On object denoting nouns: defining atoms

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Abstract

The nature of atoms (units of counting) is a matter of debate in current theories of the count/mass distinction. Are atoms required to be whole objects (natural atoms), or can they be proper parts of objects? For some authors, proper material parts of atoms are not in the extension of count nouns (cf. Link 1983, Chierchia 1998, 2010); for others, atoms can be contextually defined (Rothstein 2010). In this paper I argue in favor of a strong dissociation between natural and semantic atomicity. Based on results from language acquisition studies, I intend to show that contextually salient parts of discrete individuals can be treated as atoms of purposes of counting.

1. Introduction

In classical theories of countability, the minimal elements in the extension of count nouns are atoms, and the material parts of these atoms are not themselves part of the extension of the nouns (cf. Link 1983, Chierchia 1998, 2010). According to these theories, grammatical atomicity (what counts as an atom for purposes of counting in a language) is strongly associated with natural atomicity (what constitutes an individual of the kind described by a noun). Against this view, Rothstein (2010) argues that natural atomicity is neither required nor necessary for grammatical counting. Rothstein (2010) argues that atoms can be contextually defined. That is, count nouns like *fence*, *wall* and *bouquet* denote "different sets of atoms depending on the context of interpretation". For example, what counts as a wall-atom in a particular context (the four wall-sides of a castle that we can consider to be 'a wall') might not count as a wall-atom in a different context (the north wall of a castle, which we can also name as 'a wall'). Empirical facts across languages provide ample evidence that discrete individuals are not necessarily countable (e.g. object mass nouns such as *furniture* in English) and that nouns that denote substances are not necessarily uncountable (cf. Mathieu 2012, Lima 2014). Such evidence suggests a strong dissociation between natural and semantic atomicity. In the context of this debate, the question we address in this paper is whether the conceptual content of a noun and natural atomicity bias how units of individuation are determined. More specifically, we investigate whether contextually salient parts of discrete individuals can be treated as atoms for purposes of counting.

2. Acquisition of countability

The question whether the conceptual content of a noun affects how atoms are determined in grammar is relevant both to formal semantics and to developmental psychology. A series of studies in developmental psychology suggests that although the lexical content of nouns plays a role in the identification of atoms in their extensions (Carey, 2009; Macnamara, 1986; Xu, 2007), natural atomicity is not required for grammatical counting. Acquisition studies suggest that until 7 years of age children count parts of individuals of a certain kind (e.g. pieces of forks) as if they were themselves individuals of that kind (e.g. individual forks; cf. Shipley and Shepperson 1990). Srinivasan et al. (2013) replicate these results and in addition have shown that children cease to treat parts of individuals as whole individuals once they recognize that (pseudo)partitive constructions (e.g. "piece of") and measure phrases are more informative descriptions for parts of objects.

3. Proposal

First (H1), we argue that a proper semantic analysis of aforementioned acquisition facts require the adoption of a theory of countability in which not only natural atoms but also their material parts belong to the extension of count nouns. To illustrate, we need a theory where a whole banana and a piece of a banana belong to the extension of the noun "banana". That is, a theory where we can contextually define atoms as in Rothstein 2010. Secondly (H2), we argue in favor of a blocking mechanism that prevents speakers from referring to parts of individuals using an unmodified count noun when pseudopartitive constructions or measure phrases are available to do so. Crucially, this mechanism only applies to count nouns that have natural atoms in their extensions, i.e. nouns for which atoms are stable across contexts. For these nouns, the adoption

of a blocking mechanism makes utterances with count nouns more informative, since allows speakers to distinguish reference to natural atoms from reference to their parts. For nouns that have no natural atoms in their extension (e.g. *fence*) blocking does not increase informativity and therefore does not apply. Evidence for this mechanism comes from experimental studies with speakers of Yudja, a Tupi language spoken in Brazil that has no (pseudo)partitive constructions and measure phrases (Lima, Li and Snedeker 2015). Yudja children are raised as monolinguals and start to learn Brazilian Portuguese around 6 years of age.

4. Experiments

4.1. Participants

In both studies, a total of 9, 5-to-6-year-olds, 6, 7-to-8-year-olds, 6, 9-year- olds, and 4, 10-year- olds participated in this study. We also had a control group of 19 adults.

