

Is there Decomposition?

MARLENE M. SPETH
University of Erlangen-Nuremberg
marlene.speth@exeter.oxon.org

ABSTRACT. The complexity of the mental lexicon is explored here in the context of the processing of words. The analysis of morphologically complex words shows that in the past there have been two mutually exclusive ways of treating irregular inflected forms, derived forms and regular forms. However, in some cases differing mechanisms may also be mutually supportive.

1 Two rather contrasting theories

Many studies deal with morphologically complex words and how they are recognized and processed. Words like happiness can be broken down¹ into the morphemes *happy* and *-ness* and one may wonder whether the stem and the affix are recognized separately or rather represented in the same way as other simple words with no internal syntactic structure.

An approach to the problem of recognition might be to examine if the stem of one form primes a related form. David Caplan makes the point in *Language: Structure, processing and disorders* that “If so, researchers argue, processing of the second form must be affected by its morphologically defined components, consistent with the decomposition model. Several results indicate that suffixed words prime their stem and other suffixed words” (Caplan: 230). Stanners et al.² (1979) conducted an experiment and found that priming effects for irregularly inflected words were less strong than for regular words. However, others (Fowler, Napps, and Feldmann 1985) did not find a difference in priming effects of inflectionally and derivationally related words. Thus, it is less clear that there is decomposition when it comes to derived and irregularly inflected words rather than regularly inflected words.

First of all, one must consider more closely what exactly may be understood by ‘regularity’. Subsequently, the two mutually exclusive approaches to irregularity and regularity and decomposition or whole word storage respectively will be analysed. Ullman’s *modus operandi* is considered at the end as it seems to bring together the two supposedly opposing points of view.

¹ The breaking down of a word in its stem and affix is also called affix stripping.

² However, Stanners et al. (1979) do not take one or the other side but speak for a theory which incorporates more than one single accessing mechanism (cf. 1979:412).

2 What is ‘regular’?

What all languages have in common is morphemes and conventions of how to assemble them in significant combinations. These combinations could be in form of phrases, sentences, compounds or complex words. In the following it is dealt with the latter. Words may accept affixes, be modified for tense, number, person and much more. In all languages there are rules but also exceptions: the irregular forms. In English, irregular forms tend to be those words which are used more frequently than others and it is the plural and past tense where regular and irregular forms occur. In contrast, the progressive is entirely regular. By regular and irregular forms one may think of the pattern which a majority of words follow in a language. It is here where the debate already begins. The connectionists, when speaking of regularity, understand it in the sense of the most frequent word and go with numbers. Rumelhart and McClelland (1986) came up with a connectionist pattern associator network which suggests that inflection is not computed by rules but instead by a network. This might consist of two connected layers of neuron-like units. These units accord with phonological information in the stem and past tense form (cf. Marcus et al. 1995: 3).

Nevertheless, it can be understood in a different sense, as Pinker mentions in *Word and Rules*: “‘Regular’ here refers to a rule that speakers treat as the *default*: an inflectional pattern they can apply to any word in a category, even if the word has never been stored with that pattern, or with any pattern, in memory. According to this theory, a regular pattern could, in principle, apply to a minority of words in a language, with the majority having to be learned one by one” (Pinker: 214). Hence, regularity may not be a fact about language users but rather about the language.

Irregularities and subregularities in morphological forms are not productive and thus the question arises whether these forms are dealt with in the same way as productive regular morphological forms in the mental lexicon.

To begin with, one may wish to examine the English past tense and its implementation in the brain. The past-tense is used as it is a simple and frequent inflection and used in different languages. Regular and irregular forms may be examined for complexity and meaning and thus seem to provide an excellent basis in order to analyse the interaction between storage and computation in cognitive processes.

Thereafter we must look more closely at the German language and whether there are priming differences between regularly and irregularly inflected words.

3 Dual Mechanism Approach

The basic debate is about how complex words are learnt, represented and computed. The two positions which seem to be mutually exclusive are that

complex forms are decomposed³ into their morphemes (and subsequently put together from those parts) by a grammatical system based on rules. This system is different from the mental lexicon. On the other hand, the view is held that there is no difference in storage of complex forms to simple lexicalised forms. According to this so called single-mechanism hypothesis all forms are dealt with in the same way that is learnt and processed by the same neurocognitive mechanism (*cf.* Ullman 2009: 276).

