-dimensional shape, making it oddly malleable; more like a flexible, abstract capacity than a rigid container. Think of *there is a liter of chicken bouillon in that soup.* As a result, I would argue, the expression *liter*, which at first sight appears to be a prime example of a quantificational measure, turns out to have the properties of an (underspecified) classifier. Like a Sample, it indicates a pattern of material distribution, i.e. the result of filling a unit of capacity with a specific quantified boundary, much in the manner of *cup* or *spoonful*.

## 3.3. Material distribution and containers/measures

The notion of capacity is essential for a proper understanding of classifiers like *-ful* (*handful, mouthful, earful, spoonful, bucketful, houseful)* and *-load (carload, busload, truckload, bucketload.* Expressions such as *cup* or *glass* that do not feature *-ful* (*a cup of tea, a glass of water*) are typically analyzed as containers or units/measures (for an overview see Sag 2019). Erbach (2022) has argued that expressions like *cup* or *glass* may in fact have to be analyzed as integrating a silent classifier *-ful*. If that analysis is on the right track, the traditional perspective on containers and measures as quantifiers (see Rothstein 2017 and references therein) does not do justice to their non-quantificational properties as elements that refer to the distribution of material: cups and glasses are not just quantifiers, but refer to the capacity of holding a material that is spatially distributed in a very specific way, i.e. fluids.

Note also that the notion of capacity can be properly appreciated in the context of classifiers. A *spoonful of sugar* does not refer to the *volume* that the shallow part of the spoon can hold, but the approximate *capacity* of sugar that the spoon can hold in a space that extends well above its actual volume.

Indeed, I would like to argue that *-ful* and *-load* are classifiers that indicate material distribution and capacity: they combine with container/measure expressions to indicate how material distributes in them, and refer to the maximum amount (capacity) that the container can hold. *-ful* in *cupful* should be analyzed as a resultative form of the verb *fill* : it refers to a fluid that has flowed into the cup to fill the available space of the cup along a vertical dimension with an upward direction (even if the fluid flows *into* the cup, the cup is filled along its axis from bottom to top). Classifier *-ful* indicates the direction of flow of the fluid along the primary hollow axis of the cup, and is terminated by the capacity of *cup*. These classifiers could be said to possess the abstract structure of Accomplishments in Aktionsart: a process followed by a culmination. Conversely, *-load* expresses a downward direction: a load presses down on its container or carrier, and meets resistance.

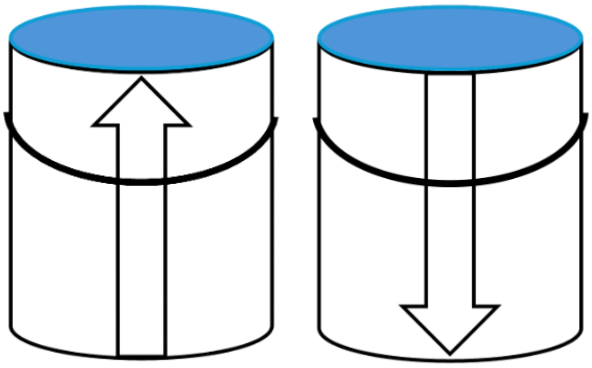

Figure 1: A visual representation of *-ful* and *-load* as minimal pairs

Like *-ful, -load* exhausts the capacity of its container: a bucketful and a bucketload of water refer to the same amount of water, but *-ful* is viewed as the endpoint of capacity, while load is viewed as a mass. In addition, *–ful* requires substantial hollowness of its container, since the filling is upward, while *-load* can be combined with shallow containers (*hand, spoon*) since it only bears down on them. Finally, the contrasting directions of flow and pressure have interesting associated implications. Since *-ful* refers to an upward movement, an implication of relative light density and lightness results. This is probably why containers that are able to carry light materials combine well with *-ful*: *spoonful, dishful, lapful, kettleful, armful,* *noseful, basinful, basketful, glassful, pocketful, sackful,* and even *truckful* or *houseful*.[11] The relatively light density can perhaps best be appreciated in *houseful*: a *houseful of guests* does not mean that the guests are packed tightly like sardines in a can, or weigh on the house. A house is not typically viewed as a container for heavy materials. This also explains the existence of *countryful, forestful*, and *churchful*.[12] By contrast, *-load* entails an interpretation of mass: heaviness and weight. This interpretation as mass can be viewed as the consequence of an implied downward spatial movement induced by gravity. *Trainload* is quite common, and even *stadiumload* is attested. A *truckful* of feathers has an interpretation that seems more loosely packed and thus 'lighter' than that of a *truckload* of feathers, even if the total weight of the feathers is identical.

The perceptive reader will argue that classifiers composed with *-ful* and *-load* are not restricted to material they can contain. *A handful of friends* or *a handful of arguments* obviously do not refer to a set of friends or arguments that can fit on a hand. I would argue that in such cases, *handful* has been grammaticalized into a quantifier, bleaching the semantic specificity of its complement. *Handful* functions in such cases as an indefinite quantifier derived from the Sample. It indicates an undefined quantity of loose elements that is proportional to the undefined amount of discrete objects that can be contained in a volume with a capacity roughly corresponding to a hand. Note that the notion ‘small amount’ is thus derived from the initial size of the Sample in a non-metaphorical manner.

# 4. Parameters of spatial distribution: Vector and Dimension

In the previous section, I have described the minimal opposition between *-ful* and *-load* in terms of the *direction* of the spatial distribution of material. Similarly, in Section 2, I mentioned that *drop* and *splash* differ minimally in terms of the type and direction of the external force applied to the liquid in their complement. Such minimal oppositions raise the question of the parameters that classifiers, and Samples in particular, are subject to. I believe they boil down to two principal ones: Vector and Dimension, which can each be subdivided further. It is not clear to me whether these are sufficient for the observed variation, but I will take these subdivisions to be the necessary minimal ones. They are summarized in Table 1 below.

## 4.1. Vector and Dimension

The *Vector* properties of classifiers refer to *magnitude* (i.e. the size of a line) and *direction. Direction* refers to the order of the points on the line and where the vector is pointed: upwards, downwards, or horizontal with respect to its plane of reference.[13] Direction is called ‘axis vector’ by Zwarts (2003). In addition, vectors can be *bounded* or *unbounded* – i.e. with a specified or unspecified magnitude – in space and time (Talmy 1988: 178-180, 2000). I will assume that some vector properties can be left underspecified. Finally, vectors can be bundled in sets. In such sets, vectors can converge on a center to express a centripetal force, or move away from a center to express a centrifugal force.They can also be aligned in time or

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[11] *-ful* seems to combine well with body parts and household items, including houses and vehicles.

[12] https://en.wiktionary.org/wiki/Category:English_nouns_suffixed_with_-ful

[13] I am intentionally simplifying the geometrical distinction between *sense* (the 'arrowhead' of the line and the implied order of the points or intervals of a line), and *orientation* (the angle of the line as compared to the horizontal axis).

space to express iteration. I will indicate such bundles of vectors by the terms *centripetal, centrifugal,* and *aligned* in Table 1 below.

Let us turn to some examples to make this clear. *Magnitude* can be small (*drop, trickle*), unspecified (*beam, stream*), or specified by another element (*cup* in *cupful*). A *stream* clearly has a downward direction, while *a beam of light* has an unspecified direction pointing away from the lightsource. By contrast, *a line of powder* has no particular direction. Direction can be upward (*cupful*), downward (*drop*), downward (*stream*), centripetal (*kernel*), or centrifugal (*splash*). Note that in *cupful*, *-ful* contributes the directional properties of the vector (pointed upwards along the primary axis of the cup).

