



How ‘some garlic’ becomes ‘a garlic’ or ‘some onion’: Mass and count processing in aphasia



Nora Fieder^{a,*}, Lyndsey Nickels^{a,b}, Britta Biedermann^a, Wendy Best^c

^a ARC Centre of Excellence in Cognition and its Disorders (CCD), Department of Cognitive Science, Macquarie University, Sydney, Australia

^b NHMRC Centre of Excellence in Aphasia Rehabilitation, Department of Cognitive Science, Macquarie University, Sydney, Australia

^c Department of Human Communication Science, University College London, London, UK

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ABSTRACT

This paper informs our understanding of the representation and processing of mass and count nouns through an investigation of the underlying causes of mass/count specific impairments in two people with aphasia, DEH and GEC. The factors influencing the production of mass and count nouns and noun phrases was comprehensively assessed. The results showed that GEC's impairment affected mass noun naming, resulting in the production of semantic paraphasias and no responses. In contrast, DEH frequently substituted mass determiners with count determiners leading to ungrammatical noun phrases. In comparison to younger control group, a control group of older adults showed similar difficulties to DEH with mass noun phrases, although less severe, indicating effects of cognitive ageing on lexical and semantic processing. DEH and the elderly controls' results replicate and support previous findings regarding the lexical-syntactic representation of mass/count information. GEC's difficulties extend these findings by providing additional evidence for a semantic component in the representation of countability (e.g., a semantic feature/concept COUNTABLE for count nouns, UNCOUNTABLE for mass nouns) which contributes to mass and count noun selection. GEC's mass noun difficulties are suggested to result from weaker connection strength between noun lemmas and mass concepts compared to count concepts as a result of the overall lower frequency distribution of mass nouns.

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1. Introduction

Countability information is a type of lexical-syntactic information that can classify nouns into mass (e.g. garlic, water) or count (e.g. onion, ocean). In English, countability defines the appropriate determiner and whether nouns can be morphologically marked for number. Count nouns can be combined with quantifiers that denu-merate and therefore express their countability semantically, such as ‘a’ which stands for one, or ‘many’ and ‘few’ which refer to a larger or smaller number of multiple objects and with numerals, such as ‘two’ or ‘three’. Count nouns can also form a plural. In comparison, mass nouns cannot be pluralised nor be combined with numerals. Instead, they can only occur with quantifiers that do not denu-merate and hence refer to their quantity as a substance, such as ‘much’ and ‘little’. The only way to precisely express the amount of such a substance is by a unit of measurement (e.g., a loaf of bread, three kilos of butter).

For many nouns, the grammatical division into mass vs. count and hence the selection of appropriate mass/count determiners, has been argued to be derived from the noun's semantics (Middleton, 2008; Middleton et al., 2004; Wierzbicka, 1988; Wisniewski et al., 2003). Nouns that refer semantically to individual, countable objects with clear boundaries tend to be grammatically treated as count nouns. Nouns that refer to substances and aggregates with no clear boundaries are uncountable and therefore grammatically categorised as mass nouns. However, a multitude of exceptions exist which have an arbitrary relationship between semantics and grammar. These include, for example, aggregates that are count nouns, such as lentils and peas and mass nouns that represent entities, such as garlic, bacon and bread. Moreover, countability grammar can be flexibly used depending on the speaker's intention to refer to mass or count noun like attributes of an object. For example, mass nouns can be used with count noun grammar to emphasise variety or individuality of an object (e.g., The bakery displayed so many breads but I bought only one.) and count nouns can be used with mass noun grammar to emphasise a substance-like state of an object (e.g., The baby had banana all over its face.) (Wisniewski et al., 2003).

Most of the research on lexical-syntactic processing of nouns

* Corresponding author at: ARC Centre of Excellence in Cognition and its Disorders, Department of Cognitive Science, Macquarie University, Sydney, NSW 2109, Australia. Fax: +61 2 9850 6059.

E-mail address: nora.fieder@mq.edu.au (N. Fieder).

and noun phrases has focused on grammatical gender (Badecker et al., 1995; Biran and Friedmann, 2012; La Heij et al., 1998; Schriefers, 1993; Seyboth et al., 2011; Van Berkum 1997) and number (Baayen et al., 1996, 1997; Biedermann et al., 2012, 2013; Luzzatti et al., 2001; Sonnenstuhl and Huth, 2002; Schiller and Caramazza, 2002) while countability has received far less attention (Fieder et al., 2014a; Herbert and Best, 2010; Semenza et al., 1997, 2000). In this study, we focus on countability, as, despite the relative paucity of research it is an equally prevalent type of lexical-syntactic information which impacts the morphological and syntactic structure of many languages.

Processing of countability information has mostly been investigated in behavioural experiments with language unimpaired participants, such as the availability of lexical-syntactic mass/count information during a Tip-of-the Tongue (TOT) state, when a person has access to a word's semantic but not to its word form. For example, in English, Vigliocco et al. (1999) found evidence for the lexical-syntactic representation of mass/count information in participants in TOT states who retrieved lexical-syntactic mass/count information at a higher rate compared to when they were not in a TOT state.

