Title	When do count nouns become uncountable?
Author(s)	Smith, F. Antonio
Citation	大阪外大英米研究. 2000, 24, p. 35-53
Version Type	VoR
URL	https://hdl.handle.net/11094/99241
rights	
Note	

When do count nouns become uncountable?

Antonio F. Smith

1. Introduction

1.1. Cross-linguistic similarity of concrete referents

The distinction between countable and uncountable nouns exists in a variety of languages. For example, one cross-linguistic study of the mass/count distinction that took its informants from a single college campus was able to include nineteen languages from six language families (Markman 1985). Naturally many other languages, such as Chinese, Tamil (Gillon, 1992), Lingala, and apparently other Bantu languages (Mufwene 1981), were not represented. In fact, virtually all languages could have a countable/uncountable distinction.

Although the referents of uncountable and countable terms vary cross-linguistically, there are consistencies. For example, Markman (1985) has demonstrated that there is a cross-linguistic tendency for superordinate categories to be mass nouns and for lower-level categories to be count nouns. Undoubtedly, a cross-linguistic study comparing prototypical concrete countable entities, such as ‘car’, ‘man’, and ‘apple’ with prototypical concrete uncountable referents, such as ‘milk’, ‘air’, and ‘sand’ would uncover an even stronger correlation between the physical properties of the referents and their category membership. As of yet, however, no such study appears to have been conducted, perhaps because the nature of the results can be taken for granted. Nonetheless, some studies involving specific languages, including Lingala (Mufwene 1981) and Korean (Kang 1994), do exist in which such basic types are considered, and the prototypical countable and uncountable nouns do exhibit distinctive behavior. Even Japanese, which is generally regarded as not having a countable/uncountable distinction, distinguishes between nouns, such as 'money' and 'sand' that co-occur with *ikura* 'how much', and nouns, such as 'oranges' and 'stones' that co-occur with *ikutsu* 'how many'.

It seems reasonable to expect that cross-linguistically, true masses, such as liquids and gases, are inevitably uncountable (except to chemists). Similarly, particulate substances, such as dusts, powders, and grains should also exhibit a strong tendency to be uncountable cross-linguistically, *despite the fact that the components of these nouns are separate physical entities.*

These facts invite the hypothesis that for concrete nouns, membership in the countable or uncountable category, or in intermediate stages of countability (Allan 1980), is largely influenced by perceived physical properties. As Lakoff (1987:428) puts it in his discussion of the relation between multiplex entities and masses, there "is a point at which you cease making out individuals and start perceiving a mass."

1.2. Why figures become ground

If some sand is on a table, one does not notice the individual grains, but if three baseball-sized stones are beside the sand, one notices each stone. From cases such as this, a question arises, "Specifically, what are the differences between how we perceive the individual grains of sand and how we perceive the stones?" The basic answer to this question is that the grains combine to be perceived as a *texture* while the stones are perceived as *objects*. The next question that arises is, "Well, what is it about the grains of sand and human brains that cause us to perceive the grains as texture and not objects, even though the grains *are* physically separate objects and are made of basically the same stuff as the stones?" A partial possible answer to this question is that the individual grains lack the necessary physical features to make them stand out as figures, but further investigation from this perspective is not likely to yield good results, since as long as a particle can be detected visually, it can be a figure. For example, a tiny white dot against a black background will be regarded as a figure (Langacker 1987). A more productive approach is to investigate the effects of grouping.

In their prototypical grouping, individual grains of sand do not possess features that allow them to stand out as figures. In fact, the component members of a mass pose an impossible or, at least, highly improbable figure/ground problem. For example, it would be virtually impossible to put together a jigsaw puzzle that depicted only sand. Moreover, in their prototypical grouping, the grains possess features that cause the grains to be treated as a unified whole. The gestalt laws of grouping (as summarized in Crick 1994) outline some of the parameters that are involved in grouping parts into wholes and treating the wholes as figures, rather than the parts. However, the laws offer only a very general explanation of grouping, since they do not specify quantitatively when parts become wholes, also they do not specifically treat the case of uncountable nouns.