*Force* is the energy applied or emitted that causes the specific type of spatial distribution of material or its separation that is expressed by the classifier. Not all forces expressed are immediately obvious, and some are implied rather than exerted. For example, *kernel* is characterized by a centripetal direction, and the force exerted on it is expressed by the idea that a kernel resists pressure, an interpretation that can be appreciated in *a kernel of hope/ truth*. A kernel is the center of a surrounding mass, identified by a centripetal direction of forces converging on it. Material can be spatially distributed by separation (*slices* and *chunks*), displacement (*drops* and *streams*), expansion (*-ful*), or pulverization (powder, *grains*). An *external* force can be applied by pushing (*slice, splash*), pulling (*chunk, dollop*) or dropping (*sprinkle, drizzle*). An *internal* force most often controls the spatial and temporal distribution of *drop, trickle, stream, whiff* and *twinkle.* Since Force includes velocity, the speed of material distribution may vary from one classifier to another: a *drop* is slower than a *splash,* and both are faster than a *dollop*: I would propose that material consistency is derived from distributive velocity.

Finally, boundedness refers to the limits of the vector. A *stream* refers to an unbounded, line-like, body of liquid, while *drop* is a bounded magnitude of water. Similarly, a beam of light can be considered an unbounded, line-like, body of light, while *flicker* is a bounded and temporally aligned set of small magnitudes of light.

Burmese as described by Becker (1975) (cited in Denny 1979:123) provides interesting minimal pairs to illustrate the magnitude (12a), direction (to the sea) (12b), and the boundedness (12c) of a vector:

| | | | |
|---|---|---|---|
| (12) | a. | myiʔ tə tan | river one line (e.g. on a map) |
| | b. | myiʔ tə ‘sin | river one arc (e.g. a path to the sea) |
| | c. | myiʔ tə θwe | river one connection (e.g. tying two villages) |

Identical bounded vectors can be bundled in aligned sets, as in classifiers that express iteration, such as *twinkle, glimmer,* and *flicker* or *trickle*. Repetition is also present in classifiers referring to strings of fish or beads, or Tatuyo *˜kúdí* 'circle of vertical units, i.e dance circle, enclosure, palisade' (Gómez-Imbert 1982:125). I will take these classifiers to be special cases of collectives like *swarm* and *heap* that will be analyzed in Section 5.

In addition to a *Vector*, classifiers encode *Dimensions*: classifiers can encode 1D (*threads, lines*), 2D (*sheets, slices*), and 3D (*lump, chunk, piece, drop, stream*) representations. This more static aspect of classifiers is what has traditionally inspired most descriptions of classifiers. The dimension parameter represents the boundaries of the spatial distribution carried out by a force: the surface tension of a drop, the irregular 3D shape of a chunk.

However, this is not sufficient. In a case like *cupful*, discussed above, the 3D axes of the container *cup* provide its dimensional boundaries, and its primary, empty axis has an upwardly pointed vector that indicates the direction of filling. In other words, the force of filling must be aligned with the upward primary axis.

This intricate relationship between primary axis, direction, and force can be further illustrated with an interesting minimal opposition between seemingly equivalent French *tranche* 'slice' and English *slice*. Both French *tranche* 'slice' and English *slice* are essentially 2D objects resulting from a cutting Force.[14] French *tranche* 'slice' and English *slice* have both a downward direction and an orientation away from the horizontal plane. This means that a slice comes about via a downward vector and force. However, French *tranche* 'slice' can only be used to refer to salami-like slices: it does not typically refer to pizza slice or a slice of pie, as in English: *une part/ *tranche de pizz*a 'a piece of pizza. Now how do we get slices of pizza and pie in English in addition to slices of salami? I would like to propose that the difference lies in the Force that is exerted via the downward direction of the vector. In the case of *tranche* 'slice' the direction and the slicing force must be aligned with the primary axes of the slice. This yields *une tranche de salami* 'a slice of salami'. By contrast, in the case of English *slice*, the direction and the slicing force need not be aligned with the primary axes of the slice, and can thus be perpendicular to it, yielding *a slice of pizza*.

## 4.2. Interioricity

In addition to the number of their dimensions, classifiers can specify two types of differentiation between their dimensions. A first differentiation among dimensions is in terms of primary and secondary *axes*. The primary axis of a cup is determined by the imaginary line that goes from the bottom of the cup to its top. A second differentiation among dimensions is defined in terms of the material distribution affecting each of them. A classifier can indicate whether material distribution includes or excludes one of the axes of the shape formed by material distribution. The material distribution of the ceramic that makes a cup, for instance, does not apply to the primary axis of the cup, allowing it to be hollow. This differentiation yields the difference between hollow shapes, which are empty along their primary axis, i.e. not affected by material distribution; and solid shapes, which are uniform in their material distribution along the primary axis.

Denny (1979) calls this important parameter the 'interioricity' of classifiers. This yields classifiers like hollow pipes, stems, and gourds, as opposed to similar shapes that are uniformly solid, and rings as opposed to disks ( *a ring/ disk of wood*). Allan (1977: 301-302) provides examples from Navajo *khq* 'rigid container with contents', Yucatec *pul* 'jug' or *lek* 'big rough gourd for animals', and the Enindiljaugwa classifier for bottles, drums, tins, pipes, and bamboo which have a long, hollow primary axis. In Mundurucu, an opposition can be perceived between the classifier *-bu* for long finger-like (solid) objects (*puy-bu* 'snake') and the classifiers for long hollow objects *-e* 'long hollow conduit' (*daxa-e* 'flame' (Pierre Pica, p.c., my interpretation).

This lack of material distribution can also apply to the secondary axis of a shape: this yields a typology of classifiers that refer to rings and holes in or through various materials, as described by Denny (1979:108ff) with examples from Bella Coola, Trukese, and Burmese,

[14] Alternatively, slices can be viewed as 3D objects with 2 primary axes and a thin third axis, of course.

and the four-hole typology (large/ small and complete incomplete perforations) that Berlin (1968:122) distinguishes in Tzeltal:

(13)

| perforation | complete | incomplete |
|---|---|---|
| small | *hom* | *puh* |
| large | *huht* | *č'ub'* |

Complete and incomplete perforations in a material resemble the difference between a hollow tube and a cup. A tube is a hollow cylindrical object with two openings, while a cup only has one opening, in the same way an incomplete perforation in a material only has one opening. I am not sure what parameter governs the distinction between classifiers that are open at both ends from those that have a bottom. But perhaps this is the wrong way to look at this difference. Cups, containers, and incomplete perforations are characterized by the fact that they can be filled up by another material, while tubes and complete perforations let material flow through, and cannot be filled up. In other words, the difference between the two could have to do with the direction of the vector of the material that interacts with a container as opposed to a tube.

## 4.3. Classifiers as the computational combination of spatial parameters

Under the view I have presented here, classifiers, and Samples in particular, i-semantically represent the spatial distribution of material along vectors in space or time under the influence of an internal or external force, resulting in a shape with specific dimensions and axes. Such a description makes it plausible that a classifier represents an internalist computational operation encoding the representation of a pattern of material distribution.

