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Claudia Lückert

Word class effect in online processing of proverbs: A reaction-time study

Abstract: Proverbs (as *Easy come, easy go*) are a type of conventionalized multiword unit that can be used as separate, complete statements in speech or writing (Mieder 2007; Steyer 2015). The rationale of this study is to examine word class effects in online processing of proverbs. In Lückert and Boland (submitted), we reported facilitative effects associated with proverb keywords which suggests that word-level properties are active alongside properties of the level of the multiword unit. Previous research has shown that individual word classes have different effects in online language processing. Numerous studies revealed that verbs are processed more slowly (Cordier et al. 2013) and involve greater processing demands compared to nouns (Macoir et al. 2019). The results of the present study suggest that verbs rather than nouns facilitate proverb processing. A distributional analysis of word classes in proverb corpora implies a trend to prefer verbs over nouns in American English proverbs.

Keywords: online processing of proverbs, word classes, word-level properties, corpus analysis, reaction-time experiment

1 Introduction: The differential processing of nouns and verbs

Proverbs (e.g., *A dog is man's best friend*, *Diamonds are forever*, or *Easy come, easy go*) are a type of conventionalized multiword unit that can be used as separate, complete statements in speech or writing (Mieder 2007; Steyer 2015). In everyday language, proverbs are typically used to comment on a situation, to give advice, and to share wisdom (Mieder 2007; Steyer 2015). In the past few decades, proverbs have increasingly been studied with empirical, quantitative methods in phraseological research (e.g., Čermák 2006; Chlosta and Grzybek 2005; Ďurčo 2005; Grzybek 2012; Lückert 2018b; Steyer 2015, Steyer 2017 etc.).

Claudia Lückert, Mergelberg 9, 48161 Münster, Germany, claurich@gmx.de

From a psycholinguistic perspective, proverbs are interesting because they are easily retrieved from memory despite being infrequent in actual use. The proverb *Beauty is only skin deep*, for example, has only 23 hits (.04 per mil) in *COCA* (*Corpus of Contemporary American English*, a general language corpus with some 575,823,672 words). 94.9% of participants in an elicitation test were, however, familiar with the proverb (Chlosta and Grzybek 2005). There is a discrepancy between the token frequency of proverbs in language use (Arnaud and Moon 1993; Grzybek 2012; Lückert 2018b; Moon 1998) and their familiarity: infrequent proverbs can still feel very familiar to language users (Arnaud and Moon 1993; Grzybek 2012; Lückert 2018b).

Previous psycholinguistic research on proverbs has focused on proverb interpretation and metaphorical mappings (e.g., Duthie et al. 2008; Ferretti et al. 2007; Gibbs and Beitel 1995; Honeck 1997). Studies on online processing of multiword units have mainly focused on idioms (e.g., Horvath and Siloni 2009; Sprenger et al. 2006) and binomial 'X and Y' expressions (e.g., Morgan and Levy 2016; Siyanova-Chanturia et al. 2011) rather than on proverbs. In Lückert and Boland (submitted), the processing of proverbs during lexical access (an early phase in comprehension and production) was examined. The focus was on frequency effects on the level of constituent words and the level of proverbs. The results of the study implied that word-level properties are active during processing of proverbs – the frequency of constituent words in the proverb context and in general language use influenced how participants performed in a self-paced reading paradigm and in recall tasks.

In the present article, it is examined whether word-level properties beyond the frequency dimension are involved in proverb processing. The effect of the syntactic categories of words – that is *word classes* (Haspelmath 2012: 110–111) – in proverbs shall be scrutinized. The proverb context is interesting because proverbs are used to express more or less complex messages succinctly and in an easily accessible and memorable way. Proverbs may thus benefit from constituent words that contribute a lot to the meaning of the multiword unit and that are quickly and reliably retrieved from memory. The rationale of the present paper is to identify which content word class(es) makes/make retrieval of the multiword unit easier and faster. It may be assumed that word classes that facilitate proverb processing have better chances of becoming part of lexicalized, entrenched structures. In the present study, corpus analysis and experimental data will be used to test this assumption.

Effects related to word class in online processing have attracted substantial interest in psycholinguistic research (e.g., Alario et al. 2002; Bultena et al. 2014; Sass et al. 2010; Shetreet et al. 2016; Sidhu et al. 2016). While many studies have examined single word processing of either nouns or verbs (e.g., Shetreet et al. 2016; Sidhu et al. 2016), some studies have explored the effect of phrase or sentence contexts (e.g., Bultena et al. 2014; Bürki et al. 2016; Meyer 1996; Sass et al. 2010; Schriefers 1992) or have focused on the differences between noun and verb processing (e.g., Bultena et al. 2014; Cordier et al. 2013; Macoir et al. 2019; Szekely et al. 2005; Vigliocco et al. 2011). In the present paper, the focus is on the effect of word classes in the processing of proverbs as a type of sentential context.

In Section 2, the current state of psycholinguistic research on word class effects will be discussed. Studies in the field agree that there are important differences in the processing of nouns and verbs (e.g., Macoir et al. 2019; Vigliocco et al. 2011) and that processing of nouns and verbs in single word processing differs from processing in sentential contexts (e.g., Bultena et al. 2014). Against the backdrop of the extant psycholinguistic research on word class effects, facilitative effects for nouns in proverb processing relative to other content word classes may be predicted.

In Section 3, findings on the distribution of the content word classes nouns, verbs, adjectives, and adverbs in *CAEP*, a specialized proverb corpus (*Corpus of American English Proverbs*; includes 28,159 word tokens [2,562 word types] across 4,164 proverb variants [2,191 proverb types]; see Lückert 2018b)[1] and in a historical proverb collection from the 16th century (John Heywood's collection, see Aurich 2012) will be reported. *CAEP* lists English-language proverbs found in modern American sources, databases etc. together with data on their frequency and familiarity. The distributional patterns of the four content word classes in the corpus will be examined so that we may learn which word classes are preferred in proverbs.

In Aurich (2012), historical corpus data has been analyzed that tracks the changes in English proverbs covering the Middle Ages and Early Modern times. In this study, I reported a trend towards increasing nominalization that was accompanied by an increasing use of proverb patterns/formulae (2012: 81). This finding from historical phraseology may also imply a facilitative effect for nouns in proverb processing.