To begin to put together a more complete answer for how individual parts form wholes composed of uncountable units, we must establish not only what gestalt and other parameters are involved in countability but also the values along the various parameters that produce concrete linguistic effects. For example, we need to learn how many individual units are necessary to make individual units a group or a mass, and how small the units must be. The proposed cross-psycholinguistic test is a starting point for this line of research.

2. Proposal

This paper is a proposal for a cross-psycholinguistic study to ascertain how three physical properties — 'visible external boundaries', 'number', and 'retinal size'—

might correlate with the countable/uncountable distinction, as well as with intermediate stages of countability.

3. The selection of parameters

There are too many possible parameters to investigate in a single test. Therefore, the proposed study will only measure the effects of varying the three aforementioned parameters : visible external boundaries, number and retinal size. The first parameter, visible external boundaries, is treated first, and a separate test is proposed to measure its effects.

3.1. Visible external boundaries

Testing for the parameter of visible external boundaries should not be difficult, because, unlike number and retinal size, it involves few pictures. Also, the presence or absence of an observable exterior boundary enclosing a collection of components is likely to influence the countability. For example, the grammaticality of (1) may result from the absence of observable boundaries.

(1) There's a lot of ocean/desert/jungle between our destination and us.

Similarly, if one is shown a close-up picture of a rock in which the boundaries of the rock are not visible, and then one is asked to name what one sees, one is likely to say, "Rock". However, if one is shown a picture of the same rock-but with its boundaries clearly visible, one is likely to refer to it as "A rock". The same phenomenon should occur for other pairs of 'material' vs. 'object', such as wood/ a board, glass/a glass, fabric/a tablecloth, haze/a haze, fog/a fog, smoke/a smoke ring or a wisp of smoke, and water/a puddle.

Effects should also be observable for textures composed of individual units, such as sand or small stones. The contrast between the external boundary of the uncountable noun with its surroundings is likely to be greater than the contrast between the boundaries separating the components of the mass. For example, when some sand is on a table, there is greater contrast between the sand and the table than between the grains of sand. This fact might lead to linguistic effects, such as 'sand' vs. 'some sand' or 'a pile of sand'.

3.2 Number and retinal size

There are several reasons to choose number and retinal size as parameters to measure :

- Essentially, cross-linguistically, for all uncountable concrete basic level nouns (1) composed of solid individual parts, the parts are numerous and small (ie., of small retinal size). (2)
- The number of distinct entities that working memory can handle is limited to specific ranges of numbers (Crick 1994).
- There is evidence that global vs. local precedence (whether the whole or the parts are perceived first) depends on the retinal size of the objects (Kinchla and Wolfe 1979).
- Variances in number and retinal size are likely to yield linguistic effects, such as 'grains of sand' vs. 'sand', and 'rocks' vs. 'gravel'.
- Number and retinal size can be measured separately without much difficulty.

These facts make number and retinal size suitable parameters for testing.

4. Treatment of other parameters

Exterior boundaries, number and retinal size are not the only parameters likely to be involved in countability judgments about physical referents. The following are other parameters likely to be involved in countability judgements and how they figure into the proposed tests, if at all. The first parameters to be treated are the gestalt laws of grouping.

4.1 Gestalt laws of grouping

There are six gestalt laws or, more accurately, heuristics (Crick 1994) of grouping: similarity, proximity, common fate, good continuation, closure, and pragnanz. They will be treated one by one.

4.1.1 Similarity

Sufficiently similar things can be counted together, but sufficiently dissimilar things, such as apples and oranges, cannot be counted together. The physical property of 'similarity' shall be taken for granted as applying between the component parts of concrete uncountable aggregate nouns, such as 'gravel', 'grass', and 'wheat'. Testing the specific ways in which and degrees to which objects must be similar to be counted together would be extremely difficult, if not impossible, at this time.