4.2. Experiment 1

Participants were asked to act as "language teachers" by judging whether a non- native speaker appropriately described pictures with sentences of Yudja. The descriptions were of the form Number+Noun (e.g., "three banana"), while pictures depicted either 1) whole objects (3 bananas) **(1)**, 2) separate cut pieces (3 pieces of banana) **(2)**, or 3) groups of individuals (3 groups of 2 bananas) **(3):**

(1-3) Examples of materials: Experiment 1
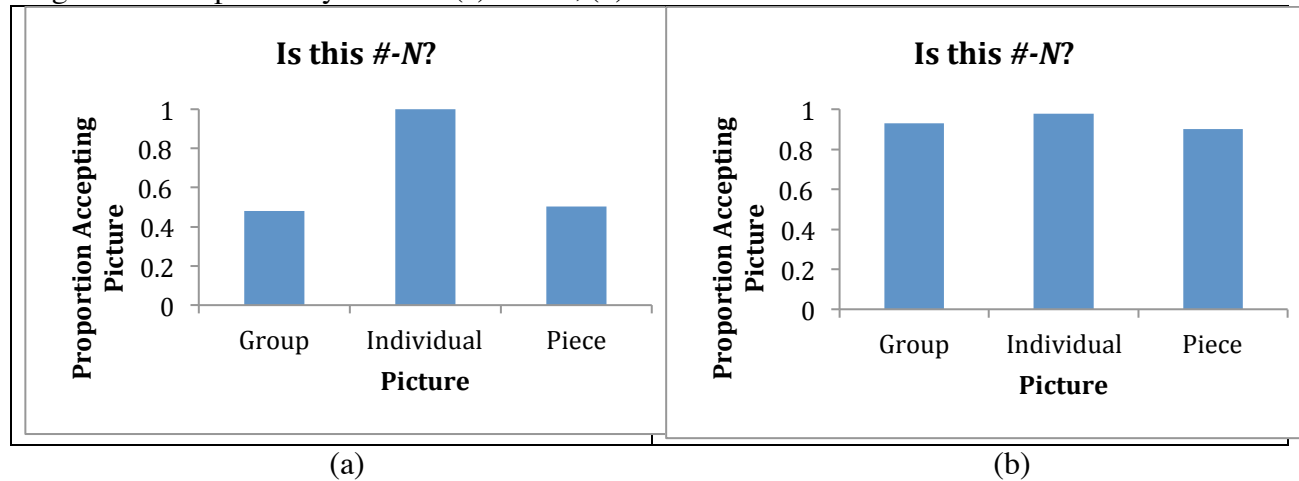

    (1)   (2)   (3)

If nouns provided individuation criteria that would restrict reference to natural atoms, speakers should only accept these descriptions for (1). However many adults also accepted these descriptions for (2) and (3), and children consistently did so.

Figure 1. Acceptance by Picture. (a) adults, (b) children.


(a) (b)

The high acceptance rate is consistent with the claim that without productive (pseudo)partitives, speakers are more likely to accept pieces or groups as valid units. The justifications that adults provided indicate that their lower rate of acceptance (in comparison with children) was motivated by the availability of alternative descriptions (non-partitive, such as: *Pakua txabïu lakïrï yahã* Lit: 'a banana broken in three [parts]' where a partitive word is not included). These results were corroborated by a follow-up study where the participants had to count how many objects were presented in a picture: 73% of children counted parts as wholes (e.g., counted a banana cut in three pieces as three bananas) while 58% of adults did the same.

4.3. Experiment 2

Experiment 2 confirmed that Yudja lacks productive (pseudo)partitives using a picture choice task. Participants heard either bare nouns (control), or N *itxukï* 'granulated' (control); or a noun followed by one of two candidate-partitives (N *atxa* 'round'; N *akuata* 'long') (critical items). These morphemes appear in a handful of lexicalized nouns (e.g., *Epa* = 'tree' and *Kania* ='animal', while *Epa akuata* = 'wood (long piece)' and *kania atxa* ='meat (round piece)') and are the best candidates for (pseudo)partitives in the language.

(4) Examples of materials: Experiment 2
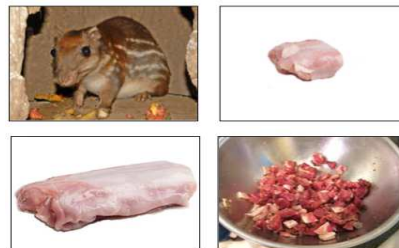
They were combined with familiar nouns (e.g., paca, potato) to form unattested combinations. After the participants heard the nouns, they were asked to identify its referents from among 4 photos of an object in different states: whole; round pieces; long pieces; granulated. Adults and children preferred the whole object for bare nouns, suggesting that they identify whole individuals in the nouns' extensions, notwithstanding the results of experiment 1. Crucially, when participants heard the combination of a noun with a candidate-partitive (*atxa* or

akuata), they did not systematically select the picture that matched the content of the candidate, corroborating previous data obtained in elicitation tasks that suggest that these morphemes are not productive (pseudo)partitive phrases. In sum, the results of experiments 1 and 2 supports our hypotheses (H1) and (H2).