Steven Pinker and Michael Ullman argue in 'The past and future of the past tense' that regular and irregular forms are dealt with differently when it comes to the question of lexical storage. They claim that regular past-tense forms have signatures of grammatical processing and differ to irregulars which have psychological, linguistic and neuropsychological signatures of lexical memory. The latter are stored in the lexicon whereas regular forms are based on rules.

Evidence for dissociations between regulars and irregulars seems to be found when comparing patients with temporal-lobe and frontal/basal ganglia damage. Patients with the latter diagnostic seem to display greater difficulties in producing, recognising and reading regular inflected word forms. Parkinson disease⁴ (PD), a neurodegenerative disease, is marked with basal ganglia degeneration, and thus, patients show impairments when it comes to inflect regulars and not irregular words. Huntington Disease (HD) patients also suffer from a degeneration of different basal ganglia structures which lead to non suppressible movements. One suspects that these patients would also have the same problems with regular inflected words. Interestingly, they show another pattern and produce "extra suffixes for regular and novel words like *walkeded*, *plaggeded* and *dugged*, but not analogous errors on irregulars like *dugug* or *keptet*- suggesting that these errors are instances of unsuppressed regular suffixation"(Pinker and Ullman, 2002:461). Even though Pinker and Ullman have a point here, one has to be aware that *dugug* and *keptet* are not analogous errors as they call it but reduplications. Analogous suffixes of dug and kept would take the form of *duged* and *kepted*.

As previously stated patients with temporal-lobe lesions show contrasting impairments. The pattern is also found in patients with Alzheimer's disease (AD) or semantic dementia. These patients show the contrasting pattern to patients suffering from damage in the frontal cortex. Here, difficulties in producing, recognising and reading irregular inflected forms are found.

It is also perhaps noteworthy that impairments with irregular forms do not necessarily also lead to semantic deficits and the other way round: Semantic deficits do not have to lead to irregular impairments. This has been found by

³ The so called dual-system hypothesis

⁴ Joanisse and Seidenberg (1999) criticised in their paper 'Impairments in verb morphology after brain injury: A connectionist model' Ullman et al.'s (1999) approach. They object to the fact that the data drawn upon was only a subset of the AD and PD patients who were tested. The number of patients per group was small which made "it difficult to assess measurement error and effect reliability [...]. The number of items per condition was small, and 4 of the original 20 irregular items were excluded from the analyses post hoc" (Joanisse and Seidenberg 1999:7595).

studies by Miozzo (2003) and Tyler (2004). Miozzo highlights that an amonic patient had no problem in accessing word meanings but word forms and at the same time had difficulties with irregulars but not with regulars (*cf.* Ullman 2009:274). Subsequently, these findings contrast the assertions of the single mechanism model⁵.

English and German are both derived from Proto-Germanic and in both languages irregular verbs have higher frequencies of use than regulars. According to Steven Pinker, “among the thousand most common German verbs, the irregulars are used an average of 640 times in every million words, and the regulars are used an average of 77 times. (The comparable figures for English are 684 and 73)” (Pinker 1999:217). However, verbs of German and English differ in one way: in German the irregular verbs are more plentiful. Even though there are less irregular verbs in English than in German, in both languages regular inflection is confined to words which can be linked to roots in the mental lexicon (*cf.* Pinker: 1999:220). The default past tense for English is *-ed* and in German, the *-t* has to be seen as the default principle although it does not apply to a majority of verbs in the German language. Marcus *et al.* (1995)’s experiments support these findings: “The German participle *-t* applies to a much smaller percentage of verbs than its English counterpart, and the German plural *-s* applies to a small minority of nouns. But the affixes behave in the language like their English counterparts, as defaults” (Marcus *et al.* 1995: 190).