4.1.2 Proximity/Density

Entities that are close together tend to be grouped together, and the density of component parts would appear to influence countability judgements. For example, the separation of 'freckles', 'pimples', and 'stars' is likely to contribute to their being countable, despite the fact that they are numerous and tiny. On the other hand, entities that are grouped together tend to be referred to by a collective name. For example, several trees grouped together can be called 'a stand of trees' and given a symmetrical groupings of dots (see Figure1) one will see either columns or rows depending on whether the dots are closer together in the vertical or horizontal dimension.

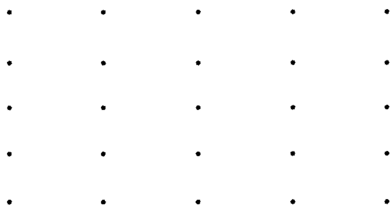

Figure 1

However, testing for density effects is problematic. Even slight changes and irregularities in proximity might influence judgements about group membership, and it would be difficult to devise a means of testing the point at which the distances between objects cause them to form or cease to form a collection or a mass, even with a sophisticated computer program.

Fortunately, however, for most, or perhaps all, uncountable aggregate nouns, the component particles prototypically overlap (as with ‘snow’, ‘sand’ and ‘gravel’) or, at least, in rare cases, almost touch each other (as is sometimes the case with‘tile’). This prototypical maximal proximity can be held constant while observing the effects of varying number and retinal size. Nonetheless, the absence of uncountable nouns with much perceived distance between the component parts suggests that proximity/density is a crucial factor in influencing humans to lump the parts together when labeling uncountable physical referents. [3]

4.1.3 Common fate/Individual behavior

Objects that move more-or-less together tend to be grouped together, while objects that move independently of other objects tend to be individuated. Bats, for example, tend to move independently of each other while many types of fish tend to school, and when they do, they are called 'a school of fish'. Similar examples include 'a swarm of bees', 'a pack of wolves', and 'a herd of cows'. The common fate constraint in predators is likely to be one of the reasons for preys' schooling and herding behavior. When creatures school and herd, predators have a difficult time picking out an individual to attack, and in some cases predators might even view the entire grouping as a single animal that is too big to attack. Also, a camouflaged animal only remains well hidden while it is still. That is, once the collection of mottled features on its external surface begin to move together, they are likely to be identified as belonging to a single entity (Yuille and Ullman 1994). Unfortunately, it would be very difficult to devise experiments measuring the degree to which the motion vectors of entities must be similar for the entities to be perceived as a whole. Therefore, for the proposed experiment, eliminating motion in the test samples shall be used to eliminate this parameter.

4.1.4 Good continuation

Good continuation is a heuristic for interpreting how the components of intersecting lines should be grouped. For example, in Figure 2, we tend to see two lines that cross, rather than two wedges or four lines that meet.

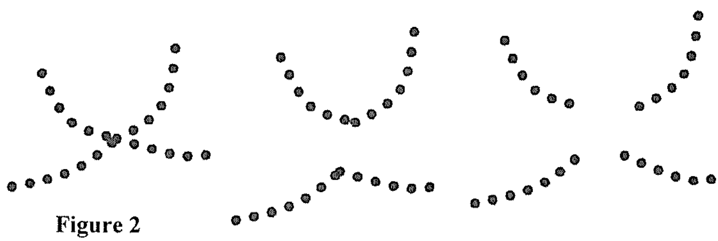

Figure 2

Good continuation might also influence a whole vs. a part interpretation of particulate masses, such as gravel. Good continuation might cause the exterior edge of an uncountable noun, such as the gravel in a pile of gravel, to be a more salient factor in determining what is to be treated as a whole than the many edges between the individual stones. The external boundary of the pile has better continuation (less drastic curvature) than the many intersecting boundaries of the component rocks. With only a few rocks, the smoothness of the external boundary of the group is similar to the curvature about a single stone, yet with many rocks, the relative smoothness of continuation between the external boundary and the internal boundaries changes in favor of the external boundary.

The relative smoothness of continuation between external and internal boundaries will not be tested because doing so would be impossible without a sophisticated computer program. However, since the smoothness of continuation parameter is inextricably linked to number for most, if not all, naturally occurring particulate masses, we will have to assume that any effects observed for number might also involve goodness of continuation.