Figure 2. Proportion of choices by picture type. (a) adults, (b) children.

| (a) | (b) |
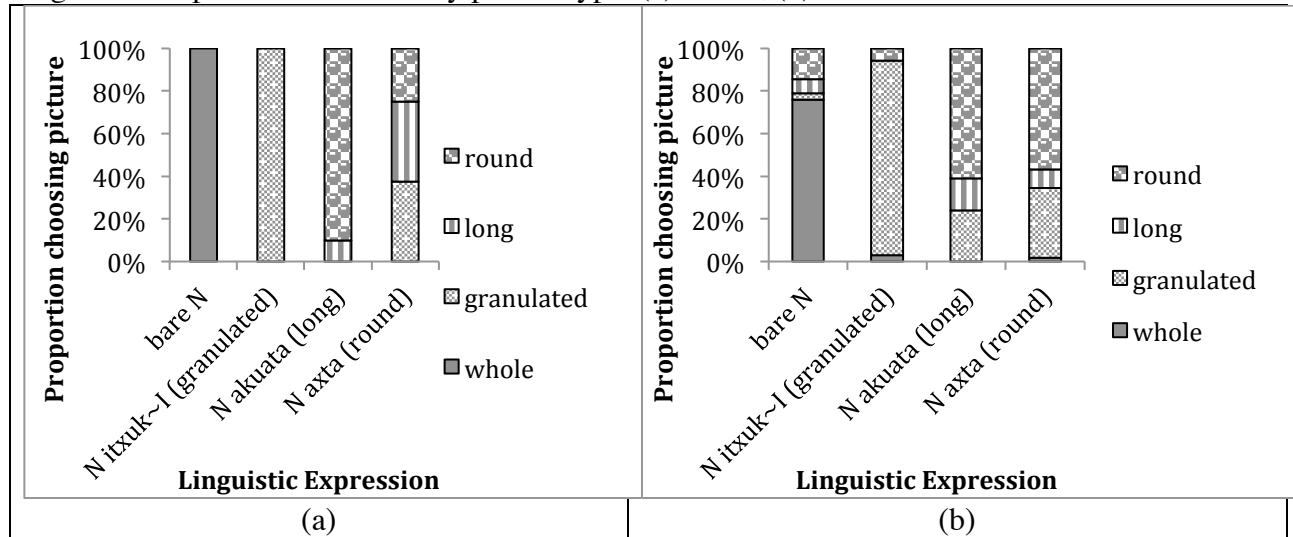
5. Analysis

We propose that any noun in Yudja denotes a set of maximally strongly connected entities (Casati and Varzi 1999, Grimm 2012), closed under sum formation (since Yudja is number neutral, see Lima 2007). An entity x is an atomic portion of a kind k in a world w only if x is a maximal self-connected part of $k(w)$. This analysis predicts that parts of a kind can be treated as atoms as long as they do not overlap with other parts that are treated as different atoms. That is, the extension of nouns that describe substances such as *y'a* ('water') and the extension of nouns that describe objects such as *pakua* ('banana') is relative to a topic situation: it is defined as the closure under sum formation of the set of maximally strongly connected portions of the substance (e.g., portions of water of different types: bottles, puddles, drops, etc) or the object (whole bananas, parts of a banana, etc) *in that situation*. In that sense, natural atomicity is neither required nor necessary for counting: natural atomicity can bias what counts as an atom in the grammar, but we can grammatically count something that is not a natural atom. Thus, counting may rely on atoms that are contextually determined (with Rothstein 2010) and atoms are maximally strongly connected portions of kind.

6. Thoughts on cross-linguistic variation

We propose that the difference between languages like English and Yudja when it comes to the grammar of countability is not a difference in the denotation of nouns or their syntactic make-up, but rather a difference in the availability of a blocking mechanism (pseudopartives/measure/container phrases, which in turns depends on the availability of pseudopartitive constructions and measure phrases in these languages.