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Understanding Deverbal Nominals: World Knowledge or Lexical Semantics?

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Abstract

The paper investigates how speakers understand constructions with deverbal nominals, i.e. nominals such as *destruction* that are morphologically related to verbs. Specifically, given the expression *the enemy's destruction*, how do the speakers decide whether the possessive argument is the entity that initiates the action (agent) or the entity that is causally affected by the event (patient)? The results of an experimental study show that this choice is dependent on the lexical semantics of the nominal. The theoretical implication is that deverbal nominals are similar to verbs in that they have argument structure. By studying comprehension of deverbal nominals the current study extends the scope of previous experimental work on lexical semantics that has been primarily concerned with verbs.

Keywords: lexical semantics; argument structure; thematic roles; deverbal nominals.

Introduction

Language comprehension crucially depends on the listener's ability to identify the type of event denoted by a sentence and the roles of event participants in the event. For example, in the sentence *The enemy destroyed the city*, the enemy is the actor, whose actions causally affect the city. This information is encoded in the lexical semantics of the verb, its event and argument structure. The event structure of the causal verb *destroy* consists of two subevents and encodes two event participants (Dowty, 1979; Jackendoff, 1990):

destroy: x CAUSE (BECOME (y be-destroyed))

The argument structure of the verb *destroy* encodes the relation between the verb and its arguments and their thematic roles:¹

destroy: (x_{agent} , y_{patient})

Linking rules determine how arguments are mapped into syntactic structure. In active sentences, the agent is mapped to the subject position, and the patient – to the direct object position. In passive sentences the mapping is reversed.

Lexical semantic properties of verbs have been studied experimentally, and the processing correlates or event and argument structure are relatively well understood. For example, McKoon and McFarland (2000, 2002) provided experimental support for the theoretical claim in Levin and

¹ The status of thematic roles is not uncontroversial, and many authors do not consider them to be theoretical primitives (cf. Dowty 1989).

Rappaport Hovav (1995), according to which change-of-state verbs belong to two classes, externally and internally caused. McKoon and McFarland showed that constructions with externally caused verbs, such as *break*, take longer to process compared to sentences with internally caused verbs, such as *bloom*. These processing differences are attributed to the differences in event structure. Externally caused change-of-state verbs lexically encode two subevents and have two participants associated with these subevents, the agent and the patient, while internally caused verbs have only one subevent and one participant. These findings suggest that lexical semantic templates, event structure, specifically, are directly involved in sentence comprehension.

Maurer, Tanenhaus, and Carlson (1995) examined constructions with implicit agent arguments, such as short passives (*The game show's wheel was spun*). The authors showed that the processing cost of rationale clauses, such as ... *to win a prize and lots of cash*, was the same when it appeared after short passives, after full passives, and after active sentences. The fact that implicit and explicit arguments have the same processing cost can be interpreted as evidence that lexical semantic information, specifically, the information that a transitive event involves two event participants, agent and patient, is activated during processing, even in constructions with syntactically unexpressed participants. In a follow-up study, Maurer and Koenig (2000) showed that processing of implicit arguments is due to the activation of argument structure rather than to world knowledge about the event denoted by the verb.

In another line of research, Hartshorne et al. (2010) examined linking rules of psych predicates in English and Japanese, and showed that the duration of the state denoted by a psych predicate affects the choice of linking rules. For long-lived psychological states (cf. *Mary loves John*) the mapping of the experiencer to the subject position is preferred, while for short-lived states (cf. *Mary frightens John*) the mapping to the object position is favored.

Compared to the impressive body of experimental work on verbs, lexical semantic properties of deverbal nominals – nouns derived from verbs, such as *destruction*, – have hardly received any attention in psycholinguistic literature. This oversight is surprising, since deverbal nominals, while similar to verbs, differ from them in several respects. A study of how speakers comprehend constructions with deverbal nominals can contribute to a better understanding of the role of lexical semantics in language comprehension.

To address this question, the current paper studies how arguments of deverbal nominals are interpreted. In what follows, I first discuss the properties of deverbal constructions, and review the theoretical literature. I then present the results of an experimental study and conclude the paper with the discussion of theoretical implications.