The combination of these three parameters can yield some surprising outcomes. For instance, Berlin (1968:205) describes a set of Tzeltal classifiers referring to the shapes of covers that are curved and rounded upward or inward:

(14)

| | |
|---|---|
| */nuh/*<br>'covering opening of jar, container, etc. with non-flexible objects, the covering object being placed with convex side up' | */hnuh p'is/* 'one covered glass';<br>*/hnuh moc/* 'one covered basket';<br>*/hnuh p'in/* 'one covered earthen jar' |
| */mahk/*<br>'covering openings of jar, containers, etc. with non-flexible objects, covering object being placed with convex side down' | */hmahk p'is/* 'one covered glass';<br>*/hmahk moc/* 'one covered basket';<br>*/hmahk p'in/* 'one covered earthen jar' |

The fact that such shapes are expressed as classifiers may look like an odd and arbitrary data point, an illustration of languages varying in unpredictable ways. However, these classifiers can be decomposed into their constituent parameters of a 2D shape combined with the result of an upward or downward force, resulting in upwardly curved or downwardly curved shapes. It is clear that the combination of these parameters allows for a rich taxonomy of classifiers in the world's languages. Further study is needed to check if they are sufficient to analyze the attested typology of classifiers.

The two main parameters of classifiers and their eight dependent sub parameters can be summarized as follows, with some examples included to show the relevant oppositions:

| | Vector | | | | Dimension | | |
|---|---|---|---|---|---|---|---|
| | ±intern-al force | magni-tude | direction | ± bounded | #D | ± axis included | ± 1ary axis & force aligned |
| *drop* | + | small | down | + | 3 | + | – |
| *splash* | – | small | centrifugal | – | 3 | + | – |
| *stream* | + | x | down | – | 3 | + | + |
| *cupful* | – | cup | up | + | 3 | – | + |
| *beam (of light)* | + | x | x | – | 3 | + | + |
| *flicker* | + | small | aligned | + | 1 | – | + |
| *chunk, piece* | – | x | x | + | 3 | + | – |
| *slice* | – | x | down | + | 2 | + | – |
| *tranche* 'slice' | – | x | down | + | 2 | + | + |
| *kernel* | + | small | centripetal | + | 3 | + | – |

Table 1: Vector and Dimension properties of classifiers

'x' indicates that the relevant parameter is variable or irrelevant: while *a splash of liquid* is typically small, it can be projected in any direction. Chunks and pieces result from an external force, are bounded, can be of any size (magnitude), but have no specific direction.[15]

In the next section, I will examine the consequences of the perspective on classifiers developed in the previous sections for a revised understanding of mass and count.

## 5. Classifiers and collectives

Classifiers and their attention to material distribution in space are reminiscent of the mass-count distinction, where the notions of differentiation, homogeneity, and cumulativity have played such an important role (see for discussion e.g. Chierchia 1998ab, Rothstein 2010,

[15] Note however that the French noun *bout* 'end/ piece' as in *le bout de la table* 'the end of the table' originally has a direction. The notion is however bleached away in *un bout de pain* 'a piece of bread', which is the classifier use of the word.

2017). In this section I suggest that these notions (and hence the mass-count distinction) can be described in terms of the analysis sketched above. I will argue that the distinction between classifiers in terms of Samples and Pointers requires a linguistic ontology of matter that can derive one that is based on individuation, homogeneity, and cumulativity.

## 5.1. Identity, similarity, mass, and count

As is well known, mass can be described in terms of cumulative reference (Krifka 1998ab). When two portions of water are combined and summed up, the result can still be called water. By contrast, the sum of two tables is no longer a table, but needs to be referred to by the plural *tables*. An alternative mereological account (Link 1983) proposes the criteria of homogeneity and quantization: a portion of water can still be called water, but a part of a table can no longer be called a table.[16] It is usually assumed that “the mass/count distinction is a grammatical distinction independent of the structure of matter” (Rothstein 2010:343). A question one might ask of course is *why* two summed portions of water are grammatically still water, while two summed tables are not. I believe that the way in which language represents the structure of matter has not sufficiently been taken into account in these issues.

In both approaches, the notion of *collective* is crucial: plurals and mass nouns can be viewed as establishing a collective relationship between individuals (*tables*) and portions (*water*), respectively. I will henceforth use the term ‘unit’ to refer to individuals and portions that are part of collectives, in order to avoid a strictly mereological interpretation of my proposal. I will use the term ‘collective’ to refer to both mass nouns and plurals. The relationship between a unit and its collective is similar to that between a classifier and the material in its complement. Classifiers establish a relation with the material in their complement in terms of the spatial distribution of that material.[17] I would like to argue that a classifier is representative of the spatial distribution of material, in a way that is similar to the way a unit in a collective is representative of that mass or plurality. To go even further, I would say that in many cases, the relation between the unit and its collective is one that describes the way in which the units distribute spatially with respect to each other inside the collective.

Now recall that I have defined Samples and Pointers in terms of functional identity and similarity, respectively. A Sample like *drop* in *a drop of water* is identical to, and typical of the water sampled. By contrast, a Pointer like *taste* in *a taste of cinnamon* only has a relation of functional similarity with the cinnamon it represents distributional properties of. These notions of identity and similarity can be brought to bear on plurals and mass nouns as well. Crucially, units of mass nouns like *water* are conceptualized as functionally identical to each other: all relevant units of water are presented as behaving in the same way in terms of their spatial distribution. While an ice cube floating in water is technically water, it is not functionally identical to the other units of water in the glass. As a result, *a glass of water* will refer to the water in it, but not the ice floating around in it. Similarly, we can point to a number of distinct and separate puddles of water on the floor and say ‘there is a lot of water

[16] Problems for these approaches have been discussed by Rothstein (2010). Mass-count nouns like *furniture* and *jewelry* are not homogeneous. Count nouns *like fence, line, plane, sequence,* and *twig* are homogeneous and can be cumulative.

[17] As mentioned before, I am deliberately avoiding a mereological or quantificational interpretation of classifiers here. Classifiers are not to be viewed in and by themselves as parts or quantities: they only and strictly encode the specific spatial distribution of the material they select in their complement. Their specific quantificational use is built on top of that original function as a matter of grammaticalization, as I have argued in (5).

on the floor'. What is being referred to is that the units of water are presented as behaving identically in all their characteristics of material distribution.

Plurals are different: a plurality of tables can, but need not include identical tables: it can include all kinds of tables as long as they are functionally similar to each other. A plural such as *tables* signals the fact that its units can differ from each other in a subset of characteristics, and therefore have a similar-but-slightly-different material distribution in space. In other words, the types of relations that hold between units of mass nouns and between individuals in plurals can be defined in terms of the fundamental properties of Samples and Pointers, respectively. Inside these collectives, units are compared in terms of similarity and identity. Mass nouns require functional identity of their units, plurals allow for functional similarity between them.

When classifiers apply to mass and count collectives, there is an interaction between the classifier-like properties of the collective and the classifier itself. Let us first examine how this works for quantifiers like *much* and *many*. I will take quantifiers like *much* and *many* to be amalgams or portmanteau morphemes of both classifier and quantificational grammatical information. It is well known that an expression like *much* can combine with any of the mass nouns mentioned in (6), as in (15):

(15) Too much water/ sugar/ fresh air/ salami/ salt/ butter/ cinnamon

The classifier properties of a quantifier like *much* can then be analyzed as follows. I propose that *much* not only quantifies over the units the mass noun in its complement, but it also requires that these units be materially identical to each other, a Sample-like property. In addition, *much* does not require the units it selects to share a shape: when we say *There is too much water on the floor*, the puddles, dribbles, and drops on the floor must be materially identical, but they do not need to share a shape. In other words, there is some sort of selection in terms of identity of units and lack of a shared shape between the classifying requirement of the quantifier and the mass noun in its complement.