Steven Pinker goes against the connectionist view and claims that the English default *-s* and the German are the same in nature. The psychology of the German *-s* is the same; it is only the history of the German language that results in a difference. The frequent usage of the English *-s* as a default is the reason why most of today’s English verbs are regular⁶. According to Pinker, the German *-s* is used as a default for German noun plurals. Interestingly, there are new words, *i.e.* *Computer* where the plural form stays the same and there are other words like *Fusionierung* where the plural takes the form of *Fusionierungen*. It is perhaps noteworthy to ask whether the plural formed with *-en* here would be regular or irregular. Pinker would classify it as irregular, even though it may for others not appear to be so. The relevant point is that one could argue that not only the *-s* is productive for novel plural forms in German.

To sum up Pinker’s point it is probably best to draw upon a citation in his *Words and Rules* where he states that “Regular and irregular forms coexist but require different computational mechanisms: symbol combination for regular forms, associative memory for irregular forms. The same may be true for classical and family resemblance categories” (Pinker: 278).

⁵ The single mechanism model asserts that irregulars, due to their inconsistent phonological patterns, rely more on semantics than on phonology.

⁶ The connectionists would argue along the lines that because most English verbs are regular, English speakers use the regular suffix as the default.

Sonnenstuhl, Eisenbeiss and Clahsen (1999) take the theory of the dual structure of language one step further. They assume that the distinction between the lexical and computational system may give reason for the priming differences between regular and irregular inflection. The German inflection is used in order to look at the controversy between single and dual-mechanism models as the German inflection is “a case in point” (Sonnenstuhl, Eisenbeiss and Clahsen 1999:207). The prediction is made that irregular inflected forms do not show full priming as the irregular forms are stored separately from the base form whereas regular word forms might undergo full priming as the decomposition of these forms results in direct access to their stems. This hypothesis was confirmed by experiments. A clear priming difference was found between regular plurals and irregular plurals and participles. The latter two appear to access full-form entries in the mental lexicon and therefore cannot prime their base entry directly.

Hence, although it seems that across different types of languages the mind may consider regular and irregular distinctions brought forward by the dual-mechanism models of inflections, more research and experiments on a larger scale may be needed to explain these findings.

4 Single Mechanism

Notwithstanding, it is indispensable to give a more specific analysis of the contrasting position of the dual-mechanism model.

The single-mechanism hypotheses do not distinguish between storage and composition. It is posited that morphologically complex forms all rely on the same computational mechanisms. Hence, irregular and regular forms can be learnt, recognised and processed in the mental lexicon and “depend on closely interconnected networks that underlie phonological and semantic processing” (Ullmann 2009:274). Because irregulars exhibit inconsistent phonological patterns, the single-mechanism model suggests that irregulars therefore rely more on semantics than on phonology. Yet, regular verbs should still rely on phonology rather than on semantics what their computation is concerned. Marc Joanisse and Mark Seidenberg argue for a connectionist model and thus for an approach which uses a single system for all forms. The intention of this mechanism is to take account of the fact that regular and irregular forms are not categorically disparate as they share some structures. The authors make the point that there is overlap between most verbs and for almost all verbs regarding past tense forms. In addition, systematic correspondence between present and past tense forms of irregular and regular verbs⁷ are found and there are again subregularities⁸ among irregular verbs. The relevant point for their model is that a single network represents people’s knowledge of words and behavioural dissociations are explained with the nature of the network. Distinct phonological

⁷ Joanisse and Seidenberg (1999) take the example of *BAKE- BAKED* and *TAKE-TOOK* which are similar forms in that the onset and coda of the past tense is retained.

⁸ i.e. *sing-sang/ring-rang*

and semantic representations which show different realisations in the brain are accommodated within that one network (*cf.* Joanisse and Seidenberg 1999:7597).