1 The corpus and the data from the reaction-time study (response times etc.) are available at the data repository Miami in Münster (URN https://nbn-resolving.org/urn:nbn:de:hbz:6-14159451681; doi 10.17879/14159451387).

To assess the assumed processing benefit for nouns in proverbs, results of an experimental study will be reported in Section 4.[2] Generalized linear mixed-effects models were fitted for the data from a reaction-time study to examine whether word class association of constituent words in proverbs predicts dependent measures in experimental tasks (response times in milliseconds, accuracy rates, recall position, and recall counts).[3] In Section 5, the central findings of the present paper will be summarized.

2 Word class effects in psycholinguistic research

Word class effects have been examined in previous experimental research.[4] The focus of earlier studies was on the content word classes nouns and verbs in single word processing and in processing in phrase or sentence contexts respectively. Nouns and verbs are distinct in several regards relating to semantics and structure and these distinct properties result in processing differences (Bultena et al. 2014; Vigliocco et al. 2011). As a result of these processing differences nouns and verbs differ in the age of acquisition: it has been observed that nouns are typically learned earlier than verbs (Bultena et al. 2014; Gentner 1981).

A further difference between noun and verb processing has been reported: nouns are often associated with object naming/knowledge, verbs with action naming/knowledge (also Haspelmath 2012: 115). As a result, different brain areas are more strongly activated by nouns and verbs. While the visual cortex is activated in noun processing, the motor cortex is more strongly activated in verb processing (e.g., Bultena et al. 2014; Pulvermüller et al. 1999). Despite differences in activation levels in different brain areas reported in previous research, nouns and verbs are not assumed to be associated with specialized neural or cognitive systems. A shared neural network is assumed to underly the processing of words from different grammatical categories (Vigliocco et al. 2011: 422).

Nouns and verbs differ substantially in their semantics. While nouns, for example, can be concrete, more imageable etc., verbs are generally considered to be more abstract (e.g., Bultena et al. 2014; Federmeier et al. 2000). Nouns tend to

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2 The experimental data was collected for a project funded by the German Research Foundation (DFG): DFG LU 1942/2-1 (grant for 2015–2019).

3 The data set of this reaction-time study has previously been analyzed for frequency effects reported in Lückert and Boland (submitted).

4 For linguistic discussions of word class distinctions see, for example, Baker (2010), Croft (2000), and Haspelmath (2012).

have more specific meanings relative to verbs (Bultena et al. 2014; Gentner, 1981). In contrast to noun meaning, verb meaning often depends on actual contexts of use – it can often be identified only in the context of complete sentences (Bultena et al. 2014; Gentner, 1981). While nouns are hierarchically organized within a taxonomic structure that involves superordinate and subordinate links, verbs tend not to be hierarchically organized (Macoir et al. 2019).

Nouns and verbs also differ in their structural properties. Verbs are considered more complex than nouns: the representations of verbs include information on the number and kinds of arguments a verb can take (Bultena et al. 2014; Macoir et al. 2019). Recent research on verb processing has shown that lexical retrieval of verbs involves exhaustive activation of all its complementation options (Shetreet et al. 2016).

The differences in semantic and structural complexity of nouns and verbs result in processing differences. These show in processing speed and demands. Verbs are, for example, processed more slowly relative to nouns (e.g., Bultena et al. 2014: 1216; Cordier et al. 2013: 21). Verbs are also assumed to be more difficult than nouns (Macoir et al. 2019; Vigliocco et al. 2011: 422). Macoir and colleagues have reviewed research on verb and noun production in individuals with various neurological disorders including the non-fluent variant of primary progressive aphasia, the behavioral variant of frontotemporal dementia, and Parkinson disease (2019: 6). These studies report an impairment of verb production relative to noun production. Action naming was more difficult than object naming – this applied to both younger and older age groups.

The role of contexts has been discussed in research. Processing of nouns and verbs in sentence contexts differs from processing in single word processing tasks. Regarding verb processing, Bultena and colleagues reported that "verb cognate facilitation was not observed as a general effect across both tasks" and that "the presence of a sentence context did seem to reduce facilitatory processing of verb cognates" (2014: 1233). In a study on noun processing, Sass and colleagues found that associations facilitated naming in single word production – in sentence production, however, associations resulted in interference (2010: 447). Ambiguity has also been demonstrated to induce word class effects. Ambiguous words result in increased processing demands. EEG studies have, for example, shown that words that are ambiguous with respect to word class differ from unambiguous words in their processing (Federmeier et al. 2000; Vigliocco et al. 2011).

Summing up, nouns are typically acquired earlier than verbs in childhood (Bultena et al. 2014; Gentner 1981) and are less affected by neurological disorders – for example dementia (Macoir 2019). Numerous studies have found that verbs are processed more slowly (e.g., Cordier et al. 2013) and involve greater processing demands compared to nouns (e.g., Macoir et al. 2019).

3 Word class distribution in proverbs: Corpus results

Before the data from a reaction-time study is reported in Section 4 below, the distribution of the content word classes shall be examined in various (sub-)corpora to identify likely preferences for particular word classes. Firstly, the type and token frequencies of word classes in *CAEP* (*Corpus of American English Proverbs*; a specialized proverb corpus, see Lückert 2019b, https://nbn-resolving.org/urn:nbn:de:hbz:6-14159451681, also Lückert 2018b) will be reported. Secondly, the proportions of the word classes from the proverb corpus will be compared to the ratio in the spoken component of *COCA* (*Corpus of Contemporary American English*) to examine whether word class distribution in the proverb context is distinct from spoken language on a more general level. Lastly, the ratio in a historical proverb collection from the 16th century (John Heywood's collection, see Aurich 2012) will be considered to test whether the same word class(es) was/were preferred or to identify likely differences that may be linked with linguistic change.

Word classes are associated with various syntactic roles in sentences. Generally, all sentence types occur in proverbs (Mac Coinnigh 2015: 113–115):

(1) simple (e.g., *Misery loves company*)

(2) complex (e.g., *Be all that you can be*)

(3) compound (e.g., *It never rains but it pours*)

(4) compound-complex (e.g., *When the oak is before the ash, then you will only get a splash; when the ash is before the oak, then you may expect an oak*)

(5) nominal (e.g., *The more – the merrier*).