Further evidence for both a syntactic and semantic mass/count distinction comes from electrophysiological (EEG) studies with English and Italian speaking participants. Differences related to grammatical processing were found in form of a left anterior negativity effect (LAN) (Chiarelli et al., 2011; Steinhauer et al., 2001) and a positivity effect in the central and posterior regions (P600) (Chiarelli et al., 2011). LAN differences have been accounted for by processing of different grammatical features for mass and count nouns, for example count nouns can be combined with the indefinite determiner 'a' but mass nouns cannot (Chiarelli et al., 2011; Steinhauer et al., 2001). Differences in brain activity combined with faster response times for grammaticality judgements for count than for mass noun sentences in syntactic violation tasks were also suggested to indicate that count nouns represent the grammatically unmarked (default) case which demands fewer cognitive resources in processing than mass nouns (Chiarelli et al., 2011; for a review of theories relating to markedness of mass and count nouns see also Fieder et al. (2014a, 2014b)).

Differences related to lexical-semantic processing were found in the N400 amplitude with a larger negativity effect for count compared to mass nouns (Chiarelli et al., 2011) and in patterns of early automatic (N150) activation with more widespread activation including the right hemisphere for mass compared to count nouns (El Yagoubi et al., 2006; Mondini et al., 2008). Furthermore, the word-class specific effects can be taken as support for mass and count nouns being organised and semantically and syntactically processed in different brain regions. Chiarelli et al. (2011) argued that different semantic processing mechanisms for mass and count nouns can be explained by differences in their structural arbitrariness. Concrete mass nouns (e.g., milk, honey) have an arbitrary structure (non-atomic) without defined boundaries, for example the combination of two portions of milk results in another entity of the same type 'milk'. In comparison, concrete count noun objects have a structure that is not arbitrary, but indivisible and atomic, for example the combination of two count noun objects of the same kind (e.g., one apple plus one apple) does result in two separate objects (e.g., two apples). Being structurally not arbitrary makes it possible to sort and count concrete count noun entities—a difference that could be reflected in the fact that their semantic processing areas are close to the ones that are used for counting and mathematical calculations (Hubbard et al., 2005).¹

There have been only four case studies to date that have investigated and/or reported on lexical, semantic and grammatical processing of mass and count nouns in people with aphasia (Fieder et al., 2014a; Herbert and Best, 2010; Semenza et al., 1997, 2000). It is likely that this reflects the fact that countability specific impairments are rare in aphasic individuals. For example, Semenza et al. (1997) tested thirteen aphasic individuals without finding anyone in the group, who showed a mass/count specific dissociation.

In the four reported case studies, three of the aphasic individuals showed a dissociation between mass and count nouns with mass noun grammar being more impaired than count noun grammar, while one individual suffered from difficulties with bare count nouns compared to mass nouns. In the following section, we briefly summarise the studies as their findings provide evidence for the grammatical specification of nouns for countability and their lexical-syntactic and lexical-semantic processing (for a more detailed description of the tasks used in these studies see Fieder et al. (2014a, 2014b)). Subsequently, we interpret these findings within an adaptation of Levelt et al. (1999) theory of language production.

Semenza et al. (1997) were the first to report a countability specific impairment in an aphasic individual: FA, an Italian speaking woman, showed difficulties restricted to mass noun grammar with pluralisation of mass nouns and substitutions of mass noun determiners by count noun determiners. FA's mass specific impairment was localised at the lexical-syntactic (lemma) level. A few years later, Semenza et al. (2000) reported a case, CN, who was worse at naming count nouns than mass nouns. To our knowledge this is the only case study that has reported a dissociation between mass and count nouns where singular count nouns were more impaired than mass nouns. Based on the absence of any countability specific difficulties in grammatical and semantic tasks, CN's count noun specific difficulties were suggested to be the result of impaired word form retrieval.

Like FA, MH (Herbert and Best, 2010), an English speaking woman, showed a dissociation in the production of mass and singular count noun phrases (although MH's difficulties *also* affected plural count noun determiners). Unlike FA, MH was also impaired in the production of bare mass nouns. However, her difficulties in producing bare mass nouns vanished when she was given mass noun determiners as cues. Herbert and Best proposed that MH's difficulties with mass nouns and their determiners could be either attributed to an impairment of specific determiners at the lexical-syntactic level or to an impairment of the links between lexical-syntactic attributes (e.g., attribute [mass]) and determiners.

Finally, Fieder et al. (2014a) investigated mass and count processing in the case of RAP, an Australian English speaking man with aphasia. A first series of tasks tested RAP's performance on processing single mass and count nouns in reading and repetition, written and spoken picture naming. He was further tested on production of mass and count noun phrases in reading and repetition and picture naming. In the picture naming task with noun phrases, RAP was presented with a picture and the beginning of a sentence (e.g., "I see _.") and was asked to complete the sentence with a noun phrase which included one of two possible determiners (e.g., count singular condition: 'a'; mass condition: 'some') and the picture name (e.g., 'a lion', 'some garlic'). The results revealed that RAP had greater difficulties naming pictures with mass noun phrases than count noun phrases but showed no difference between mass and count in the production of nouns in isolation (so called 'bare' nouns). In the picture naming tasks with noun phrases, RAP frequently substituted mass noun determiners² (e.g.,

¹ However, as Chiarelli et al. (2011) pointed out it is not possible to draw definitive conclusions on the spatial distribution of the semantic processes of mass and count nouns as the spatial resolution of the ERP technique is limited.

² The term 'mass noun determiner' is used when we refer to mass nouns and the determiners with which they can be combined with to form a grammatically correct noun phrase. The term 'count noun determiner' is used when we refer to count nouns and the determiners with which they can be combined with to form a

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