Let us now turn to *many* and count nouns. Like *much, many* can be viewed as an amalgam of a quantifier and a classifier. *Many* not only quantifies over units in the plural collective, but it also requires the units it selects to share a similar or identical shape, a classifier-like property. A plural like *teapots* can refer to identical teapots or to similar ones that do not even share the same material. Note that many quantifiers that select count nouns encode the variation and differentiation that is enabled in the plural set by the similarity requirement of plurals: quantifiers such *various, different, sundry, miscellaneous, diverse* and *all manner of* insist on the variety and differentiation among the units of the plural set. If plurality were just a matter of cumulativity or quantization, this insistence on differentiation within the set would be mysterious.

*Much* and *many* can then be viewed as polar opposites in terms of checking the shape of units inside mass nouns and count plurals. They both express quantification, but their classifier-like requirement differs in the way it compares the units of their sets in terms of shape, identity and similarity of material distribution.[18]

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[18] Distributive quantifiers like *each* and *every* also seem to be characterized by the identity/ similarity dichotomy. Knowlton et al. (2023) analyze the difference as follows: "*each* and *every* call for treating the individuals that constitute their domain differently: as independent individuals (*each*) or as members of an ensemble collection (*every*)". I would like to propose that this distinction derives from the fact that *each* requires

Summing up the discussion so far, mass refers to units that do not share a shape when they materially distribute in space, while count refers to units that do share a shape when they distribute in space. In addition, mass nouns require these units to be materially identical to each other, while plurals do not impose such a requirement.

Plurals are thus underspecified for the similar/ identical distinction. But there is more. As Goddard (2017) has pointed out, a subset of plurals requires its units to be similar and distinct. This is the case of superordinate nouns like *weapons, vehicles, vegetables, tools, furnishings.* The question then arises whether there are plurals that require their units to be presented as identical to each other. I believe generic bare plurals and kind readings fulfill that criterion, as they typically refer to 'undifferentiated' exemplars of a species or type: *elephants are the largest animals on dry land, bikes are useful in an urban context*. (see the rich literature starting with Schubert & Pelletier (1987).

The same mechanism also allows to provide a more precise definition of mass-count or collective nouns like *cutlery, jewelry,* or *furniture*. Such nouns are like count nouns in that they implicitly refer to units that are *not* identical to those of other units in the set, but that nevertheless typically share something other than their form, at least unity of location (a house for furniture, the body for jewelry), and function (home functionality for furniture, adornment for jewelry). Goddard (2017:252, 255) notes that Wisniewski et al. (1996: 297) observe that 'mass superordinates' are "united by spatial contiguity and/or a common purpose that is achieved through the joint participation of multiple objects" (see also Wierzbicka 1985).

The question remains what mass nouns and mass-count nouns have in common semantically in addition to their singular morphology and the fact that they need a classifier to be individuated (*a portion of water, a piece of furniture*). I would like to propose that the notion 'unity of location' that applies to mass-count nouns can usefully be extended to all mass nouns as well. In the same way that similar but distinct pieces of furniture must display a 'unity of location', the units of mass nouns that behave identically in terms of their spatial distribution (*water, sand, gold, chocolate*) must show a unity of location as well: they have to be sufficiently contiguous, as the puddles of water in *There is a lot of water on the floor*, or they are more commonly conceptualized together in a single mass, which can be viewed as the strictest type of 'unity of location'.

If these reflections are on the right track, mass and count are just a particularly abstract instantiation of an i-semantic mechanism of identity and similarity of spatial distribution, as well as shape vs function/ use, which can be viewed as a linguistic way to evaluate material distribution. Humans seem to pay an inordinate amount of attention to the way matter behaves and changes in space. I would argue that quantification is entirely dependent on this more elementary mechanism.

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similar but distinct individuals, while *every* requires the individuals in its domain to be identical. This explains the fact that *every* can easily be used in generic contexts (where all individuals are treated identically). It also accounts for the fact that *each* is required in contexts where the individuals are characterized by specific differences: *My new running shoes are great: each/ *? every shoe has a different insole*. Also: *Each/ *?Every season of this show has 10 episodes*.

## 5.2. More patterns of spatial distribution: swarms and heaps

In the previous sections, I have defined classifiers in terms of material distribution, and I have treated consistency as a corollary or semantic implication of this pattern of spatial distribution. In this section, I will focus on a type of Samples that are only about spatial distribution, and do not trigger any semantic implications about the consistency of the material they are composed of. They provide the best examples that classifiers primarily focus on spatial distribution of, and only secondarily carry implications about material consistency.

This is the case for a subset of collective nouns like *swarm, bunch, bouquet,* or *grove* (Henderson 2017). First of all, swarm nouns share with furniture nouns the property of requiring a 'unity of location'. Nevertheless, the unity of location is expressed differently in either case. Henderson (2017:8) notes: "swarm nouns denote individuals that are constituted by a contextually specified, large plurality that occupies a circumscribed region of space." This can be made even more precise. In swarm nouns, units are distributed in terms of a particular spatial configuration with respect to each other. In a swarm, the units in the swarm move at a particular speed and distance to each other. Similarly, a bouquet of flowers requires the flowers to be more tightly bundled together than a bunch of flowers. In other words, while a typical Sample refers to the spatial distribution of the material in its complement, swarm nouns refer to the spatial distribution of the units of its complement. By contrast, the unity of location required by mass-count nouns like *furniture* is of a different nature: the items included in *furniture* belong in a defined space.

Swarm collectives also impose another familiar restriction on the units in their complement. These are presented as identical to all other units in the set: in a swarm, each insect is viewed as identical to every other insect in the swarm: individual distinctions are erased, and units are undifferentiated. Thus, swarm collectives can be distinguished from typical plurals in terms of identity: while plurals contain units that can share either a similar or identical shape with other units, swarm collectives contain units that are presented as identical to and indistinguishable from other units in the set. This is likely also why swarm collectives cannot have small sets of units in their complement: Henderson (2017) observes the contrast between *A swarm of two-hundred bees attacked the beekeeper.* vs # *A swarm of two bees attacked the beekeeper.* In the perspective presented here, this is because a small number forces a differentiated reading.

Even if in reality a flock of sheep is composed of distinguishable individuals and subsets like rams, ewes and lambs, the noun *flock* treats them as undifferentiated sheep. Henderson (2017) distinguishes these collectives from what he calls group nouns such as *family, team, committee, group*. Interestingly, these almost all require that their members or subunits be similar but distinct in their roles (with the exception of *group*). Henderson (2017) notes that the following opposition holds:

(16) a. The family/ team looks alike (Henderson 2017:11(29-30))
b. # The grove/ the bouquet looks alike

The sentence in (14a) means that the members of the family look similar. Note that # *The family/ team looks identical* is odd under a reading where the family members are compared to each other. Under the analysis presented here, this contrast may be related to the fact that the group collective in (14a) is characterized by similarity, while the swarm collective requires identity of its units. Admittedly, # *The grove/ the bouquet looks identical* is also odd, but this likely has to do with the fact that individual properties of the units in a swarm collective are never accessible, while those of group collectives are, as suggested by the contrast between *The team/ family/ # grove/ # bouquet looks good together*.