4.1.5 Closure

For masses of particles, closure equates to the parameter of observable external boundaries discussed earlier. Without observable boundaries the material has no obvious closure and is therefore unlikely to be perceivable as an object/whole. Objects without observable boundaries are predicted to be interpreted as uncountable materials, substances or textures.

4.1.6 Pragnanz/"goodness", optimization and evolution

From an evolutionary perspective, the function of the senses has been to focus on features of the environment that made the "difference between the enhancement and the impediment of life" (Arnheim 1969:19). Pragnanz refers to the tendency for the visual system to arrive at the simplest, most regular and symmetrical interpretation of the incoming visual data. From an information processing point of view, the tendency to make pragnanz interpretations of visual data is analogous to (and likely to be the result of) 'optimization' [4] processes. Brains have a limited number of neurons arranged in networks that have limited processing capacity. In order to maximize the chances of survival, brains do not want to process more information than necessary. Optimization procedures allow computer neural nets and probably biological neural nets as well, to find simple global solutions given only complex local data.

Assuming that optimization/pragnanz is indeed the driving force behind perceptual constraints, we can also assume that the human visual system is likely to be hardwired to treat incomimg number and retinal size data in the simplest way possible without compromising survival. That is, if similar, maximally densely clustered items are numerous enough and small enough they will not be individuated, but, rather, 'lumped together', so as not to waste neural resources.

For the purposes of the present study, optimization/pragnanz is not a parameter to be measured but the underlying motivation for ignoring extraneous details in favor of a more useful 'big picture'. Nonetheless, the number of separate entities in a group and optimization/pragnanz are, no doubt, directly related, and any observable tendency to treat component parts as a whole is likely to be ultimately related to optimization/pragnanz.

4.2 Non-gestalt factors

4.2.1 Frequent or prototypical interaction patterns

Prototypical interaction with individual units or small numbers of units, rather than large numbers together, might lead to a count interpretation even when the units are numerous, tiny and densely grouped when stored. This might be the case with objects such as BBs (tiny round metal projectiles fired from an air gun), which are stored in bulk but are usually individually loaded into a BB gun. Similarly, the countability of marbles might be influenced by the fact that when playing with marbles, they are shot with the thumb one at a time (although their often distinct colors and sizes might also be involved). Also, the fact that candies are normally eaten one at a time might influence the point at which they become the uncountable term 'candy'. Prototypical interaction patterns could also influence the countability of seeds, that are often planted individually and even peas and beans, that can be picked or pushed from their pods one by one, although rapidly. Even the small numbers of oats that one sees in the spoon might have something to do with it's being countable while wheat is uncountable. Unfortunately, I know of no existing means with which to directly measure prototypical interaction patterns.

4.2.2 Standardized/regular configuration of components

The single file arrangement of peas and beans in a pod could influence countability judgements. Also, when viewing a dozen eggs arranged in a carton one might refer to them as 'a dozen eggs'. But if one sees a dozen eggs arranged randomly on a plate, or worse still in a bowl, and one is asked to name what one sees, one might say, 'eggs', 'some eggs', or 'a bunch of eggs'. In the above examples, 'eggs' maintains its plural ending, but it takes on the modifiers 'some' and 'a bunch of', which also co-occur with uncountable nouns. The effects of configuration on grouping and countability should be an interesting area of research, but not one that is appropriate for this study.

Configuration effects might be largely influenced by prior knowledge (Jackendoff 1983 : 47) and vary from culture to culture. For example, in some cultures groupings of a dozen are a type of standard, but in others they are not. Furthermore, regular configurations tend not to apply to naturally occurring uncountable nouns, such as 'sand' and 'gravel'.

4.2.3 Occlusion

Occlusion might influence countability. For example, tiles that do not occlude each other might be able to occur in greater numbers than tiles that do occlude each other before speakers refer to them as the uncountable 'tile'. Unfortunately, occlusion and density appear to be inextricably intertwined, which should make measuring their effects separately quite difficult. However, occlusion can and will be made constant while number and retinal size are varied.