The content word categories – noun, verb, adjective, and adverb – perform various functions in these sentence types (cf. Baker 2010; Croft 2000; Haspelmath 2012). In view of sentence functions in proverbs, Mac Coinnigh observed that functions vary and that there seems to be "a clear preference for simple indicative statements over the majority of other forms in modern English-language proverbs" (2015: 130).

In the perception of language users, the four content word classes do not seem to have an equal impact on the overall meaning of phraseological units. Ďurčo (1994) used informant rating to examine how much individual constituents contribute to the overall phraseological meaning. In his study, nouns and verbs but also adjectives were regarded as key constituents. While the ratings for specific phraseological units differed across participants, there was usually a clear pattern. Phraseological comprehension processes may vary across individual language users (cf. Häcki Buhofer 2007: 845).

Nouns are the numerically strongest word class in the proverb corpus both by types and tokens. While the *type frequencies* of word classes in the subset of the most frequent and/or familiar proverbs from the proverb corpus ('x3', Lückert 2018b) relative to the whole proverb corpus do not differ significantly (Tab. 1), the *token frequencies* reveal significant differences (Tab. 2). By token frequencies, nouns and adverbs are significantly under-represented and verbs and adjectives are significantly over-represented in the 'x3' subset relative to the complete proverb corpus. This may imply a preference for verb and adjective constructions in current proverbs.

If we compare the 'x3' component of the proverb corpus (*CAEP*) to the spoken component of *COCA*, we find significant differences in the token frequencies of word classes (Tab. 3). Both nouns and verbs are under-represented in the proverb corpus. Adjectives and adverbs, however, are over-represented in *CAEP*. This may

Tab. 1: Type frequencies of word classes in proverb corpus (*CAEP*); comparison of 'x3' types (most frequent and/or familiar proverbs from *CAEP*; *N* = 247 proverbs) and types in complete proverb corpus (*N* = 4,164 proverbs); observed (OF) and expected (EF) frequencies were compared by log likelihood ratio test (LL) as goodness-of-fit test; odds ratio as effect size measure

	OF X3 Types	OF CAEP Types	EF X3 Types	EF CAEP Types	LL	LL+/–	*p* value (Df 1)	Odds Ratio
noun	207	1543	228.35	1521.65	2.36	LL–	$p < 0.1$	0.79
verb	93	536	82.08	546.92	1.61	LL+	$p < 0.1$	1.2
adj	73	490	73.46	489.54	0.003	LL–	$p < 0.1$	0.99
adv	55	283	44.10	293.90	2.90	LL+	$p > 0.1$	1.34
	428	2852						

Tab. 2: Token frequencies of word classes in proverb corpus (*CAEP*); comparison of 'x3' tokens (most frequent and/or familiar proverbs from *CAEP*; *N* = 247 proverbs) and tokens in complete proverb corpus (*N* = 4,164 proverbs); observed (OF) and expected (EF) frequencies were compared by log likelihood ratio test (LL) as goodness-of-fit test; odds ratio as effect size measure

	OF X3 Tokens	OF CAEP Tokens	EF X3 Tokens	EF CAEP Tokens	LL	LL+/–	*p* value (Df 1)	Odds Ratio
noun	2173	6037	2465.55	5744.45	50.83	LL–	$p < 0.001$	0.77
verb	2072	3823	1770.33	4124.67	71.33	LL+	$p < 0.001$	1.37
adj	1549	3384	1481.43	3451.57	4.37	LL+	$p < 0.05$	1.09
adv	1166	2972	1242.69	2895.31	6.85	LL–	$p < 0.01$	0.9
	6960	16216						

Tab. 3: Token frequencies of word classes in 'x3' component of proverb corpus (*CAEP*) relative to spoken component of *COCA* (*Corpus of Contemporary American English*); comparison of 'x3' tokens (most frequent and/or familiar proverbs from *CAEP*; $N = 247$ proverbs) and tokens in spoken component of *COCA*; observed (OF) and expected (EF) frequencies were compared by log likelihood ratio test (LL) as goodness-of-fit test; odds ratio as effect size measure

	OF X3 Tokens	OF COCA Spoken Tokens	EF X3 Tokens	EF COCA Spoken Tokens	LL	LL+/–	*p* value (Df 1)	Odds Ratio
noun	2173	19297498	2267.34	19297403.7	3.98	LL–	$p < 0.05$	0.94
verb	2072	24806129	2914.49	24805286.5	271.16	LL–	$p < 0.001$	0.59
adj	1549	6250438	734.49	6251252.5	682.78	LL+	$p < 0.001$	2.43
adv	1166	8882663	1043.68	8882785.3	13.81	LL+	$p < 0.001$	1.14
	6960	59236728						

be due to proverb patterns/formulae in which adjectives (e.g., *better* in *Better X than Y*; see Mac Coinnigh 2015: 117) and adverbs (e.g., *never* in *Never* Verb [e.g., *Never say never*]; Mac Coinnigh 2015: 120; Mieder 2012: 147) are used as structural elements.

Interestingly, the ratios of content word classes in the 'x3' subset of *CAEP* do not differ significantly from the ratios in the 16th-century Heywood proverb collection (Tab. 4). Nouns seem to be less frequent in the modern proverb corpus relative to the historical collection. Verbs, however, seem to have become more important. The proportions of adjectives and adverbs have remained very stable. A historical corpus-based study of English proverbs (Aurich 2012) reported a trend to nominalization and increasing use of proverb patterns/ formulae in proverbs found in medieval and early modern sources. While the corpus comparison (Tab. 4) does not reveal significant differences in the distribution of word classes, results may point to a weak trend towards the use of more verbal structures in modern English proverbs.

This assumed trend towards increasing use of verbs in English-language proverbs may go hand in hand with the trend towards "simple indicative statements" (Mac Coinnigh 2015: 130). Traditional proverb formulae that were associated with nominal structures (e.g. *Better X than Y* or *No X no Y*) are no longer prevalent (Mac Coinnigh 2015: 118; Mieder 2012). Mac Coinnigh (2015: 119–120) quotes the typical modern formulae from Mieder (2012: 144–147):

(6) A(n) / noun / verb ...
A diamond is forever.