Deverbal Nominals

Similarly to verbs, deverbal nominals denote events or states. However, there are several important differences between these two lexical classes. First, arguments seem to be optional in nominal constructions. Thus, while the omission of the agent argument in active sentences leads to ungrammaticality (cf. **Destroyed the city*), the agent argument of deverbal nominals can be unexpressed, as in *The city's destruction was horrible to watch*. This observation might suggest that deverbal nominals lack argument structure. An alternative explanation is that deverbal nominals have argument structure but that the mapping rules are more flexible in the nominal domain.

Second, in nominal constructions both the agent and the patient can appear in the same syntactic position. For example, in *the enemy's destruction* the prenominal possessive argument is usually interpreted as patient but in *the enemy's invasion*, the possessive argument receives an agentive interpretation. On the first sight the ability of different arguments to appear in the same syntactic position seems to parallel the difference between active and passive verbal constructions: the subject position is occupied by the agent in active constructions (*The enemy destroyed the city*) but by the patient in passive sentences (*The city was destroyed by the enemy*). However, these similarities are superficial: while in the verbal domain the mapping is marked morphologically on the verb and thus can serve as a cue to argument interpretation, there is no equivalent of passive morphology in the nominal domain. These observations suggest that the syntactic position is not a reliable cue for argument interpretation in deverbal nominals. In the absence of any reliable morphological and syntactic cues, how do the listeners decide whether the prenominal possessive argument in *the enemy's destruction* is an agent or a patient?² Before addressing this question, I discuss current linguistic theories of deverbal nominals.

Theoretical Background

Apparent optionality of arguments in nominal constructions led some authors to believe that deverbal nominals do not have argument structure (Dowty, 1989; Higginbotham, 1983). This position was most notably challenged by Grimshaw (1990), who showed that certain classes of nominals – Argument Structure (AS) nominals – have the properties associated with the corresponding verbs: they

² In nominal constructions with two expressed arguments morpho-syntax is a reliable cue for argument interpretation. In such cases the prenominal argument is interpreted as agent, and the argument realized with the preposition *of* is interpreted as patient, as in *the enemy's destruction of the city*.

denote events or processes and obligatorily realize their patient arguments. Thus, the nominal *destruction* in *the enemy's destruction of the city* is an AS-nominal. The nominal *chair*, as in *John's chair*, is not an AS-nominal: it refers to an object rather than to an event and does not have associated arguments. Interestingly, under Grimshaw's analysis, the nominal *invasion*, as in *the enemy's invasion*, would be analyzed as a non AS-nominal. Even though it refers to an event, it lacks the patient argument. The distinction between AS-nominals and non AS-nominals proposed by Grimshaw became a foundational assumption for many linguistic theories of deverbal nominals. In what follows, I discuss two alternative approaches to how prenominal possessive arguments are interpreted, one that adopts the proposed classification of nominals as AS and non AS, and another that does not.

Syntax and World Knowledge Approach

Many authors assume that constructions with a single possessive argument in the prenominal position, the so-called passive nominals such as *the city's destruction*, are AS-nominals (Alexiadou, 2001; Doron & Rappaport Hovav, 1991). According to Doron and Rappaport Hovav (1991), the lexical semantic representation of these nominals involves one subevent and one event participant. Thus, these nominal constructions differ in complexity from the corresponding verbs (cf. the representation of *destroy* in the Introduction section).

destruction: (BECOME (*y* be-destroyed))
 destruction: (*y*_{patient})

The assignment of thematic roles also differs from that in the verbal domain. According to Alexiadou (2001), the single argument in passive nominals is directly merged in the prenominal possessive position (Spec,DP). This syntactic position is not associated with a particular thematic role. As observed by Alexiadou, Anagnostopoulou, and Schäfer (2009), the interpretation of the prenominal possessive argument “is rather free, and is mainly dependent on the concept expressed by the possessee [...] In the case of object nouns that lack argument structure, the possessor can be interpreted as owner or author, [cf. *John's book*]. In the case of *destruction*, the possessor can be interpreted as agent/cause, based on our encyclopaedic knowledge about *destroy*.” According to this approach, the speakers interpret the prenominal possessive argument in *the enemy's destruction of the city* as agent or cause, since they know that events of destruction usually involve a cause. However, since the interpretation of the possessive argument is free, in the construction *the city's destruction* the prenominal argument can receive a patient interpretation. Under this approach, it is difficult to see what would guarantee that the prenominal argument in the latter construction receives the patient interpretation. One can argue that if an AS-nominal, such as *the city's destruction*, realizes one argument only, this argument would receive a patient interpretation, since

AS-nominals by definition must realize their patient arguments.