5 Other considerations about the tests

5.1 Cross Linguistic Differences

Prototypicality of a given scene may vary from one speech community to another. If the prototype does not involve large numbers or the retinal size is large, then a plural term is more likely to be used than a count. For example, if a speech community does not often see large numbers of candies together, a speaker might always say candies instead of candy.

5.2 Controls

Density, distance, color, occlusion and configuration should be controlled. For example, when testing for number effects, a constant object size should be maintained for large and small numbers of objects of a given type; when testing for retinal size, the number of objects should remain constant while the size of objects of a given type vary. In both cases, a constant distance should be maintained between the subject and the pictures.

5.3 Inherent problems

Unfortunately, some parameters, such as number, occlusion and configuration are sometimes inherently in opposition. For example, naturally configured objects, such as fish, in very small numbers might not occlude each other, but in large numbers they would. Lack of occlusion should work in favor of countability and the presence of occlusion should work against it. However, arranging the fish so that they do not occlude each other imposes an unnatural configuration that might influence the informants' judgements. Therefore, for the various objects, I will attempt to photograph the objects in a natural or normal configuration. Thus, pebbles should be on the ground; the fish should be in a tray like at a fish stand, etc. This may, however, yield slightly different results for different object types. For example, the non-occlusion of the spines of books on a shelf may yield a higher threshold of countability for the books than for a jumble of little fish.

5.3.1 Photographs

Because subjects' viewing two-dimensional photographs of objects is not the same as viewing objects in the real world, it would be preferable to have subjects' looking at real objects in their natural environment. This, however, is practically impossible. Nonetheless, results based on photographs should still be a useful indicator of how external boundaries, number and retinal size influence countability in general.

5.4 Expected results

It is expected that there will be a cross-linguistic tendency for linguistic effects to group around certain numbers and/or retinal sizes. For example, it may turn out to be the case that there is a cross-linguistic tendency to state the number of pebbles up to 7 plus-or-minus 2. Above that, the tendency might be to just say the equivalent of 'pebbles', and at an even greater number, there might be some other change, such as the English use of 'gravel'. As for retinal size, similar components above a certain size, perhaps 8-10 degrees of visual angle (about the size of one's fist at arm's length) might always be countable. For example, silicate units above a certain size, such as large stones and boulders, are never treated as uncountable in English. Moreover, the uncountable noun 'gravel' is likely to be interpreted as the countable noun 'stones', when retinal size is increased by reducing the distance between the eyes and the stones.

6. Tests

6.1 Test one

Purpose : This test aims to establish the effect of visible external boundaries on countability cross-linguistically.

Subjects : Native speakers of at least 5 different languages

Test Design : The experimenter will explain to prospective subjects that the test involves two steps :

1. Looking at 15 pictures and recording the name of what they see on a tape-recorder.
2. Going over the tape with the experimenter to make an interlinear transcription.

Before the experiment begins, the proctor will say the following :

"I am going to show you some pictures. When you see a new picture, please say what you see in your native language. Please do not hesitate or think about your response; just look and speak."

The pictures to be shown are represented below:

	unbounded	bounded	partly bounded
1	wood	a board	part of a board
2	carpeting	a carpet	some carpeting
3	sand	some sand	some sand
4	gravel	some gravel	some gravel
5	glass	a glass	part of a glass

6.2 Test two [5]

Purpose : The aim of this test is to bring to light cross-linguistic effects that are associated with number.

Subjects : Native speakers of at least 5 different languages

Test Design: The experimenter will explain to prospective subjects that the experiment involves two steps :

1. Looking at 60 pictures and recording the name of what they see on a tape-recorder.
2. Going over the tape with the experimenter to make an interlinear transcription.

Before the experiment begins, the proctor will say the following:

"I am going to show you some pictures. When you see a new picture, please say what you see in your native language. Please do not hesitate or think about your response; just look and speak."