(7) A(n) / adjective / noun / verb ...
A wise head is better than a pretty face.

Tab. 4: Token frequencies of word classes in 'x3' component of proverb corpus (*CAEP*) relative to Heywood Corpus (16th c., cf. Aurich 2012); comparison of 'x3' tokens (most frequent and/or familiar proverbs from *CAEP*; $N = 247$ proverbs) and tokens in Heywood Corpus ($N = 100$ proverbs); observed (OF) and expected (EF) frequencies were compared by log likelihood ratio test (LL) as goodness-of-fit test; odds ratio as effect size measure

	OF X3 Tokens	OF Heywood Tokens	EF X3 Tokens	EF Heywood Tokens	LL	LL+/–	*p* value (Df 1)	Odds Ratio
noun	2173	150	2194.07	128.93	3.47	LL–	$p < 0.1$	0.78
verb	2072	103	2054.28	120.72	2.89	LL+	$p < 0.1$	1.26
adj	1549	89	1547.09	90.91	0.04	LL+	$p > 0.1$	1.03
adv	1166	67	1164.57	68.43	0.03	LL+	$p > 0.1$	1.03
	6960	409						

(8) The / noun / verb ...
The world hates a quitter.

(9) You can't (cannot) / verb ...
You can't unscramble eggs.

(10) Don't (do not) / verb ...
Don't believe everything you think.

(11) Never / verb ...
Never work with children or animals.

These modern formulae rely heavily on verb structures (both copula constructions, e.g. in *A diamond is forever*, and full verbs, e.g. in *The world hates a quitter*). In sum, the corpus results point to the assumed preference for nouns in proverbs but also seem to indicate that verbs have increasingly become more important.

4 The role of word class in online processing of proverbs: Experimental data

Given the findings on noun and verb processing reviewed in Section 2, we may expect nouns to facilitate processing of proverbs. Results of a study will be reported that was run in the Boland Lab at the University of Michigan, Ann Arbor (USA) in February 2018 (the data including all stimuli are available at URN https://nbn-resolving.org/urn:nbn:de:hbz:6-14159451681; cf. Lückert 2019b). The data of 97 participants (mean age 19.65, sd .88) were analyzed. The experimental tasks included self-paced word-by-word reading, expected recognition, and free recall (see Tab. 5).[5] In Lückert and Boland (submitted), the focus was on frequency effects on word and proverb level in self-paced reading of proverbs.[6] By contrast, the role of word class in processing in all three tasks shall be reported in the present paper.

5 Participants were tested individually in a separate room. E-Prime software was used to present stimuli on a computer screen and log responses. For the reading tasks, participants were instructed to read at their own pace trying to read fast but attentively as there would be a subsequent recognition task. We used a moving-window script for proverb reading to present the sentence stimuli word by word. Participants saw a fixation cross for 500 ms followed by a row of dashes which indicated the length of the whole sentence. At each button press only one word of the sentence was uncovered at a time. Once 'Space' was pressed when the last word of the sentence was shown, the monitor stayed blank until 'Space' was pressed again. Then the whole procedure started anew (fixation cross etc.). Participants could thus pause between trials. For recognition, participants were instructed that they would view a list of words or proverbs on the computer screen and that they should identify items they recalled from the study list by pressing button 1 on the keyboard and new items which had not been presented before by pressing button 9. In the word-list task, participants first saw a fixation cross in the center of the screen for 1000 ms, then the stimulus was presented until participants pressed button 1 or 9 on the keyboard. Then a fixation cross would be shown again followed by a new word. In the proverb-list task, sentences were presented in their entirety. Participants saw a fixation cross for 1000 ms followed by the stimulus. For free recall, participants were asked to generate as many words and proverbs from previous tasks as possible without any explicit memory cue. Participants had between 5 to 15 minutes to type their answers into the computer (using E-Prime).

6 Proverbs were read faster than matched non-proverb phrases. In addition, keywords (content words that are strongly over-represented in proverbs) were read more quickly than other words in both existing proverbs and novel phrases. Both types of sentences that have a higher ratio of keywords were associated with shorter average reading times compared to sentences with a lower ratio of keywords. In the recall tasks (not reported in Lückert and Boland [submitted]), proverbs with many keywords were recognized more slowly and more accurately than proverbs with high proportions of other types of words (maybe as a result of competition). In free recall, proverbs with many keywords were cited more often and were mentioned earlier. These findings suggest a multi-level representation for proverbs in the lexicon (dual layer model, also Lückert 2018a, 2019a).

Tab. 5: Study design

1 Preparation Phase	demographic background, rating task (proverb familiarity/use/attitudes), proverb identification task (*N* = 97 subjects)	
2 Self-Paced Reading	**2a proverb list** (*N* = 60 stimuli) word-by-word reading, moving-window script	**2b word list** (*N* = 18 stimuli) word-by-word reading
3 Recognition	**3a proverb list** (*N* = 100 stimuli, 50 target items, 50 fillers)	**3b word list** (*N* = 36 stimuli, 18 target items, 18 fillers)
4 Free Recall	5–15 min written recall of all stimuli (words and proverbs, targets and fillers), non-recall counted as ‘0’ (*N* = 97 subjects)	

Note. All participants performed the proverb-list and word-list tasks. Block order was varied between subjects: Word-first group (*N* = 46 subjects); Proverb-first group (*N* = 51 subjects). Trials within each task were randomly ordered. A total of 75 existing proverbs and 35 novel proverb-like phrases were included.[7]

For data analysis, generalized linear mixed-effects models were fitted with the lmerTest package within the R environment for Statistical Computing (R Development Core Team, v. 3.5.1, 2018) for each dependent measure and experimental task with random intercepts for participants and items (and with random slopes by subject for Sentence Type [existing proverbs/novel phrases] unless this resulted in model over-specification). The binomial accuracy data were fitted with logit link function, the recall count data with Quasi-Poisson link function. The dependent measures included response times in milliseconds, accuracy rates, recall count, and recall position. For analysis, the focus was on the assumed word class effect and further variables that have been reported in previous research on word class effects (imageability, length, etc.). Frequency effects were largely excluded from analysis (these effects, in particular the keyword frequency effect, have been reported in Lückert and Boland [submitted]). Control variables that were not part of theoretically interesting interactions with word class were pruned by stepwise backwards elimination of insignificant factors.