Non AS-nominals, such as *John's analysis* or *the enemy's invasion* are assumed to lack event and argument structure. Their lexical semantic templates do not encode any information about event participants or their roles in the event:

invasion: ()

Prenominal arguments in non AS-nominals are treated as adjuncts, and their semantic interpretation is “free-thematic”. As discussed by Doron and Rappaport Hovav (1991), in a non AS-nominal, such as *John's analysis*, *John* can be either agent (*John analyzed something*) or patient (*someone analyzed John*). This suggests that world knowledge would play a role in how prenominal arguments of non AS-nominals are interpreted.

To summarize, under the approach discussed in this section, the interpretation of the argument in the prenominal possessive position is to a large extent determined by world knowledge. World knowledge supplies information about the number of participants compatible with a given event and their roles in this event. I refer to this approach as Syntax and World Knowledge because the world knowledge interpretation kicks in when the argument appears in a particular syntactic position, the prenominal possessive.

Lexical Semantics Approach

An alternative approach developed in Smirnova (2015) assumes that argument interpretation in deverbal nominals is based not on encyclopedic or world knowledge but depends on the lexical semantics of the nominal. In this approach classification of nominals as AS and non AS becomes irrelevant, since all deverbal nominals are assumed to have argument structure.

Smirnova (2015) classifies nominals into Agent-dominant and Patient-dominant groups, depending on how their single possessive argument is interpreted. The nominal *admiration* belongs to the former group, since its prenominal argument is obligatorily interpreted as agent, as in *John's admiration*. On the other hand, *destruction* is a Patient-dominant nominal, since its prenominal argument is interpreted as patient, as in *the enemy's destruction*. The membership in Agent- and Patient-dominant groups is determined by the behavior of the corresponding verbs, specifically, the type of alternations that the verbs show, as discussed in Levin (1993). If a verb participates in argument alternations that favor one argument over the other so that the argument is realized in a syntactically more prominent position, the same mapping preferences are found in the corresponding nominal. From this perspective, argument mapping patterns in nominals are viewed as reflecting the same lexical principles that determine argument alternation in the verbal domain.

Patient-dominant nominals are nominals whose corresponding verbs participate in alternations that favor the

patient argument. Verbal counterparts of these nominals participate in Causative alternation, Instrumental Subject alternation, etc., and are members of the following Levin's classes: Change of State, Murder, Destroy, and others. The Causative alternation (*The government escalated the conflict / The conflict escalated*) favors the patient argument in a sense that this argument is unaffected by the alternation, while the agent argument is deleted. Another example is the Instrumental Subject alternation: *The builders destroyed the warehouse with explosives / The explosives destroyed the warehouse* (from Levin, 1993). In this alternation the agent is replaced with an instrument, but the patient is unaffected. The Lexical Semantics approach specifies that if a verb participates in alternations that favor the patient argument, the corresponding nominal favors patients as well. Thus, in the nominal domain *the builders' destruction of the warehouse* alternates with *the warehouse's destruction* (the patient is preserved, the agent is absent) rather than with *the builder's destruction* (the agent is preserved, the patient is absent). Under this approach, the possessive argument receives a patient interpretation because of the lexical semantic properties of the head nominal.