The objects in the pictures will increase according to a logarithmic scale. The following graphic shows the type of object and the number of objects to appear in each picture.

	pebbles	candy	marbles	books	fish	sand grains
1						
2						
4						
8						
16						
32						
64						
128						
256						
512						

6.3 Test three

Purpose : The aim of this test is to bring to light cross-linguistic effects that are associated with retinal size.

Subjects : Native speakers of at least 5 different languages

Test Design: The experimenter will explain to prospective subjects that the experiment involves two steps :

1. Looking at 66 pictures and recording the name of what they see on a tape-recorder.
2. Going over the tape with the experimenter to make an interlinear transcription.

Before the experiment begins, the proctor will say the following :

"I am going to show you some pictures. When you see a new picture, please say what you see in your native language. Please do not hesitate or think about your response; just look and speak."

In this test numbers of objects will be held constant (except with boundless masses) and only retinal size will vary. This will involve photographs of boundless masses of very high number (e.g., sand), bounded masses of a constant number (a pile of sand) and collections of a constant number (e.g., 5 grains of sand) taken from different distances. The distances will correspond to normal human viewing conditions, such as on hands and knees, on knees only, sitting and looking at the ground, standing and looking at the ground at one's feet, standing and looking out 1 meter, 2 meters, 4 meters, 8 meters, 16 meters, 32 meters. The example below is for sand, but other materials, such as gravel, and bricks from a brick square or walk will also be used, if possible.

view point	boundless sand	bounded sand	4 grains	8 grains	16 grains	32 grains
all fours						
knees						
sitting						
standing looking straight down						
standing looking 1m. out						
standing looking 2m. out						
4 meters out						
8 meters out						
16 meters out						
32 meters out						
64 meters out						

7. The value of such a study

Quantitative results from this study of concrete nouns should contribute to the understanding of countability in general and its role in language and cognition. For example, let us consider the case of salient external boundaries. As mentioned in section 3.1, examples, such as "a lot of jungle still remains between our destination and us," might be explicable in terms of a lack of perceived boundaries for 'jungle'. Also,one will recall that in the physical domain, a close-up view of a board is predicted to only be identifiable as wood and a close-up view of a carpet is predicted to only be identifiable as carpeting. Analogously, in the more abstract domain of time, a lack of salient temporal boundaries might correspond to an event taking progressive vs. perfective aspect (Langacker 1991). Numerous other examples relating mass and count to other aspects of language can be found in Moltmann (1997).

Also, the role of number in determining the countability of physical nouns might provide a useful perspective for understanding the behavior of abstract nouns. For example, in the physical domain, large numbers are predicted to contribute to uncountability, as with 'stones' vs. 'gravel'. Similarly, it might be the case that a sufficient number of individual 'pieces of advice' lead to 'advice'. Large numbers might also be behind the fact that plurals and aggregate terms can be found in the same syntactic constructions, such as the partitive construction, which is generally obligatory for the quantification of masses. Consider 'a pound of butter', 'a herd of cows', 'hundreds of questions' (Channell 1994).

The small retinal size of individual members of adjoining objects might lead to a mass interpretation, as with 'rocks' vs. 'sand'. A similar phenomenon might be at work (together with number) when small similar actions combine to form iterative verbs, such as 'clap', 'cough', 'walk' 'breathe'. However, it is not just iterative verbs but probably most action verbs (consider : 'dance', 'read' 'clean') that involve ignoring sub-actions in favor of the larger, named, action. (6)

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Notes

(1) 'Furniture', for example is not a basic level noun, but 'chair', 'table', and 'desk' are.

(2) For liquids, gases and the like, of course, the component parts are too small to be perceived with the naked eye.

(3) The components of the milky way are physically far apart but perceived as a gas-like mass.

(4) Optimization is "Finding the best solution to a problem bounded by a number of constraints [...]. Solutions can be found by relaxation of a suitable network such as the Boltzmannmachine to a global energy minimum." (Chuchland and Sejnowski 1992 : 470).

(5) I would like to thank Stephen Palmer of the University of California at Berkeley for suggesting this test design.

(6) However, a lack of distinct temporal boundaries might also be involved in the lumping together of the small actions that are involved in larger motions.