7 The proverbs and matched novel phrases were controlled for multiple properties including, among others, frequency of multiword units and constituent words, length, metaphoricity, proverb patterns, word classes, etc. The novel phrases were included to have sentence stimuli with zero multiword frequency in the data set and to have stimuli for which only compositional processes are available (cf. Lückert and Boland submitted).

4.1 Word tasks

Individual proverb words were examined to compare the word class effect in single word processing to the effect in proverb processing. For the reading data of the word list, no mixed effects model was fitted because of the low number of stimuli in the task ($N = 18$). Results of the study/test list for proverb words, however, reveal an advantage for nouns relative to other content word classes in recognition and free recall: nouns were responded to significantly faster ($t(31.09)$ –2.211, $p = .035$; Fig. 1) and tended to be recalled more accurately ($z = 1.396$, $p = .163$; Fig. 2) in recognition; nouns were also often named earlier ($t(11.3) = -0.552$, $p = .591$; Fig. 4) in free recall. Nouns were, however, cited less often ($t = -2.769$, $p = .0058$; Fig. 3) relative to other content word classes in free recall.

4.2 Self-paced reading of proverbs

Word class significantly predicted response times in self-paced reading of proverbs. The mean reading-time latencies by word class for word positions 1 to 5 and for the conditions 'existing proverbs' and 'novel proverb-like phrases'

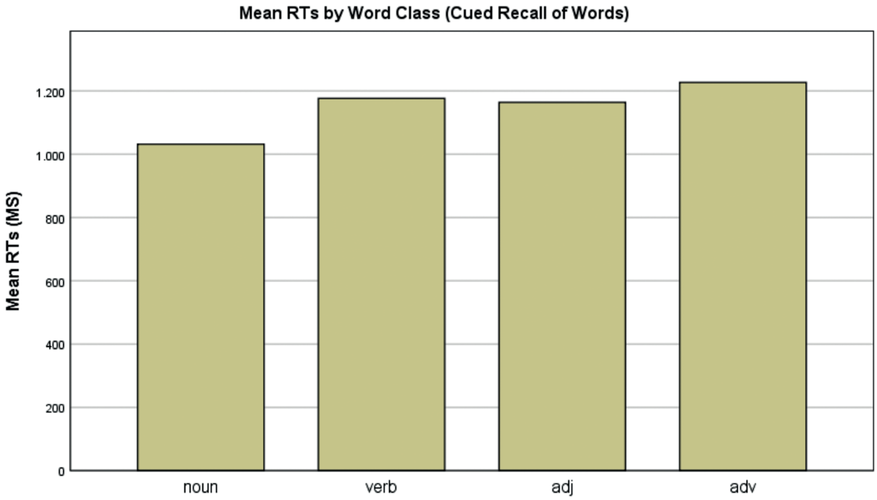

Fig. 1: Mean reaction-time latencies by word classes in cued recall of words (recognition). Both target words and fillers were included.

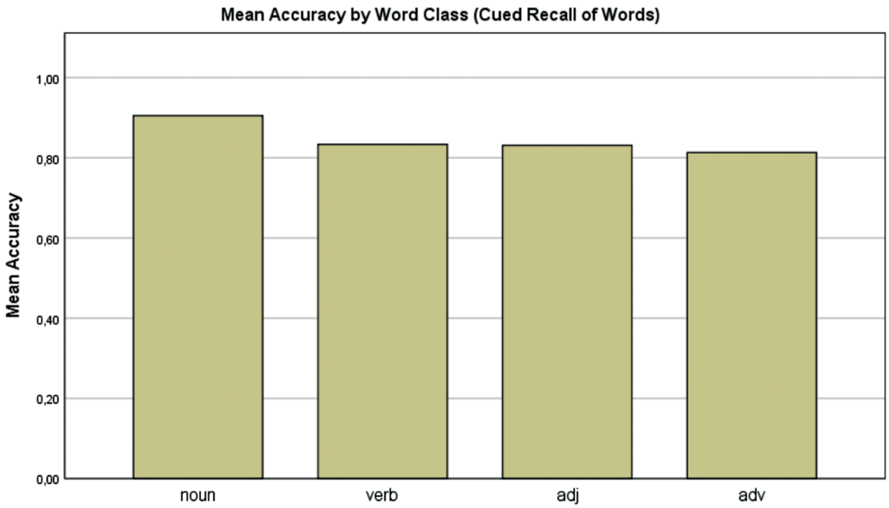

Fig. 2: Mean accuracy by word classes in cued recall of words (recognition). Both target words and fillers were included.

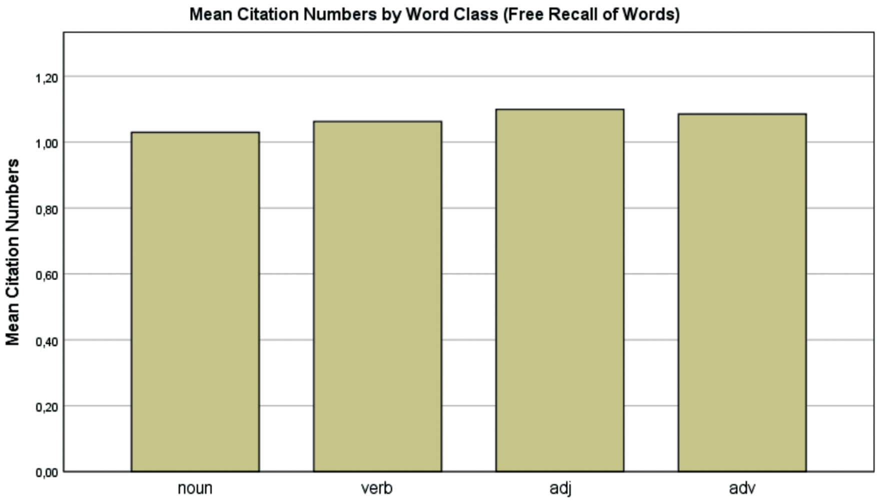

Fig. 3: Mean citation numbers (recall count) by word classes in free recall of words. Citation numbers are proportions of number of times a word was named. Non-recall was counted as '0'. The list of possible responses included target items and fillers. Higher values correlate with increased memorability.