5 Conclusion

At the beginning, the question was asked whether morphologically complex words are decomposed or fully stored in the mental lexicon. Having looked at different mechanisms of dealing with regular and irregular morphology, one suspects that there are only two mutually exclusive ways of treating irregular inflected and derived forms and regular forms. Michael Ullman makes the point in ‘The biocognition of the mental lexicon’ that even though redundancy might be costly it may also show certain advantages. One may argue that his comparison with thermal regulation⁹ in order to illustrate his point is not exactly correlated with the processing of morphological forms. However, he might be right when stating that “research rarely focuses on examining whether more than one mechanism can play the same functional role in language, or what factors within or across individuals may result in changes in the relative dependence on different systems serving the same function”(Ullman 2009:275). This is to say that the initial question cannot be answered by taking on one or the other position but rather, in some cases differing mechanisms may also be mutually supportive. It has been stated previously that regular inflected forms are computed by the compositional system. Notwithstanding, there is also evidence that in some cases, they are stored and processed in the mental lexicon showing traces of a single-mechanism. Equally, stored complex forms may be used more frequently by people who have better memories. Interestingly, sex differences also appear to play a role. Females who have an oestrogen-related advantage at remembering verbal material seem to draw more often on complex forms from memory and are less likely to use decomposition (*cf.* Ullman 2009:276). Hence, the mental lexicon shows redundant mechanisms and it must also be borne in mind that variation across individuals may occur. Thus, there is definitely potential for “new kingdoms of research” (Bachmann-Medick).

⁹ Ullmann states that „biological solutions for thermal regulations include fur, fat, size (larger animals lose heat more slowly), evaporation (a panting dog, a sweating athlete), various metabolic processes, and even anti-freeze molecules” (Ullmann 2009:275).

References

- Caplan, David (2006): *Language: Structure, Processing and Disorders*, The MIT Press: Cambridge, Massachusetts.
- Clahsen, H., I. Sonnenstuhl, J.P. Blevins (2003): Derivational morphology in the German mental lexicon: A Dual Mechanism account, in *Morphological structure in language processing* (eds.) H. Baayen & R. Schreuder, Mouton de Gruyter: Berlin, 125-155.
- Fowler, C.A., S. Napps, and L.B. Feldman (1985): Relations among regular and irregular morphologically related words in the lexicon as revealed by repetition priming, *Memory and Cognition*, 13, 241-255.
- Joanisse, M.F., and M.S. Seidenberg (1999): Impairments in verb morphology after brain injury: a connectionist model, *Proceedings of the National Academy of Sciences of the United States of America*, 96: 7592-7.
- Marcus, G.F., U. Brinkmann, H. Clahsen, R. Wiese, & S. Pinker (1995): German inflection: The exception that proves the rule, *Cognitive Psychology*, 29, 189-256.
- Miozzo, M. (2003): On the processing of regular and irregular forms of verbs and nouns: evidence from neuropsychology. *Cognition*, 87:2, 101-127.
- Pinker, S. and M. Ullman (2002): The past and future of the past tense, *TRENDS in Cognitive Sciences*, 6:11, 456-463.
- Pinker, S. (1999): *Words and rules: The ingredients of language*, New York: Basic Books.
- Rumelhart, D and J. McClelland (1986): On Learning the past tense of English verbs. Implicit rules or parallel distributed processing? In J. McClelland, D.Rumelhart, & the PDP Research Group (Eds.), *Parallel distributed processing: Explorations in the microstructure of cognition*, MIT Press: Cambridge, MA.

- Sonnenstuhl, I., S. Eisenbeiss and H. Clahsen (1999): Morphological Priming in the German mental Lexicon, *Cognition*, 72, 203-236.
- Stanners, R.F., J.J. Neiser, W.P. Herson, and R. Hall (1979): Memory representation for morphologically related words, *Journal of Verbal Learning and Verbal Behavior*, 18, 399-412.
- Ullman, M. (2009): The biocognition of the mental lexicon, in *The Oxford Handbook of Psycholinguistics* (ed.) Gareth Gaskell, Oxford: OUP.
- Ullman, M.T., S. Corkin, M. Coppola, G. Hicock, J.H. Growdon, W.J. Koroshetz & S. Pinker (1997): *J. Cognit. Neurosci.* 9, 266-276.
- Wasow, Thomas. Reviewed work: *Words and Rules: The Ingredients of Language* by Steven Pinker, *Language*, 77:1 (Mar., 2001), 168-171. published by: Linguistic Society of America.