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POLYSEMY IN THE MENTAL LEXICON: EVIDENCE FOR DIFFERENT PROCESSING AND SEPARATE STORAGE OF WORD SENSES

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Abstract. We studied the mental representations of literal, metonymical, and metaphorical senses in Russian nouns and adjectives. Previous studies suggested either a single representation, separate representations, or hybrid representations for different word senses (metonymy is stored with literal senses, metaphor is separate). We used primed recognition experimental tasks and tested recognition with consistent and inconsistent priming (primed by the same or different sense types). Expanding previous research, we hypothesized that recognition can be affected not only by consistency, but also by sense type (metaphor priming metonymy can yield different results from metaphor priming the literal sense) and direction (metaphor priming metonymy vs. metonymy priming metaphor). Our hypothesis was confirmed: consistency helps recognition, but only for metaphor and metonymy; metaphoric primes help the recognition of metonymic senses but not vice versa. Literal primes were poorly recognized, as previously seen in both inconsistent and consistent conditions. We interpreted our results as evidence supportive of the hybrid account; however, unlike previous research, metonymy appears to overlap with metaphor more than with literal senses. Apart from polysemy-related factors, recognition is apparently affected by general mechanisms of memory: less regular and hence more salient usages (metaphor and metonymy) were recognized better than regular literal usages.

Keywords: polysemy, priming, recognition, consistent, inconsistent, metaphor, metonymy, literal sense

Introduction

Our research aim was to investigate how polysemous words are represented in the mental lexicon. There are three existing experimental accounts of polysemy: all senses are stored together (Nunberg 1979; Frisson, Pickering, 1999); all senses are stored separately (Klein, Murphy, 2001; Pykkänen et al., 2006); metonymy and literal senses are stored together, while metaphor has a separate representation (Klepousniotou et al., 2008; Lopukhina et al., 2018). Previous studies had certain limitations that our study aspired to at least partially overcome: most researchers used limited linguistic material, namely, studied only one sense type (metonymy) in only one part of speech (nouns). Some other studies considered other polysemy types and/or speech parts (Klepousniotou et al., 2008; Lopukhina et al., 2018; Yurchenko et al., 2020), but used only one type of experimental

task (sensicality judgment or semantic clustering). We investigated metonymic and metaphorical senses in nouns and adjectives using a primed recognition task (applied in Klein, Murphy, 2001 to the study of metonymy in nouns). Unlike sensicality judgment and semantic clustering, recognition does not involve deep semantic processing, and thus allows a glimpse into the unconscious online processing of these different sense types. We expected that recognition would be affected not only by consistency (with consistent priming recognition rating higher than with inconsistent), but also by sense type (e.g., metaphor priming metonymy may behave differently from metaphor priming literal) and direction (metaphor priming metonymy may behave differently from metonymy priming metaphor). Following Klepousniotou et al. (2008), Lopukhina et al. (2018), and Yurchenko et al. (2020), we expected to find a considerable overlap between literal and metonymic senses and little or no overlap of literal sense and metaphor. Thus, we expected the greatest advantage for consistent priming of any sense type (literal-literal, metonymy-metonymy, metaphor-metaphor), a weaker advantage for literal-metonymy and metonymy-literal pairings, and a disadvantage for literal-metaphor and metaphor-literal pairings. In other words, we expected pairs like *красная крыша – железная **крыша*** (literal-literal) to be remembered best, pairs like *железная крыша – **крыша** над головой* (literal-metonymy) to be recognized slightly worse, and pairs like *крышу сносит – железная **крыша*** (metaphor-literal) to have the greatest disadvantage.

Methodology

We conducted a primed recognition experiment.

Participants. One hundred ninety four adult native Russian speakers were paid to participate in the experiment via Toloka and PClbex. Twenty five participants had linguistic education, one hundred sixty nine did not. The age ranged from 18 to 77 years. Average age was 39 years. The results were processed using R generalized linear regression with random effects.

Materials. Using data from the Russian National Corpus, we prepared 108 phrases with 9 polysemous nouns and 9 polysemous adjectives representing literal, metonymic, and metaphorical senses (two syntactically different phrases for each sense type, i.e., 6 phrases per word). The phrases were organized in 54 pairs of 9 distinct pairing types, 3 consistent and 6 inconsistent with different sense types and different directions (Table 1 illustrates all 9 types of priming we used in the experiment). Syntactic structures of prime and target phrases could be the same (e.g., Adj + N_{nom?}, Adj + N_{nom?}) or different (Adj + N_{nom?}, V + N_{acc?}) both for semantically consistent and inconsistent priming, and syntactic consistency between prime and target was included in our model as a separate condition. We had six experimental lists, so that each participant saw only one pairing type for each word and saw one example of each pairing type, i.e., was exposed to the total of 27 prime-test pairs including fillers. In order to prevent potential participant bias from influencing our experimental results, we employed the use of filler words to ensure that our participants remained unaware of the true purpose of the experiment. For fillers, we used monosemous

nouns and adjectives. The experiment was conducted in 3 phases. Each phase contained 9 pairs of phrases for recognition (3 adjectives, 3 nouns, and 3 fillers of the literal-literal type).