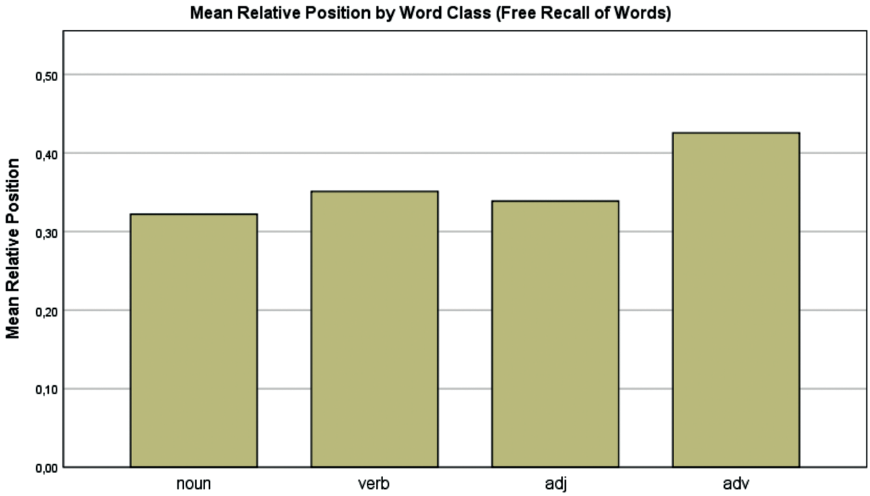

Fig. 4: Mean relative position (recall position) by word classes in free recall of words. Relative Position was measured on a scale where smaller values (closer to '0.00') are associated with earlier positions and values closer to '1.00' are associated with later positions. Lower values correlate with increased memorability.

(Sentence Type) in this task are summarized in Tab. 6. Word class is a categorical variable. For the mixed effects analysis, the results for individual word classes were therefore contrasted with adjectives (Tab. 7). In most word positions, nouns and adverbs were read more slowly, verbs were read as fast as adjectives (Figs. 5 and 6).[8]

Tab. 6: Mean reading-time latencies by word class in word positions 1 to 5 for existing proverbs and novel proverb-like phrases in self-paced word-by-word reading

	W1		W2		W3		W4		W5	
	exist. M (SD)	**novel M (SD)**	**exist. M (SD)**	**novel M (SD)**	**exist. M (SD)**	**novel M (SD)**	**exist. M (SD)**	**novel M (SD)**	**exist. M (SD)**	**novel M (SD)**
noun	659 (43.8)	632 (47.9)	592 (55.0)	615 (71.2)	591 (102.6)	660 (176.6)	589 (96.3)	620 (194.1)	748 (155.5)	1196 (85.4)
verb	596 (19.2)	609 (33.2)	537 (30.4)	562 (16.6)	579 (305.1)	666 (152.9)	578 (127.7)	573 (16.8)	534 (40.9)	889 (501.9)
adj	606 (34.3)	654 (114.6)	538 (21.1)	537 (21.4)	613 (161.9)	496 (13.4)	583 (117.5)	688 (229.5)	531 (144.3)	722 (326.4)
adv	595 (6.4)	623 (331.3)	549 (4.0)	573 (21.1)	643 (168.7)	590 (290.3)	530 (129.9)	642 (174.4)	464 (272.7)	823 (353.0)

8 Note that the directions of effect for word classes in Tab. 7 are counter-intuitive. This effect is related to the inclusion of interactions in the mixed model.

To test the relationship of higher or lower ratios of nouns or verbs in proverbs with response times, two identical models were fitted – one with noun density as factor, one with verb density (the two density variables are not completely independent of each other). While the proportion of nouns in a given proverb (Noun Density) did not influence latencies (Tab. 7), a higher ratio of verbs resulted in faster responses (Verb Density $t(58.3) = -1.876$, $p = .066$).

Tab. 7: Critical fixed effects from linear mixed model of word-by-word reading times in self-paced reading of proverbs (only word positions 1 to 5 were analyzed; Noun Density model)

	Estimate	Std.Error	Df	*t* value	*p* value
Adv	−6.972e+01	2.249e+01	1.450e+04	−3.100	0.00194 **
Noun	−1.580e+02	1.577e+01	1.637e+04	−10.016	< 2e-16 ***
Verb	−2.181e+01	1.954e+01	1.418e+04	−1.116	0.26437
Noun Density	3.147e+00	3.823e+01	5.984e+01	0.082	0.93466
Word Position: Adv	1.780e+01	6.361e+00	1.651e+04	2.799	0.00514 **
Word Position: Noun	6.688e+01	4.692e+00	1.644e+04	14.253	< 2e-16 ***
Word Position: Verb	2.491e+01	5.947e+00	1.380e+04	4.189	2.82e-05 ***
Sent. (novel): Adv	−6.979e-02	2.214e+01	1.078e+04	−0.003	0.99748
Sent. (novel): Noun	2.499e+01	1.356e+01	1.639e+04	1.843	0.06530
Sent. (novel): Verb	−4.071e+01	1.671e+01	1.442e+04	−2.436	0.01486 *

Note. Control variables came out as expected.[9]
$p = 0$ '***' $p < 0.001$ '**' $p < 0.01$ '*' $p < 0.05$ '.' $p < 0.1$ ' '

Nouns led to long response latencies (Tab. 7, Figs. 5 and 6). This effect is not necessarily tied to an increased processing cost for nouns in the proverb context, it may rather be explained by task type: in an expected memory task, participants have intuitions about which constituent words would make memorizing easier. In the learning phase (reading task), nouns attracted more attention than other word classes – as a *strategy*, participants may have chosen to dwell longer on nouns to commit the whole proverb to memory.