Agent-dominant nominals are deverbal nouns whose corresponding verbs participate in alternations that consistently favor the agent argument, such as the Unspecified Object alternation, the Possessor Object alternation, and others. The verbal counterparts of Agent-dominant nominals are members of such Levin's classes as Admire, Avoid, Inherently Directed Motion, and others. The Unspecified Object alternation – *John attacked the library / John attacked* – favors the agent argument, since the agent argument is obligatorily present in both constructions, while the mapping of the patient is optional. Similarly, in the Possessor Object alternation the patient argument is absorbed into the argument that expresses the attribute, while the agent is unaffected, as in *John admired the volunteers for their dedication / John admired the volunteers' dedication* (adapted from Levin, 1993). The corresponding nominals show the same pattern: the prenominal argument of *admiration* receives the agent rather than the patient interpretation.

To summarize, the Lexical Semantics approach makes clear predictions about argument interpretation: nominals derived from verbs that are members of Change of State, Murder, and Destroy classes are nominals whose single possessive argument would be interpreted as a patient. Nominals derived from verbs belonging to Admire, Avoid, and Inherently Directed Motion classes are Agent-dominant nouns. Their single prenominal argument would be interpreted as an agent. In what follows, we check the predictions of this approach experimentally.

Experiment

Participants

Thirty participants were recruited through Amazon Mechanical Turk web service. They were compensated with

\$3 for their time. All participants were native speakers of English. 67% of participants were males, and 33% were females. The average age was 33, with the youngest participant being 21 and the oldest 55 years old.

Stimuli

I constructed two lists of nominals, representative of Agent-dominant and Patient-dominant classes, using the criteria identified in Smirnova (2015). Specifically, using Levin (1993) as a source, I first constructed a list of verbs. For Agent-dominant group, I used verbs that were members of Admire, Avoid, and Inherently Directed Motion classes. For Patient-dominant group, I selected members of Destroy, Murder, and Change of State classes.³ Next, I considered whether the verb can plausibly appear with the same word as subject and object. Verbs that impose different animacy requirements on their subject and object arguments were removed. For each of the remaining lexical items, three sentences were constructed. The first two sentences involved a verb, and the third sentence contained the corresponding nominal. The stimuli for *assassinate/assassination* looked as follows:

- The killer assassinated the victim. (1)
- The gang assassinated the killer. (2)
- The killer's assassination was recorded on camera. (3)

Zero-derived nominals and their corresponding verbs, such as *love*, as well as nominals with *-ing* suffix, were discarded at this stage. The sentence with the corresponding nominal was constructed in such a way so that it does not bias the interpretation towards the event reported in either of the previous two sentences.

These sentences were read by 2 native speakers of English, and were judged as natural or unnatural. Unnatural sentences were removed from the list. Using this methodology, I arrived at 16 items for the Agent-dominant group, and 28 items for the Patient-dominant group. In order to control for group sizes, I randomly selected 14 items from the latter. Thus, the final list of stimuli consisted of 30 items. Full list of the items can be found in the appendix.

Design

The study consisted of two parts. In the first part I asked participants to judge the naturalness of sentences. Each verb

³ Certain classes were excluded for syntactic and semantic reasons. For example, the class of Correspond verbs (Agent-dominant group) was not included because these verbs either require a plural subject (*The trucks collided*) or a complement introduced by *with* (*The truck collided with the lamppost*). Since both constructions are syntactically different from plain transitive constructions used in the experiment, this class was not included. Amuse verbs (Patient-dominant group) were not included because the group is not homogeneous: some of these verbs, such as *amuse*, allow their subject arguments to receive an agentive interpretation, while others, such as *concern*, do not (Levin, 1993). Since the availability of an agentive interpretation is crucial to the study design, Amuse verbs were not included in the experiment.

was paired with a particular noun, so that in one sentence the noun appeared as the verb's subject, and in another sentence the noun appeared as the verb's object. For example, the noun *killer* paired with the verb *assassinate* resulted in the following two sentences:

- Subject form: The killer assassinated the victim. (1)
- Object form: The gang assassinated the killer. (2)

Since each of the original 30 verbs was used twice, as shown above for *assassinate*, there were a total of 60 sentences. I expected that all of these sentences would be judged natural, which can potentially make the task monotonous and boring. To control for this, I also included 40 filler items, which were deliberately constructed to sound unnatural (*The lamp chased the mouse*). The order of all sentences was randomized. The naturalness task was included as a control to ensure that any observed experimental effects are not due to unnatural language use.