Combining this analysis with that of mass and count in the previous section yields the following table:

<table>
<tr><th>Units</th><th>Identical</th><th>Similar</th></tr>
<tr><td rowspan="2">Share a shape</td><td colspan="2">teapots, tables, cups</td></tr>
<tr><td>generic plurals/ kind readings:<br>bees are useful</td><td>weapons, vehicles, tools, furnishings</td></tr>
<tr><td>Share a shape and a unity of location/ a shared connection</td><td>swarm, grove, flock, murmuration, herd</td><td>family, team, alliance, committee, group</td></tr>
<tr><td>Share a use and a unity of location</td><td>water, sand, chocolate</td><td>furniture, cutlery, crockery, jewelry, fruit, vegetables</td></tr>
</table>

Table 2: Types of collectives.

Sets containing units that share an (identical or similar) shape allow access to individual members of the set. This access to individuals derives from the fact that it is necessary to compare the shapes in the set to check whether they share an identical shape (*bees in a swarm*), or whether the shape can be identical or similar (*a variety of teapots vs all the same teapots*). Therefore, only units that share an identical or similar shape can be individuated, and individuation should be viewed as a notion that is derived from the sharing of a shape rather than as a primitive function.

Access to individuals makes them countable, and this countability can be expressed in various ways. In the case of *swarm*, countability is expressed via the complement of *swarm* in *a swarm of bees*, or by viewing *swarm* as a location for a plurality of bees (*the bees in this swarm*). In the case of the plural *teapots*, countability is expressed via quantificational expressions preceding the plural. Such sets allow their units to organize in terms of partial ordering. By contrast, units that only share a function or use do not allow for countability (*Much/ *Many furniture/ water*). Two units of water need not be identical in size, but they must be functionally identical. Mass-count nouns such as *furniture, poultry, jewelry,* or *cutlery* refer to a set whose units have something in common other than their shape.[19] More specifically, they share a use and a unity of location. As Goddard observes, when furniture is not for use inside the house, the location will be specified, as in garden furniture. Similarly, jewelry involves items to be worn on the body, vegetables and fruit refer to a shared use as foodstuffs, etc.

The lack of a shared shape seems to be what makes these units inaccessible for countability. Mass and mass-count units are only compared in terms of a shared property, and properties

[19] Restrictions on *furniture* are precise: they include beds, tables, chairs and cupboards, but not household appliances of similar size (but definitely different use). Similarly, *poultry* refers to birds with a domestic use, and *jewelry* to bodily adornments, excluding tattoos.

do not by themselves lead to individuation. In such cases, a classifier is needed to individuate a unit of the set. In addition, a collective such as *swarm* and a mass noun such as *water* have in common that all units in the set are presented as identical to each other: a *swarm* is a collective of identically shaped units moving in a particular way. Water is a mass noun whose units are always functionally identical to each other. Note that the opposition identical/ similar evaluates the shape of units in a set. By contrast, the vertical dimension – shape, use, and unity of location in Table 2 – evaluates what exactly is compared and evaluated across the identical or similar members of a set.

Collectives such as *swarm* and mass nouns such as *water* share another property. They can be the target of grammatical operations of individuation. More particularly, in many languages, a subset of swarm nouns can have singulatives, which turns the collective into an individual. In Breton *gwenan-enn* 'bee' is derived from a generic plural *gwenan* 'bees' (Jouitteau & Rezac 2015) and Biblical Hebrew *śaʕar-â* '(one) hair' from *śēʕar* 'hair (collective)'. Singulatives 'zoom in' on the differentiating characteristics of a single item in the collective. From the perspective adopted here, singulative morphemes seem to change the 'identity' requirement on the units in a collective into a 'similarity' requirement, and thus allow for individuation by making the unit similar to but distinct from the others in the collective.

Mass nouns like *water* can be subject to a similar operation allowing them to change the property of identity across units into similarity across units and countability. It is well known that Dutch diminutives can turn mass nouns into distinct units (e.g. De Belder 2011): *water-tje* 'water-DIM' and *chocolaa-tje* 'chocolate-DIM' respectively refer to a contextually defined unit of water (a glass or a bottle), and a bite-size, individual piece of chocolate. I would argue that the Dutch diminutive has the same function in this case as the singulative for swarm nouns: it changes the 'identity' requirement between the units of the mass nouns to one of similarity, forcing individuation.

Moving on to other collective nouns like *heaps, stacks,* and *piles,* it may be clear that these are similar to swarm nouns in that they express spatial configurations. First of all, *heaps, stacks,* and *piles* require the objects constituting them to be very close or touching each other, with at least some on top of each other, and with the grouping spatially delimited by the set of elements touching each other. Secondly *heaps, stacks,* and *piles* seem to differ in terms of their organization. A *heap* is mostly unorganized, a *pile* can be organized (*a pile of papers*) or unorganized (*a pile of dirty laundry*), and a *stack* must be organized in the sense that its objects have to be vertically aligned in some way (*a haystack, a stack of logs*).[20] This requirement of orderly alignment accounts for the fact that mass nouns cannot be selected by *stack*, as in (17b): since mass nouns do not denote elements of similar or identical shape, they do not allow for physical alignment of their units.

(17) a. A heap/ pile of bricks/ sand
b. A stack of bricks/ *sand

Other collective nouns pay attention to the spatial proximity of their members; a *crowd* is different from a *group* in that individuals in a crowd do not only constitute a large group, but are necessarily close to each other. *Gathering, group,* and *assembly* presuppose a spatial

[20] On https://english.stackexchange.com/questions/79739/stack-vs-pile-vs-heap-of-paper the relation between *heap, pile,* and *stack* is viewed in terms of increasing orderliness: each stack is a pile (but not vice versa), and each pile is a heap (but not vice versa).

movement and disposition of their members that constitutes the collective: these nouns are not accidentally related to the verbs that refer to that activity.

Finally, spatial configurations of objects bring us to the plethora of nouns denoting animal collectives: *a herd of buffalo, a shoal of fish, a gaggle of geese, a pride of lions, a murmuration of starlings* and so on. Even if many of these are terms were invented in the 15th century, the question is of course why they could be imagined in the first place: i.e. there must be an underlying system that allows to generate these, rather than, say, words for distinct spatial configurations of mushrooms in the woods (admittedly, there are terms like *troop* and *cluster* for collectives of mushrooms, but note that these are not specific to mushrooms). In all these cases of animal collectives, the nouns refer to groups of animals that not only have specific habits of movement but also a specific social structure that suggests 'movement' of a more abstract type. I propose that this propensity in language for animal collectives derives from the fact that animate collectives allow for a far greater and more fine-grained number of spatial and social interactions than is possible between inanimates.[21]

Furthermore, the analysis of the more common collectives indicate other spatial characteristics that tend to be stable across languages. A *herd* refers to a group of animals on land, a *school* to sea animals, and a *flock* to birds. The same is true for French: *un troupeau de vaches* 'herd of cows', *un banc de poissons* 'school[22] (lit. 'any volume with a horizontal primary axis') of fish', and *une volée d'oiseaux* 'a flight/ flock of birds'. Greek *kopadi* refers to a herd of domesticated animals, while *agelē* is used for packs of predatory animals, suggesting a distinction in terms of proximate and distal. *Smēnos* is used for birds or insects.

