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Sortal concepts and pragmatic inference in children's early quantification of objects

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ABSTRACT

It is typically assumed that count nouns like *fork* act as logical sortals, specifying whether objects are countable units of a kind (e.g., that a whole fork counts as "one fork") or not (e.g., that a piece of a fork does not count as "one fork"). In four experiments, we provide evidence from linguistic and conceptual development that nouns do not specify units of quantification, but include both whole objects and their arbitrary parts in their denotations. We argue that, to restrict quantification to whole objects, nominal concepts are enriched pragmatically, via contrast with concepts denoted by alternative descriptions: a piece of a fork is not counted as "one fork" because it is "one piece of fork." Experiment 1 replicated previous findings that children count pieces of broken objects as whole objects (e.g., two pieces of fork as "two forks"), and showed that children also accept whole object labels as descriptions of object pieces (e.g., "two forks" to describe two pieces of fork). Experiment 2 showed that although children accept such descriptions in isolation, they prefer measure phrases (e.g., "two pieces of fork") when they are explicitly presented as alternatives. Experiment 3 found that children were better at excluding pieces from their counts of whole objects when measure phrases were primed prior to counting, making them accessible as alternatives to whole object labels. Finally, Experiment 4 taught children names for novel objects, and found that they do not count parts that are given unique labels or that have non-linguistic properties that suggest they are members of distinct object kinds (e.g., unique functions or physical affordances). Together, our results suggest that for children and adults alike, nominal concepts do not provide necessary

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and sufficient criteria for excluding parts from object kinds. To specify units of quantification – and do the work of sortals – concepts are contrasted with one another and enriched pragmatically.

1. Introduction

"Only a concept which isolates what falls under it in a definite manner, and which does not permit any arbitrary division of it into parts, can be a unit relative to a finite Number."

– Gottlob Frege, The Foundations of Arithmetic

What do children learn when they acquire the meanings of nouns? Typically, it is assumed that common count nouns like *dog*, *table*, and *kite* are logical sortals: they not only distinguish between different kinds of things, but they also encode criteria for judging whether an object is a countable unit of a kind (see Frege, 1884/1980; Geach, 1962; Quine, 1960; Strawson, 1959; Wiggins, 1967). For example, although a request to "count the things in the room" is too vague to satisfy, a request to count "the books" or even "the pages" provides a clear specification of what should be counted. Thus, by most accounts, nouns specify units of quantification, guiding not only counting, but also the use of quantifiers and number marking in natural language. In this paper, we question whether nouns act as sortals, and thus, the role they play in quantification. Based on data from the counting behavior of 3- to 7-year-old children, we argue that the conceptual content of nouns does not alone explain how units of quantification are specified. Instead, we suggest that, to identify individual units, language users supplement noun meanings with a simple form of conversational inference, rooted in the pragmatics of lexical contrast (Clark, 1987, 1990).

There is widespread recognition that nouns play a critical role in specifying units of quantification (for discussion, see Carey, 2009; Macnamara, 1986; Xu, 2007). This is because, in the absence of conceptual constraints, almost anything can be considered an individual unit. Humans count objects ranging from planets and stars to blood cells and molecules. Even substances, events, and abstract entities can be counted, so long as they are first individuated. Nouns are important because they appear to specify which of the many candidate individuals to consider when choosing units for quantification. This is true not just in the case of counting, but also when interpreting linguistic forms such as quantifiers, determiners, and number agreement.[1]

Despite a general consensus that nouns specify units of quantification, there is little agreement regarding how they might do so, and more generally, what form concepts take. Since Plato, discussions of concepts have begun with the intuition that they might be something like definitions, an idea sometimes called the "classical theory" of concepts (e.g., Carnap, 1932; Katz, 1972; Locke, 1690; see Clark (1973) for an example from developmental psychology). When we ask, in conversation, "What is a car?" we expect an answer that differentiates cars from all other things, and thus which provides necessary and sufficient conditions for reference. In simple cases, like *car*, the answer might include an appeal to an object's physical constitution (wheels, seats, a protective structure), its function (rapid transportation of multiple people along streets and highways), or its origin (an artifact made by humans, either by hand or by machine; see Bloom, 1996; see also Malt, in press). These criteria offer an account of how a word like *car* might be applied to cars (but not to motorcycles), and whether an individual is the "same car" over time. Further, and most relevant to this paper, they offer an account of what counts as one whole car – e.g., why half of a car cannot be counted as "one car". For example, if a car is an object that fulfills a particular function, and half a car fails to support this func-

[1] We should note that this conclusion has been largely overlooked by recent work on the approximate number system and "numerical perception", where it is often assumed that the representation of numerosity is automatic and pre-attentive, rather than a computation over conceptually restricted sets of individuals (e.g., Burr & Ross, 2008; Cantlon & Brannon, 2007; Dehaene, 1997).