Table 1. Priming Types

Priming types	Priming phrase-test phrase
Literal – Literal	умный адвокат – УМНЫЙ критик
Literal – Metonymy	сильный богатырь – СИЛЬНАЯ армия
Literal – Metaphor	горячий песок – ГОРЯЧИЙ спор
Metonymy – Literal	стальной цвет – СТАЛЬНАЯ труба
Metonymy – Metonymy	спокойный голос – СПОКОЙНЫЙ взгляд
Metonymy – Metaphor	седая голова – пустая ГОЛОВА
Metaphor – Literal	взять под крыло – раскрыть КРЫЛЬЯ
Metaphor – Metonymy	железная рука – ЖЕЛЕЗНАЯ руда
Metaphor – Metaphor	выучить язык – трудный ЯЗЫК

Procedure: Experiment had 3 phases. Each phase consisted of two parts:

1. Participants were asked to memorize 9 phrases (3 fillers, 3 nouns, 3 adjectives) that appeared on the screen for 2 seconds.
2. Phrases with highlighted words were demonstrated and participants were asked to press the Y button if they had seen the highlighted words in the first part of the experiment and N if not.

Results

The rates of recognition are presented in Tables 2 and 3. Table 2 shows that the rates of recognition in consistent and inconsistent conditions were almost the same, which suggests that consistency is not the only relevant factor. Instead, consistency may be a contributing factor for some stimuli pairs which is demonstrated in Table 3.

More detailed descriptive statistical data in Table 3 shows that recognition rate is higher than non-recognition rate in three conditions, metaphor-metaphor, metonymy-metonymy, and metaphor-metonymy. It suggests that consistency of priming does indeed positively affect recognition, but not for every sense type. Namely, consistency aids recognition only in metaphoric and metonymic senses. In fact, consistent literal pairing is recognized worst of all: it has the lowest ratio of recognized stimuli among all the conditions. Quantitative data also suggests that metaphor as a prime creates an advantage for metonymy in the recognition phase, since in that condition the recognition rate is also higher than non-recognition. However, in the metonymy-metaphor pairing the recognition rate is fairly low which suggests that direction of priming matters for recognition, as well.

Table 2. Consistent and Inconsistent Priming Recognition Rate

Type	Recognized	Not recognized
Consistent	528 (46.0%)	630 (54.0%)
Inconsistent	1034 (44.5%)	1294 (55.5%)

Table 3. Recognition Rate With Priming Type (Raw Numbers)

Priming type	Recognized	Not recognized
Literal – Literal	135	251
Literal – Metonymy	171	217
Literal – Metaphor	186	202
Metonymy – Literal	153	235
Metonymy – Metonymy	198	188
Metonymy – Metaphor	163	225
Metaphor – Literal	164	224
Metaphor – Metonymy	197	191
Metaphor – Metaphor	195	191

In order to evaluate the statistical significance of the observed quantitative tendencies, we processed our results using R generalized linear regression with random effects. Table 4 shows statistically significant differences of various priming types as compared with the literal-literal pair. We included two factors in our model, the type of semantic relation between a prime and a target (“type of correlation” condition) and the type of syntactic relation between a prime and a target (“same syntax” condition). The “*same syntax*” parameter was introduced to determine if the consistency of syntactic structures between a prime and a target had any effect on the recognition rate. The “*type of correlation*” parameter includes three aspects: sense type, direction of priming, and type of priming (consistent/inconsistent).

The linear regression test confirmed the significance of all three tendencies observed in the descriptive statistics section. Indeed, consistently primed metaphors and metonymies and the inconsistent pairing metaphor-metonymy are recognized significantly better than the least recognized literal-literal pairing. Linear regression test also demonstrated additional effects: namely, that metaphor-literal, literal-metaphor, and literal-metonymy pairings were recognized significantly better than the literal-literal condition. However, there were no statistically significant differences between the literal-literal condition and either metonymy-literal or metonymy-metaphor pairings. Also, contrary to our expectations, we did not discover any effects of syntactic consistency between a prime and a target on the recognition rates.