In the second part the participants had to choose a continuation of a story. The pairs of sentences with the same verb were presented as the beginnings of two different stories, i.e. (1) above as the beginning of Story 1, and (2) as the beginning of Story 2. After reading the two beginnings, the participants were presented with a new sentence. The new sentence contained a deverbal nominal with the prenominal possessive, as in (3) above. The prenominal possessive has previously appeared as the subject (1) and the object (2) in the verbal constructions.

The participants were asked if the new sentence continued the first or the second story. Based on Smirnova (2015), I expected that the new sentences will be more likely to be paired with the object form in the Patient-dominant group compared to the Agent-dominant group. For example, since *assassination* is a Patient-dominant nominal, (3) should be judged as a continuation of sentence (2) more often than sentence (6) is judged as continuation of sentence (5), since the latter has a nominal from the Agent-dominant group.

- Subject form: The magician admired the singer. (4)
- Object form: The child admired the magician. (5)
- New sentence: The magician's admiration became an obsession. (6)

The answers to the continuation judgments task were marked on an 11 point Likert scale, from 1.0 to 2.0 with one decimal point interval between alternatives. The answers between 1.0 and 1.4 indicated preference for Story 1, the answers between 1.6 and 2.0 indicated preference for Story 2, and 1.5 indicated that the new sentence could be a continuation of either story.

Procedure

After reading the instructions the participants were presented with 60 experimental items and 40 filler items from the naturalness judgments task. In the second part of the experiment, participants were presented with 30 paired

stories from the continuation judgments task. The study was conducted on-line, using the Quartics survey software, and for most participants it took between 15 and 20 minutes to complete the study.

Results

First I checked if the target sentences in the naturalness task were judged acceptable. If a sentence was judged natural, the answer was coded as 1, and if it was judged unnatural, the answer was coded as 2. Collapsing across individual verbs, there was a strong pattern for judging the target sentences as acceptable, for the Patient-dominant ($M=1.08$, $SD=0.05$) and for the Agent-dominant groups ($M=1.06$, $SD=0.05$), while the filler sentences were judged unnatural ($M=1.99$, $SD=0.01$). There was a significant trend for the Agent-dominant sentences to be judged more natural than the Patient-dominant sentences ($t(29)=2.30$, $p=0.03$, two-tailed), yet both types of target sentences were overwhelmingly judged natural. The observed pattern is illustrated in the top panel of Figure 1.

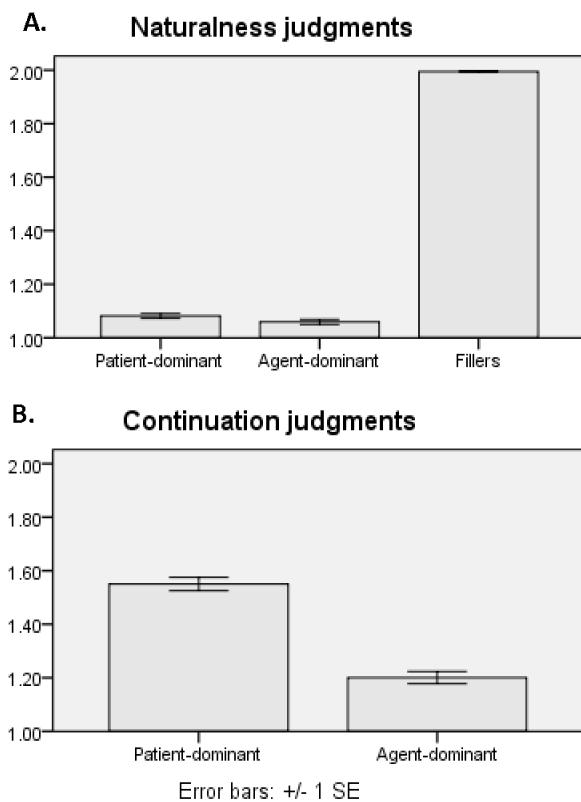


Figure 1: Naturalness and continuation judgments

Knowing that both types of target sentences are perceived as natural allowed me to proceed to testing my main hypothesis, namely, that sentences with Patient-dominant nominals will prompt object-based inferences more than sentences with Agent-dominant nominals. The answers from the continuation task were used to compute preference