While adverbs had the same effect in existing proverbs and novel proverb-like phrases (interaction with Sentence Type was not significant; Tab. 7), nouns and verbs were strongly affected by item type (Tab. 7). Nouns and verbs index specific proverbs more strongly than other content word classes. Language users tend to consider nouns (and verbs) key constituents of proverbs (e.g., Ďurčo 1994). In novel phrases, nouns and verbs successively activate and cancel existing proverb representations in the mental lexicon (cf. superlemmas, Lückert 2018a, Lückert

9 Control variables: Word Position ($t(1.640e+04) = -0.561$, $p = 0.57$); Word Length ($t(1.101e+04) = 15.192$, $p = < 2e\text{-}16$); Sentence Type (novel) ($t(8.221e+01) = 2.195$, $p = 0.031$).

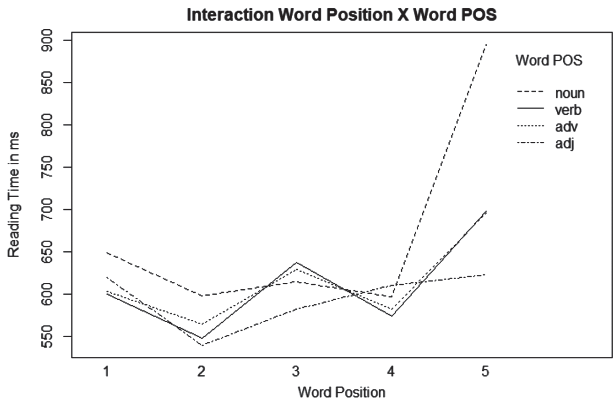

Fig. 5: Mean reading-time latencies by word class across word positions 1 to 5 in self-paced reading of proverbs

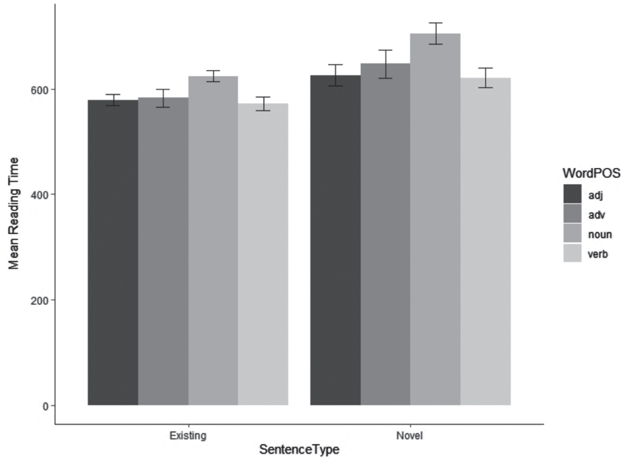

Fig. 6: Mean reading-time latencies by word class and Sentence Type in self-paced reading of proverbs

2019a, Lückert and Boland submitted). This is linked with a high processing cost. Word position modulated the effect of all word classes on reading times.

4.3 Recognition of proverbs

Word class did not robustly predict the dependent measures in this recall paradigm. A higher proportion of nouns in a proverb tended to result in slightly shorter reaction times ($t(322.4) = -0.829$, $p = 0.41$) and in slightly lower accuracy ($z = -0.360$, $p = 0.72$).[10] In the same mixed model, this time with the factor verb density only, a higher number of verbs in a proverb resulted in slightly shorter reaction times ($t(527.2) = -1.259$, $p = 0.21$) and in higher accuracy ($z = 1.285$, $p = 0.199$). A possible reason may lie in the differential representation of nouns and verbs in the mental lexicon. Nouns – because of their hierarchical structure – may compete more with other nouns in this forced-choice paradigm, while verbs may be less affected by competition.

4.4 Free recall of proverbs

In this recall paradigm, word class tended to influence position data but not count data. A higher number of nouns in a proverb resulted in slightly higher recall counts ($t = 0.963$, $p = 0.335853$) and in later positions ($t(41.6) = 1.929$, $p = 0.061$).[11] In the same mixed model, this time with the factor verb density only, a higher number of verbs in a proverb resulted in slightly lower counts ($t = -1.238$, $p = 0.216$) and in earlier positions ($t(39.3) = -1.884$, $p = 0.067$).

4.5 Discussion of experimental results

Word class was revealed to predict several dependent measures in the experimental tasks. This implies that word-level properties are active during processing of proverbs. In Lückert and Boland (submitted), we showed that frequency in the proverb context and in general language use – on the level of constituent words and proverbs – is an important determinant in proverb processing. The present study indicates that there are further word-level properties beyond the frequency

10 Control variables in the RT model: Recognition Accuracy ($t(9225.1) = -6.254$, $p = 4.18\text{e-}10$); Sentence Type (novel) ($t(103.1) = 4.298$, $p = 3.92\text{e-}05$), Sentence Length ($t(93.6) = 6.856$, $p = 7.48\text{e-}10$), Sentence Concreteness (abstract +) ($t(93.5) = 2.928$, $p = 0.0043$), Sentence Concreteness (abstract +/–) ($t(93.5) = 1.815$, $p = 0.073$). Control variables in the accuracy model: Sentence Length ($z = 2.058$, $p = 0.0396$); Sentence Type (novel) ($z = 0.748$, $p = 0.4544$); Recognition Speed (RTs log transformed) ($z = -8.556$, $p = <2\text{e-}16$).

11 Control variables in the recall count model: Sentence Concreteness (abstract +) ($t = 2.260$, $p = 0.024$); Sentence Concreteness (abstract +/–) ($t = 3.394$, $p = 0.000713$); Sentence Type (novel) ($t = -0.010$, $p = 0.99$). Control variables in the relative position model: Sentence Concreteness (abstract +) ($t(45.2) = 2.679$, $p = 0.01026$); Sentence Concreteness (abstract +/–) ($t(34.7) = 0.841$, $p = 0.406$); Sentence Type (novel) ($t(51.5) = 2.126$, $p = 0.038$); Sentence Length ($t(53.6) = 3.258$, $p = 0.00195$); Recognition Accuracy ($t(826.7) = -1.718$, $p = 0.086$).

dimension that become active in online processing of proverbs: the syntactic word categories of constituent words predicted performance of participants in reading and recall tasks.

In the reading task (learning phase of expected recall tasks), nouns were read more slowly than adjectives, adverbs were read a little slower than adjectives, and verbs were read about as fast adjectives. This effect probably reflects a conscious learning strategy of participants who felt that nouns would be key to memorizing the proverbs (cf. research by Ďurčo [1994]). The effect of nouns on reading-time latencies strongly depended on word position in the proverb and on item type (existing proverb or novel phrase; see Tab. 7).

