

Plural Morphology in Compounding is not Good Evidence to Support the Dual Mechanism model

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Abstract

The compounding phenomena is considered to be good evidence to support the dual mechanism model of morphological processing (Pinker & Prince, 1992). However evidence from initial neural net modeling has shown that a single route associative memory based account might provide an equally, if not more valid explanation of the treatment of plurals in compounds. Further neural net modeling and empirical work is proposed to test this single route account.

Key words: Psycholinguistics, compounding, neural net modeling, connectionism

Introduction

The Compounding phenomenon Psycholinguistic research has shown that compound words with irregular plural nouns in non-head position (e.g. mice-eater) are produced far more frequently than compound words with regular plural nouns in non-head position (e.g. *rats-eater) (Gordon, 1985).

The Dual Mechanism Model's Explanation of Compounding It has been argued (Marcus, Brinkmann, Clahsen, Weise & Pinker, 1995) that the compounding phenomenon provides good evidence for the dual mechanism model of morphological processing (Pinker & Prince, 1992). The dual mechanism model proposes that irregular nouns and their plurals are stored as memorised pairs of words in the mental lexicon (e.g. mouse-mice) but that regular plurals are produced by the addition of the [-s] morpheme to the regular stem at a post lexical stage (e.g. rat + s = rats). Compounds are created in the lexicon by joining two stems together to form one word. Thus as irregular plurals are stored in the lexicon they are available to form compound words but as only the singular stems of regular nouns are stored in the lexicon the regular plural is never available to form compounds.

A Single Route Associative Memory Based Explanation of Compounding An explanation of the compounding phenomenon based on the frequency of occurrence of items in the linguistic input has not been considered to date. However an explanation of this sort may explain the treatment of both regular and irregular plurals in compounds (Murphy, 2000). The hypothesis has been put forward that children do not include the high type frequency regular [-s] plural morpheme in the middle of compounds because they

will always have heard it, and almost all other inflectional morphemes in English for that matter (Chandler, 1993), at the end of words (van Valin, personal communication). Thus, regular plurals are excluded from compounds due to an overwhelming input pattern in which the regular plural morpheme [-s] never occurs in the middle of words. Conversely, irregular plurals may appear in compounds as their usage is not guided by such a dominant input pattern. Irregular plurals have a much lower type frequency and while some irregulars are phonologically similar e.g. mouse-mice/ louse-lice; tooth-teeth/foot-feet/ goose-geese; man-men /woman-women there is no one dominant phonological pattern occurring in one particular place in the structure of English morphology.

An associative memory-based account of inflectional morphology has been investigated by numerous connectionist models. While the earliest connectionist model of inflectional morphology (Rumelhart & McClelland, 1986) was criticised for misrepresenting the input set available to children, subsequent models have successfully simulated the putative dissociation between regular and irregular inflection for both verbal morphology (Daugherty & Seidenberg, 1994) and plural morphology (Plunkett & Juola, 1999) using a single learning mechanism and no explicit rules. Thus it is entirely possible that a single route connectionist model could also simulate the behavioral dissociation between the treatment of regular and irregular plurals in compounds. Furthermore, as well as being able to learn mappings from input to output, connectionist models have also been able to learn sequential mappings (Elman 1990). Thus it is envisaged that a single route associative memory system could learn that the inclusion or omission of the regular plural morpheme [-s] is influenced by where that [-s] morpheme occurs in a sequence of language input.

Thesis Research Summary

Study 1: The Letter [-s] as a Predictor of Word Endedness An experiment has been carried out to test any role that [s] (either the letter or the morpheme) might play in indicating word endedness in a stream of concatenated letters. A neural network was trained on a concatenated stream of 200 sentences of child directed speech taken from the CHILDES (Child Language Data Exchange System) corpora (MacWhinney & Snow, 1985). The study was based on Elman (1990) who trained a simple recurrent network to discover word boundaries from a concatenated stream of

letters. The network was required to predict the next letter it expected to occur given the letters it had seen previously. At the beginning of a word the error was high but as more letters were presented to the network the error decreased until it was at its lowest at the end of the word. It was hypothesised in that on a "next letter" prediction task of this kind, a neural network would learn that after the input [-s] there was a high probability that the next input would be a word ending marker i.e. that [-s] is a good predictor of word endedness.

The network's ability to learn that [-s] is a good predictor of word endedness was tested using 19 unseen words that ended in [-s] and 19 words that ended in other letters. The network was found to be more accurate (i.e. the error was lower) at predicting a word ending marker after an [-s] than after all other letters combined ($t = -2.08$, $df = 18$, $p = 0.05$). The network's ability to learn that [-s] is a good predictor of word endedness was further tested by comparing the output for 5 unseen words that ended in [-s] with the output for 6 sets of 5 unseen words that ended in either [-d], [-e], [-g], [-l] [-r] and [-t] respectively. The difference between the mean error rate for a word ending marker after an [-s] was significantly lower than that recorded after [-l] ($t = 5.63$, $df = 4$, $p < 0.01$) and [-r] ($t = 4.30$, $df = 4$, $p = 0.01$). However, while the mean error on predicting a word ending marker after [-s] was also lower than the error rate for a word ending marker after [-d], [-e], [-g] and [-t] this difference was not significant.

As this model was intended to be a preliminary investigation of how the distribution of [-s] might influence its usage in compounds we can only draw tentative conclusions. However, it does seem that the presence of [-s] in the input is strongly associated with word endedness.

Study 2: Nouns never follow the plural [-s] morpheme

Frequency counts of child directed speech taken from the Wells corpus (1981), have shown that not only does the plural [-s] morpheme never occur in the middle of words it is also never followed by another noun. Thus further neural network modeling is planned in which it is hypothesised that on a syntactic class prediction task (Elman, 1990) that after the plural [-s] morpheme the error on predicting a noun will be much higher than the error on predicting any other syntactic class.

Further Neural net modeling In subsequent modeling the role that the possessive [-'s] morpheme may play in combination with the plural [-s] morpheme in predicting the next syntactic class will also be investigated. Several versions of the model are planned in which phonetic and semantic coding will be adopted.

Empirical Work Two empirical studies will also be carried out. The first study has examined whether presentation and response modality affect the rate at which plurals are included in compounds. The second empirical study will

consider how word recognition might be impaired by the presence of inflectional morphology in the middle of words, as this is such an infrequent pattern in English.

Summary It is envisaged that it will be possible to show that a single route associative memory system can master the compounding phenomena. This will be achieved by demonstrating that the putative dissociation between regular and irregular plurals in compounds is due to learning that the regular plural [-s] morpheme is never present in the middle of a word and is never followed by a noun. If this is achieved, then an account, such as the dual mechanism model, which relies upon multiple forms of representation and learning mechanisms, is unwarranted.

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