To conclude this section, I would like to note that under the traditional view that plurals and collectives just refer to cumulative sets of individuals, there is no fundamental reason why such sets would be defined in terms of the relatively precise spatial (and social) configuration of their members. However, under a perspective that such collective nouns are in fact a type of classifier, the existence of just such a class of expressions, and a richly varied one at that, is expected. The attentive reader will also have noted that I have not made a distinction between parts (e.g. *a piece of salami*) and pluralities (e.g. *a string/ bunch of salami*). That is because I view both parts and pluralities as classifiers first and foremost: units that display specific characteristics of distribution in space in terms of identity and similarity. This is not to say that parts and pluralities do not exist, but they are derived notions rather than primitive ones. Parts derive from classifiers that focus on specific types of boundedness: a *drop* focuses on the drop-like spatial distribution of a liquid. Since that is a particularly 'small', or more accurately, narrowly defined spatial behavior, it can subsequently give rise to 'small' unit or part readings in the syntactic derivation. By contrast, classifiers that focus on a more 'holistic' comparison of a complete set of spatial behaviors or distributions across individual units give rise to plurals and collectives. That perspective no doubt needs considerable refinement, but the general direction of the argument is clear, I hope.

To underscore the importance of the notion of identity and similarity in terms of spatial distribution, it is perhaps useful to conjure up imaginable but non-existing alternatives. Why don't human languages have the equivalent of **a translucent/ turbid of water* to refer to a

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[21] I owe this observation to Camil Staps.

[22] *banc* literally means 'bench', but it can be applied to any 3D volume with a horizontal primary axis: *banc de glace* 'a floe of ice', *banc de sable* 'sandbank', *banc de nuages* 'a bank of clouds', *banc de tulipes* 'a bed of tulips'.

translucent or turbid unit of water? We could imagine groupings in terms of colors, say **a green of vegetables* or **a red of roses*, which would refer to a set of green vegetables or red roses. Another nonexistent grouping could refer to sound, for instance **a peep of animals* for all animals that make high-pitched sounds. None of these exist, and neither translucency or color involve perceptible spatial distribution, suggesting that consistency and spatial distribution play a key role in the way we conceptually represent material.

## 6. Pointers in more detail

As noted in the introduction, Pointers (*hint, whiff, trace, inkling, tinge, spot,* and *note*) only indirectly refer to distribution of material in space. They represent the distribution of material *indirectly* by referring to a characteristic that is hard to perceive by the senses: a vague or intuitive indication, a fleeting or imperfect impression. Formally, I have distinguished them by the fact that they do not combine with numerals, see (2), repeated here:

| | | | | |
|---|---|---|---|---|
| (2) | a. | A trace/(*two) traces of blood | b. | A whiff/ (*two) whiffs of perfume |
| | c. | A tinge/(*three) tinges of green | c. | A note/ (*four) notes of cinnamon |

Pointers also are functionally similar to the material they represent rather than identical to that material. In terms of spatial distribution, Pointers differ from Samples in that they do not necessarily feature all three parameters of material distribution (Force, Vector, and Dimension/Axis) that I had defined in Section 6 as typical of classifiers. All Pointers have Force, to the extent that they all encode a particular distribution of their complement as the result of an external (*trace*) or internal (*whiff, tinge, note*) force. However, this distribution is not necessarily spatial, nor does it have specific spatial dimensions, as shown by the distribution of color in *a tinge of green* or taste in *a note of cinnamon*.[23] More specifically, many Pointers lack direction, and only have (small) magnitude. This seems to be the case for all the Pointers in (2). This suggests that Pointers have less properties than Samples, an idea that I will come back to later in this paper.

To illustrate the peculiar properties of Pointers, it is useful to examine some of them in terms of their dictionary definitions. I will discuss them in order increasing perceptibility, starting with vague indications and intuitions perceived by the mind. Google's English dictionary (Oxford Languages) defines *hint* as a slight or indirect indication or suggestion. The Merriam Webster definition of *inkling* is "a slight knowledge or vague notion". A similar definition can be found in the aTILF (http://atilf.atilf.fr/) for one of the meanings of French *soupçon* 'suspicion': "*Simple conjecture, avis, hypothèse ou intuition concernant quelque chose sans connotation défavorable*" 'Simple conjecture, hypothesis or intuition about something without a negative connotation', and "*apparence légère, perceptible à l'œil, à l'oreille ou à l'esprit*" 'light appearance, perceptible by the eye, the ear, or the mind'. A Google search provides examples as in (18ab):

(18) a. an inkling of truth/ honesty/ love/ jealousy
b. a hint of cinnamon/ criticism/ pride/ colour
c. "Un soupçon d'accent étranger, de moustache, de soleil, de tristesse" (aTILF)
'A trace of a foreign accent, a mustache, sunlight, sadness'

[23] Perhaps the representation of Pointers can be viewed in terms of Churchland's (1986) notion of 'state space', where e.g. colors can be represented as points in a space defined by axes for hue, saturation, and brightness.

Pointers with some, but still rather vague visual perception include English and French have *shadow* and *ombre*, as in (19a). French *ombre* ‘shadow’ has as one of its definitions in French (aTILF): “*Apparence trompeuse, image imparfaite de quelque chose; phénomène éphémère”* ‘false appearance, imperfect image of something, fleeting phenomenon’. The definition is also decidedly non-material: *“Ce qui est sans poids, sans épaisseur, sans importance”* (‘that which is without weight, thickness, or importance’). Another example is *tinge*, which originally refers to a hard to perceive, faded trace of color, but also applies to (often negative) emotions.

(19) a. Une ombre de moustache; sans l’ombre d’un doute;
‘A shadow of a mustache, without the shadow of a doubt
sans une ombre de malice, de pitié
without a shadow of malice, pity’
b. a tinge of pink/ regret/ anxiety/ panic/ sadness/ desire/ cynicism/ intolerance

Finally – but I do not claim to have exhausted the possibilities – there are what I would like to call Pointers of spatio-temporal perception: *trace, note* and *spot*. The Merriam-Webster definition of *trace* is both “a mark or line left by something that has passed” (*traces of deer*) and “a minute and often barely detectable amount or indication”, as in *a trace of a smile*. The original, non-classifier meaning of *trace* is a temporal one: it refers to something that indicates that its complement has been there, but is no longer directly perceptible. This lack of direct perception is then what is used to build the classifier use of *trace*: a bare detectable indication. The same is true for *note*: originally it refers to a short written mark or mnemonic to remember something, but as a Pointer it functions as an indication of something that is not directly perceptible: *a note of chocolate, regret, optimism*. Finally, the primary meaning of *spot* is “1. a small area that is different from other areas 2. A small amount of a substance that is on something” (Merriam-Webster). This second meaning of *spot* thus resembles that of *trace*: a stain of some substance, which then evolves into a Pointer, and eventually a quantifier. In British English, *spot* can refer to a small amount of mass nouns (matter), event nouns (*lunch, weeding, leave*) and abstract nouns like *trouble* or *bother*: *a spot of tea/ light/ rain/ lunch/ weeding/ leave/ colour/ trouble/ bother*.

All of these examples of Pointers require considerable descriptive refinement. For example, they are not easily interchangeable in all contexts: *a trace of a smile* can be opposed to the infelicitous **a note of a smile*, while for the abstract noun *optimism* both can be used: *a trace/ note of optimism*.