The effect of nouns and verbs respectively is *distinct* in single word processing compared to proverb processing. This is consistent with findings from previous research on word class effects in sentential contexts (e.g., Bultena et al. 2014; Sass et al. 2010). In recognition of proverbs (contextual task), nouns led to shorter response times (insign.) and lower accuracy (insign.). In recognition of words (single word processing task), nouns resulted in shorter response times (sign.) and higher accuracy (insign.). Interestingly, the effect of nouns in free recall of words (single word processing task) was completely contrary to the effect in free recall of proverbs (contextual task). While, in single word processing, nouns led to lower recall counts (sign.) and earlier positions (insign.), in processing in the proverb context, nouns resulted in higher recall counts (insign.) and later positions (approached sign.).

Surprisingly, *verbs seemed more beneficial to proverb processing than nouns* in most tasks. In the reading task, a higher ratio of verbs led to faster reading times (approached sign.). In recognition, verbs resulted in shorter response times (insign.) and in higher accuracy (insign.). In free recall, verbs were associated with lower recall counts (insign.) and with earlier positions (approached sign.). Going by the token frequencies in the ‘x3’ set of the most frequent and/or familiar proverbs in *CAEP*, verbs are almost as frequent as nouns (Tab. 2) in current English-language proverbs in the American context. The type frequency of verbs is, however, much lower compared to noun type frequency – this means that a comparatively small set of verb types is used over and over again in the proverb context. This re-use of verbs may contribute to their association with the proverb context. The low recall counts linked with verbs in proverbs in free recall can probably be explained by the overall low number of verb types in proverbs together with the non-hierarchical representation of verbs in the mental lexicon (Macoir et al. 2019). This non-hierarchical representation makes co-activation of related words harder.

Within-sentence priming between words has been reported in previous research (e.g., Carrol and Conklin 2019). Stronger association between component words led to faster responses in a reading task (Carrol and Conklin 2019: 20). By contrast, Sass and colleagues reported that associations facilitated naming of nouns in single word production, whereas, in sentence production, associations resulted in interference (2010: 447). A similar inhibitory task type effect may be observed in the present study: in single-word processing tasks, nouns tended to facilitate processing. In sentential contexts, the co-activation patterns associated with nouns were found to inhibit processing of proverbs. Verbs, however, seemed to benefit from their integration in proverbs – the increased processing demands for verbs in (freely formed) sentences seem to diminish in proverb sentences (entrenched sentences).

5 Conclusion

In the present study, the effect of word classes on proverb processing was examined. Previous psycholinguistic research has shown that the word classes nouns and verbs, for example, differ in their effects in language processing. Verbs are, for example, often considered more complex than nouns (e.g., Bultena et al. 2014) and have been shown to be processed more slowly than nouns (e.g. Cordier et al. 2013). Based on these findings (Section 2), nouns (rather than verbs) were assumed to facilitate proverb processing.

The distributional analysis of word classes in various corpora presented in Section 3 was meant to highlight likely preferences for specific word classes in proverbs. It may be assumed that word classes that facilitate proverb processing have better chances of becoming part of lexicalized, entrenched structures. While nouns are the numerically strongest class in all proverb (sub-)corpora considered, there may be a (current) trend towards an increasing importance of verbs in English-language proverbs in the American context.

In Section 4, results of an experimental study were discussed that was originally designed to examine frequency effects on the level of constituent words and the level of proverbs (Lückert and Boland submitted). The word and proverb stimuli in the experiment run at the University of Michigan had been manipulated such that different word classes were all represented rather evenly. The data set was thus suited for an analysis of word class effects.

The analysis of the experimental study showed many null effects for word class. Despite the low number of significant effects for word class, interesting trends could be identified in the data. Contrary to expectation, verbs rather than nouns seemed to facilitate proverb processing in various experimental tasks. This trend in the experimental data cannot, however, explain by itself why there seems to be a trend towards more verbs in modern English-language proverbs in the American context. It remains to be seen whether the effects tied to the word class of constituent words of proverbs of the present study can be reproduced with a more varied population sample (including older people)[12] and in *contextual* testing paradigms that make it possible to avoid learning strategies (cf. discussion in Section 4.2).[13]

The processing benefit associated with verbs in proverbs appears to be rather weak. It thus stands to reason to assume that the increased importance of verbs in American English proverbs can be explained by *changed cultural norms and discourse practices*. It has, for example, been noted that "straightforward indicative formulae, which appear to be void of many of the traditional proverbial markers, especially syntactic and phonological devices" are favored today (Mac Coinnigh 2015: 119) and that "the obvious didactic nature of many traditional proverbs appears to be on the decline" (Mieder 2012: 147). The typical modern formulae in the form of simple indicative statements rely heavily on verb structures (Section 3).

Given the surprising results for verbs in proverb processing, it would seem desirable to investigate the processing of verbs in multiple types of sentence contexts including proverbs and other reproducible multiword contexts and non-entrenched sentence contexts.[14] Lexical retrieval of verbs has been shown to involve exhaustive activation of all its complementation options (Shetreet et al. 2016). This may be different in entrenched sentence contexts such as proverbs.

12 I'd like to thank an anonymous reviewer for suggesting to also include older participants in future studies.

13 Proverbs with verb rather than noun structures scored high in the free recall task (a list of 146 possible responses; cf. URN https://nbn-resolving.org/urn:nbn:de:hbz:6-14159451681): e.g., *Never say never* (rank 2 citation numbers / rank 49 relative position), *Easy come, easy go* (rank 14 citation numbers / rank 20 relative position), *Keep it simple* (rank 15 citation numbers / rank 36 relative position), *Keep it real* (rank 21 citation numbers / rank 41 relative position), or *It takes two to tango* (rank 25 citation numbers / rank 43 relative position).

14 I'd like to thank an anonymous reviewer for raising issues about the status of proverbs. While I do think that proverbs are indeed "different from literal language" which the reviewer seems to doubt (proverbs are reproducible entrenched multiword units), I agree that proverbs cannot clearly be distinguished from all other kinds of multiword expressions and that readers may not implicitly recognize proverbs as a class on its own.

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