Table 4. The Linear Regression Test Results on the Prime-Test Correlation Type with Regard to the "Literal-Literal" Correlation

Type	Estimate std.	Error	Z value	Pr(> z)
Intercept	-0.9117	0.2046	-4.456	8.36e-06***
Literal – Metaphor	0.6828	0.2299	2.969	.00298**
Literal – Metonymy	0.5982	0.2277	2.627	.00861**
Metaphor – Literal	0.4650	0.1766	2.633	.00847**
Metaphor – Metaphor	0.9299	0.2274	4.089	4.34e-05***
Metaphor – Metonymy	0.9639	0.2287	4.215	2.50e-05***
Metonymy – Literal	0.2056	0.1746	1.178	.23892
Metonymy – Metaphor	0.3246	0.2295	1.414	.15725
Metonymy – Metonymy	0.9534	0.2266	4.208	2.58e-05***
Same syntax (Yes)	0.0393	0.1266	0.310	.75625

Thus, semantically consistent pairs of figurative senses (metonymy-metonymy and metaphor-metaphor) had the highest recognition rate, confirming the significance of both sense type and semantic consistency parameters. Also, recognition rates were high for the semantically inconsistent pair metaphor-metonymy, but not for its directional opposite metonymy-metaphor, which suggests the importance of direction in priming in addition to sense type. Metaphorical primes also enhanced recognition for literal senses, albeit not as strongly as for figurative senses. Metonymies as primes facilitated recognition only in the consistent condition, but not for literal or metaphoric senses. Literal primes enhanced recognition somewhat, but only in inconsistent conditions. Therefore, all three aspects of semantic relations between a prime and a target were found to affect recognition: semantic consistency between a prime and a target enhances recognition, but only for metaphor and metonymy (consistency and sense type parameters); metaphor as prime enhances recognition for all sense types, but this effect is strongest for figurative senses (sense type and direction of priming parameters); literal senses are poorly recognized unless primed by metaphor (sense type); metonymic primes enhance recognition only in the consistent condition (sense type and consistency).

Discussion and Conclusion

The goal of the study was to investigate whether literal, metonymic and metaphoric senses differ in their representation in the mental lexicon. We conducted an experiment where participants were asked to recognize phrases with different sense types primed with consistent or inconsistent senses. Similar to previous studies, we found that consistent priming works better than inconsistent priming, which can be interpreted as evidence of difference in processing among different senses. However, we observed this effect only in metaphorically and metonym-

ically consistent pairings, which further supports different processing for literal vs. figurative senses. This difference may be explained by the lower memorability and poorer recognition of phrases with literal senses due to their cognitive “ordinariness”. On the other hand, stimuli with figurative senses represent semantically less trivial usages and, as such, may be more memorable. Our second finding is that of the two figurative senses, metaphor creates a greater recognition advantage, since it facilitates the recognition of both metaphors and metonymies and, to a lesser extent, even literal senses. Finally, our results suggest a greater overlap between metaphor and metonymy (i.e., figurative senses) than between literal and metonymic senses, unlike previous studies (Klepousniotu et al. 2008, Lopukhina et al. 2018, Yurchenko et al., 2020). On the whole, our results support hybrid storage account, with literal sense opposed to figurative senses, but only a partial overlap between metaphor and metonymy.

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ПОЛИСЕМИЯ В МЕНТАЛЬНОМ ЛЕКСИКОНЕ: СВИДЕТЕЛЬСТВО РАЗНОЙ ОБРАБОТКИ И РАЗДЕЛЬНОГО ХРАНЕНИЯ СМЫСЛОВ СЛОВ

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Аннотация. Мы изучали ментальные репрезентации прямого, метонимического и метафорического значений у полисемичных русских существительных и прилагательных. Предыдущие исследования постулировали либо единую репрезентацию

всех значений, либо отдельные репрезентации, либо гибридные репрезентации (метонимия хранится вместе с буквальными значениями, а метафора — отдельно). Мы провели эксперимент на узнавание и протестировали запоминание полисемичных слов с последовательным (в праймах и в тестовых фразах представлено одно значение) и непоследовательным праймингом (в праймах и в тестовых фразах представлены разные значения). Мы предположили, что на способность опознавать увиденное слово влияет не только тип прайминга, но и тип значения (например, метафора как прайм к метонимии даст иной результат, чем метафора как прайм к букальному значению) и направление (метафора как прайм к метонимии даст иной результат, чем метонимия как прайм к метафоре). Наша гипотеза подтвердилась: последовательный прайминг положительно влияет на узнавание, но только для метафоры и метонимии, у буквальных значений этот эффект отсутствует; метафорические праймы способствуют узнаванию метонимических значений, но не наоборот. Наши результаты свидетельствуют в пользу гибридного подхода; однако, в отличие от предыдущих исследований, указывают на большее пересечение метонимии с метафорой, чем с буквальным смыслом. Помимо факторов, связанных с полисемией, на запоминание, видимо, влияли общие механизмы памяти: метафора и метонимия, будучи семантически менее регулярными, запоминались лучше, чем привычные буквальные употребления.

Ключевые слова: полисемия, прайминг, узнавание, последовательный, непоследовательный, метафора, метонимия, буквальное значение