As in the case of Samples, Pointers give rise to quantificational interpretations. The fact that Pointers are hard to perceive makes them compatible with an interpretation of small quantity: their low degree of perceptibility is quantificationally interpreted as a low quantity. But as I have said before, the quantificational interpretation derives from the use as a classifier, not the other way around.

# 7. From concrete to abstract nouns

## 7.1. Classifiers and abstract nouns

In the preceding discussion of Pointers, I noted that they are compatible with abstract nouns. Hitherto, I have mostly focused on cases where classifiers select nouns referring to concrete materials. The question arises whether the concrete/ abstract distinction corresponds to the distinction between Samples and Pointers. At first sight, that is to be expected: spatial distribution is a property of concretely perceptible material, and as such it could be viewed as the hallmark of Samples. It is not immediately obvious that abstract nouns can be characterized in terms of spatial distribution (Vector and Dimensions) in the same way as concrete material. Since Pointers lack Direction, and do not have Dimensions, it can be expected that they combine particularly well with abstract nouns which lack these properties as well. The cases in (20-22) bear out this expectation:

(20) a. a touch of ginger/ wine
b. a touch of madness/ the flu/ hesitation/ color

(21) a. a whiff of perfume/ garlic/ fresh air
b. a whiff of hypocrisy/ injustice/ fraud

(22) a. a glimmer/ glint/ twinkle/ flicker of gold/ light
b. a glimmer/ glint/ twinkle/ flicker of hope/ amusement/ understanding/ despair/ disappointment

*A touch of ginger* refers to a slight taste, *a whiff of perfume* to a fleeting smell. But it would be hard to characterize the abstract nouns *truth*, *madness, flu, hypocrisy,* and *injustice* in these terms. Rather, they all refer to amounts or degrees that only carry a connotation of the sensory. A *touch of madness* is a light degree of madness, deriving its lightness from the sensory aspect of touch. A *touch of color* is a lightly perceptible amount of color. But *a touch of ginger* can either be a taste or a small amount. A *whiff of hypocrisy* is a faintly perceptible degree of hypocrisy, while a whiff of perfume or garlic must refer to smell. A *glimmer of gold/ light* refers to blinking and brightness, while a *glimmer of hope* is a small degree or measure of hope. In all of these cases, I would like to propose that the Pointer functions as a measure, a degree, or a quantifier.

However, it seems that at least some Samples can also apply to abstract nouns. In (23), I present cases involving both concrete and abstract nouns in the complement of Samples:

(23) a. a kernel of wheat/ wisdom/ of an argument
b. a grain of corn/ truth/ insanity
c. a drop of water/ wisdom/ insanity/ hypocrisy

Note that changing the complement from concrete to abstract is accompanied by a concomitant change in the ability to combine with numerals:

(24) a. five kernels of wheat/ *wisdom/ *of an argument
b. four grains of corn/ *truth
c. three drops of water/ *wisdom/ *insanity/ *hypocrisy

When selecting a concrete material, the examples in (24) clearly function as Samples. A *drop of water* has been extensively described as a Sample earlier in this paper, with a downward direction induced by the Force of gravity. *A kernel of wheat* is hard, granular, typically at the center of a larger fruit or husk, and resists pressure. This can be translated in terms of direction as the result of i-semantically represented center-directed Vectors that converge on a center. By contrast, *grain* can be analyzed as forming a minimal pair with kernel: instead of carrying an inward-directed Vector, it can be analyzed as having an outward-bound force: grains are seeds that inherently carry a force of growth and expansion. This analysis is not a just-so story, but it can explain contrasts of interpretation like the following:

(25) a. a kernel of hope
b. a grain of hope

The Free dictionary defines *kernel of hope* as “A tiny amount of hope or optimism that exists within an abundance of doubt, skepticism, or pessimism”. So even the use of *kernel* with an abstract noun conveys its direction of center-boundedness: it is the hope that is left, and resists pressure. By contrast, *a grain of hope* conveys the idea of a beginning of hope that can grow. This is why *a grain of hope for the future* is better than #*a kernel of hope for the future*.

But although *kernels of wisdom, grains of truth*, and *drops of insanity* still carry the meaning effects of these spatial Vectors, they are no longer properly spatial in the sense that wisdom, truth and insanity do not allow for a properly spatial mapping of the directions inherent in the classifier. The impossibility to map out the vector directionally is probably what allows the classifier to turn into a quantifier. A *kernel of wisdom* is a small, central amount of wisdom: it derives the notion ‘small and central’ from *kernel*, but otherwise functions as a quantifier.

Now the inability to combine with numerals suggests that the Samples in (21) have turned into Pointers, but that is not the conclusion I would want to draw here. Rather, I propose to syntactically implement the observation that classifiers generally can become quantifiers via grammaticalization by incorporating the Classifier (both Samples and Pointers) into the Q-head of a QP projection (where Q is a convenient shorthand for measure, amount or degree).

(26) $[_{QP}$ [Class°+Q°] $[_{ClassP}$ ~~Class°~~ $[_{NP}$ N° ]]]

I propose that incorporation of Class° into Q° correlates with bleaching the classifier's original Vector and Dimension properties, so it can function as a quantifier while being modified by the remaining properties of the Classifier.

## 7.2. Countability and Direction

If Samples do not become Pointers in (23) when they combine with abstract nouns, why are they unable to combine with numerals? The inability to combine with numerals is after all a defining property of Pointers.

I would like to propose that a more general property of classifiers is at work here, and that the (in)ability of specific classifiers to combine with numerals is due to the presence of a single vectorial property: spatial Direction. Classifiers that display the property of Direction can be modified by numerals, those that lack this property cannot. *Drops, slices, splashes, lumps,* and *spoonfuls* have Direction when they describe the spatial distribution of a concrete material: the Force that is exerted is aligned with an ordered direction: downward in the case of *drop* and *slice*, centrifugal in the case of *splash* and *grain*, sideways in the case of *lump*, centripetal in the case of *kernel*, upwards in the case of *spoonful*. *Traces, tinges, whiffs* and *notes* seem to lack Direction. This is even true for the spatial distribution of light. *A beam/ flash of light* has length and a spatial direction, and thus *five beams/ flashes of light* is fine. By contrast, *a glimmer/ gleam/ glint/ twinkle/ flicker of light* lack spatial direction: these are short, often iterative changes in luminosity perceived by an observer. Note however that *glimmer, twinkle,* and *flicker* do not lack direction altogether: their iterative meaning implies a temporal order and direction rather than a spatial direction. I would like to propose that this lack of spatial Direction is what makes **five glimmers/ gleams/ glints/ twinkles/ flickers of light* ungrammatical. Similarly, this analysis accounts for those cases where Samples as in (24) combine with abstract nouns: I take this to involve the loss by grammaticalization of spatial Direction. In other words, countability may well entirely depend on spatial Direction.

An interesting case is French *brin* 'thin blade of grass', defined more precisely by aTILF as a "petite tige allongée et fragile, qui provient de la germination d'une graine" 'long, small, and fragile stalk that is the result of the germination of a grain'.

(27) a. un brin d'herbe/ de chanvre/ de lin
'a small stalk of grass/ hemp/ flax'
b. Cinq/ plusieurs brins d'herbe/ de chanvre/ de lin
'five/ many small stalks of grass/ hemp/ flax'

In terms of its material consistency, a *brin* is flexible. In terms of its distribution in space, a *brin* points to the beginning of a plant that grows upwards. I take this to mean i-semantically that it refers to a small vector projected in space. Since it has spatial Direction, it can be quantified, as illustrated in (25b).