for the object versus the subject form, where 1.0 was absolute preference for the object, and 2.0 was absolute preference for the subject. For the Agent-domain group, the mean was $M=1.20$, $SD=0.13$, indicating strong preference for subject-based continuation (the mean was significantly different from the chance level at 1.5, $t(29)=13.08$, $p<.001$, one sample one-tailed test). The mean for the Patient-dominant group was $M=1.55$, $SD=0.14$, which showed a weak but statistically significant preference for object-based continuation ($t(29)=2.02$, $p=.03$, one sample one-tailed test). The pattern is presented in the bottom panel of Figure 1. Most importantly, confirming my hypothesis, there was a strong difference between the Agent-dominant and the Patient-dominant groups ($t(29)=10.15$, $p<.001$, one-tailed paired t-test), suggesting that subject-based continuations were more likely for the Agent-dominant verbs, while object-based continuations were more likely for the Patient-dominant group.

Taken together, the observed results suggest that deverbal nominals reflect the semantic properties of the verbs from which they are derived, and that such differences cannot be simply explained by the effect of world knowledge.

General Discussion

Language comprehension crucially depends on the listener's ability to understand what roles participants have in a given event. While previous experimental studies have focused primarily on representation and processing of lexical semantic information in verbs, I presented the results of what I believe is the first experimental study on the interpretation of arguments in deverbal nominals. The results have a number of theoretical implications. First, I showed that argument interpretation in nominals is sensitive to the type of the corresponding verb. Nominals whose corresponding verbs participate in alternations that favor the agent argument are nominals whose single prenominal argument tends to receive the agent interpretation. Nominals whose corresponding verbs participate in alternations that favor the patient argument are nominals whose single prenominal argument tends to be perceived as patient. The observed results provide empirical support for the generalizations presented in Smirnova (2015).

Second, the observed correspondences between verbs and nominals can be explained if we assume that nominals inherit argument structure of the corresponding verbs. These results are incompatible with the assumption that nominals lack argument structure altogether (cf. Dowty, 1989; Higginbotham, 1983).

Third, the results of this study contribute to the discussion about the assumed ontological distinction between AS-nominals, i.e. nominals that have verbal properties and obligatorily realize the patient argument, and non AS-nominals, i.e. nominals that surface without expressed patient arguments. A general consensus in the literature is that non AS-nominals, such as *the magician's admiration*, lack argument structure, and that the interpretation of their

prenominal argument is “free-thematic” – it depends on the speakers’ world knowledge about the type of the event or state denoted by the nominal. The results of the experimental study reported here show that the interpretation of prenominal arguments in the so-called non AS-nominals is not free: these nominals strongly favor the agent interpretation. Importantly, this preference cannot be explained in terms of world knowledge, since each event had two plausible event participants, as naturalness judgments indicated, yet the choices of the interpretation differed from chance. These results challenge the analysis of these nominals as lacking argument structure, and invite us to reconsider the motivation for grouping constructions such as *John’s admiration* together with nominals referring to objects, such as *John’s book*.

Acknowledgments

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Appendix

Patient-dominant Group

1. enlarge / enlargement
2. escalate / escalation
3. compress / compression
4. democratize / democratization
5. devastate / devastation
6. magnetize / magnetization
7. demolish / demolition
8. assassinate / assassination
9. harmonize / harmonization
10. eliminate / elimination
11. expand / expansion
12. decentralize / decentralization
13. levitate / levitation
14. improve / improvement

Agent-dominant Group

1. admire / admiration
2. tolerate / tolerance
3. appreciate / appreciation
4. depart / departure
5. enjoy / enjoyment
6. hate / hatred
7. venerate / veneration
8. exalt / exaltation
9. avoid / avoidance
10. revere / reverence
11. lament / lamentation
12. idolize / idolization
13. evade / evasion
14. resent / resentment

15. enter / entrance
16. adore / adoration

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