*Brin* 'small stalk' can easily be combined with abstract nouns, as in (28):[24]

(28) Un brin/ *cinq brins de magie, démesure, malice, nettoyage, folie, fierté, mélancolie, scepticisme, romantisme, réflexion, tradition, pénitence, désinvolture, ingéniosité.
'A bit of magic, exaggeration, malice, cleaning, madness, pride, melancholy, skepticism, romanticism, reflection, tradition, repentance, offhandedness, ingeniosity.

In all of these cases, the meaning of *brin* takes on quantificational properties while essentially preserving its original Sample properties. In those cases where the abstract noun is compatible with a temporal duration (e.g. cleaning, repentance, reflection), the quantificational interpretation is that of an undefined short duration, a fleeting moment in time. The space-to-time mapping in passing from the concrete to the abstract complement is familiar enough. In addition, the material flexibility is translated to a flexible temporal interval, the shortness of *brin* is preserved in the briefness of the temporal meaning, and that the notion that *brin* is part of a spatial vector is mapped to a temporal vector.

What is more surprising is that the change from spatial direction to temporal duration is accompanied by the impossibility to quantify *brin* 'stalk', mirroring what we observed for the iterative light-related classifiers *glimmer, glint* and *flicker* above. This is even true for more concrete meteorological nouns as in (29), which obviously lack the spatial vector of plants, and combine with *brin* to yield a temporal interpretation:

(29) un brin/ *cinq brins de vent/ de soleil/ de pluie
'a/ five brief moment(s) of wind/ sun/ rain'

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[24] All examples attested on https://www.linguee.fr/francais-anglais/traduction/avec+un+brin+de.html, consulted on 27 September 2021.

Also note that Samples are not freely interchangeable in these contexts. Let us examine *grain* 'grain' to provide a minimal contrast. As a Sample, the material consistency of 'grain' is hard, granular, and resistant to pressure. Both *brin* and *grain* can be applied to abstract nouns, as in (30):

(30) a. Un grain de vérité/ réflexion/ folie/ romantisme/ malice/ fierté/ magie
b. Un brin de vérité/ réflexion/ folie/ romantisme/ malice/ fierté/ magie
'a grain/ bit of truth/ reflection/ madness/ romanticism/ malice/ pride/ magic'

In these cases, *brin* and *grain* simply seem to involve small amounts or degrees of the abstract noun in their complement, with slightly different connotations. Like a *kernel of truth*, *a grain de vérité* translates the hardness of the kernel/ grain into an interpretation of incontestability: an incontestable element of truth. By contrast, a *brin de vérité* does not carry that incontestable meaning, and is more flexible in its interpretation.

However, in those cases where a clear temporal meaning is required, *grain* cannot replace *brin*:

(31) a. *un grain de vent/ de soleil/ de pluie
'a grain of wind/ sun/ rain'
b. *un grain de nettoyage/ pénitence/ réflection
'a grain of cleaning/ repentance/ reflection.

I attribute this to the fact that *grain* lacks the meaning of a spatially or temporally projected vector that is inherent in *brin* 'small stalk'. This type of careful comparison of Samples in their various uses could provide a better understanding of the invariant primitives of meaning that they are composed of.

## 7.3. Classifiers and their 'exceptions'

In many languages, classifiers combine with nouns referring to individuals with specific properties of shape, but in addition to these, they combine with nouns that at first sight have no clear relationship with the shape attributed to the classifier. These nouns are then often viewed as exceptions, much in the same way that gender classes refer to male and female individuals in the case of animate nouns, but to a seemingly random and variable set of inanimate nouns. While it is very likely that some classifiers may have become grammaticalized in their use to combine with nouns that have nothing to do with spatial distribution, I believe the relationships described above between classifiers on the one hand and concrete and abstract nouns on the other could yield new insight into such 'exceptions'. After all, the elements that determine spatial distribution are very abstract, and often have nothing to do with our 'natural' perception of objects and materials. This is *a fortiori* the case with abstract nouns: there is nothing natural about conceptually representing truth or magic, as in (30) above, in terms of something that is resistant to pressure, such as a grain, or something that may grow like a stalk.

The Mandarin classifier *tiáo* 'lit. branch' may serve as an example. This classifier is typically said to refer to a long shape, as in (32):

| | | | | |
|---|---|---|---|---|
| (32) | sān | tiáo | hé | [Mandarin] |
| | three | long.flex.cl | river | |

'three rivers'

It combines with nouns referring to animals such as *gǒu* 'dog', *niú* 'cow', or *jīngyú* 'whale', which could be said to have an elongated shape, but also to *wānlù* 'detour, zigzag', *bǎngzi* 'shoulder', as well as abstract nouns such as *dìngyì* 'definition', *guīzé* 'rule, regulation', *yuánzé* 'principle' etc. where the semantic component of 'long shape' does not seem to apply.[25]

However, the parameters I have proposed in Section 4 above are formulated in terms of dynamic spatial distribution rather than simple shape. When these are applied, a different pattern emerges. The animals in question can be viewed not so much in terms of their elongated shape but in terms of the Direction of their vector: animals typically move along flexible trajectories parallel to their plane of reference. It is easy to see how this characterization would extend to *wānlù* 'detour, zigzag', although *bǎngzi* 'shoulder' still presents a challenge (although the articulated nature of 'shoulder' may play a role here). Most importantly, I think the notion of Direction also extends to *dìngyì* 'definition', *guīzé* 'rule, regulation', and *yuánzé* 'principle': these are abstract notions that can be easily conceptualized as 'directions to follow'. Even in English, 'direction' can both be used to refer to a concrete path or trajectory on the one hand and to abstract rules and indications that must be followed on the other. I think this is the level of abstraction that is needed if we want to better understand the function of classifiers. It certainly opens up an interesting avenue of inquiry.

# 8. Conclusion

In this paper, I have argued that classifiers represent an overlooked dimension of functional categories, throwing new light on how language i-semantically represents the spatial distribution of material in terms of direct and indirect sensory perception (Samples and Pointers). Classifiers examine the spatial distribution of material in a surprisingly fine-grained way, with far-reaching consequences for the mass-count distinction and the spatial configurations inherent in collective nouns.

The paper thus sketches the outlines of a research program that would review the literature on classifiers, mass-count, and collectives in light of the characteristics and definitional parameters of classifiers proposed here. It also calls for a theory of i-semantic spatial representation that is able to reduce the rich variety of spatial distribution properties of classifiers to a finite number of calculable primitive geometrical coordinates, forces, and vectors in an internally represented Cartesian coordinate system.

The analysis proposed also carries implications for the semantic representation of objects and their description in the lexicon. Take the noun *table*. In e-semantics, the denotation of *table* is the set of tables in the world. But *table* is polysemous: it can be used for (1) tables to sit and (2) tables to enter numbers into. These could of course be seen as homonyms, but that would not explain why we can both sit at the top or the end of a table and enter numbers at the top or the end of a table.I would propose that in i-semantics, *table* is a flat 2D plane that sits away from but is aligned with its plane of reference, and that serves as a surface to place (distribute) things on. This captures both meanings of *table* in English, and in addition it

[25] I owe these examples, as well as the observation that 'long shape' is too simple for *tiáo*, to Waltraud Paul. The analysis proposed here is entirely my responsibility.

affords to understand the meaning of *table* as a verb with the meaning of 'put on the table' (as in 'to table a motion').

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