

The Object-Relation Continuum in Language

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Abstract

Gentner (1981, 1982; Gentner & Boroditsky, 2001) identified a number of ways in which noun meanings differ from verb meanings. One striking difference is that nouns tend to name objects, while verbs tend to name relations that hold between objects. In this paper, we ask whether other differences noted between nouns and verbs might generalize to differences between names of objects and names of relations. Focusing on the test case of mutability of meaning under semantic strain, we find evidence for a relationality continuum.

Keywords: relational language; mutability; semantic strain

Introduction

Differences between nouns and verbs have long been recognized as spanning both syntactic and semantic features (Gentner, 1981, 1982; Gentner & Boroditsky, 2001). Syntactically, verbs function as the center around which a sentence is built, according their contribution to the meaning of a sentence particular importance. Semantically, in comparison to noun meanings, verb meanings have been argued to be broader, less straightforwardly translatable, more variable across languages, and more prone to mutation in response to semantic strain (Gentner, 1981; see also Levin, 1993). As a result, verbs are more difficult to recognize (Kersten & Earles, 2004) and slower to be acquired (Gentner, 1981, 1982; Gentner & Boroditsky, 2001) by both children and second language learners.

Given the relative breadth of meaning typical of verbs, it is unsurprising that they would exhibit the other semantic and psychological traits that have been noted for them. Consider first the issue of translation. In order to find a maximally appropriate translation, it is necessary to identify a word in the target language which can be used in the same range of semantic and syntactic contexts as the original word. As breadth of meaning increases, so too should the range of possible contexts in which the word would be acceptable, which would in turn adversely affect the likelihood that a single word in the target language can be used in the same set of contexts.

Similarly, it is to be expected that greater breadth of meaning would lead to greater semantic mutability, i.e., tendency of a word to change its meaning as a function of context. One way in which the mutability of noun and verb meanings has been studied has been to create semantically strained sentences, then present them to participants to be

paraphrased. Afterwards, the paraphrases are presented to a new set of participants whose task is to either paraphrase the paraphrased sentences (Gentner & France, 1988) or to choose the original word from a set of possibilities in a “retrace task” (Fausey et al., 2006; Gentner & France, 1988). Assuming that the less a word’s meaning changes, the more likely it is to be recovered (Gentner & France, 1988), the rate at which the original noun or verb is either produced (in the back-paraphrase task) or chosen (in the retrace task) is taken to be indicative of the extent to which the meaning of the word has remained stable despite the semantic incompatibility of the original sentence. In English, it has been found that nouns are both reproduced and chosen in a retrace task more commonly than are verbs (Fausey et al., 2006; Gentner & France, 1988), although this finding has not generalized beyond English (Fausey et al., 2006).

Like the semantic features of translatability and mutability, the psychological differences between nouns and verbs may relate to the relatively broader meanings associated with verbs. For instance, Kersten & Earles (2004) found that verbs are more difficult to recognize in new semantic contexts than are nouns, suggesting that this may be due to the variation in verb meaning as a function of semantic context. As a case in point, the way in which a horse *runs* is different from the way in which a machine *runs*. Because the action that will come to mind when told that a horse *runs* is different from the action associated with a machine *running*, it may be difficult to recognize *run* in the context of a machine having encoded it in the context of a horse. This difference is argued to be less pronounced for the concepts associated with nouns: the animal that comes to mind for “the *horse* runs”, for example, is not very different from the one that comes to mind for “the *horse* eats”.

Finally, it has been argued that both children and second language learners are slower to acquire verbs than nouns (Gentner, 1981, 1982; Gentner & Boroditsky, 2001), a difference that likely stems from the difference in breadth of meaning, as it stands to reason that it would be simplest to learn to consistently use a word in its appropriate contexts if there are few such contexts.

While the differences noted between nouns and verbs may be based on a difference in breadth of meaning associated with the two word classes, it is by no means clear that even this difference stems from the lexical class *per se* of the

words in question. Rather, it may be that differences in the *nature of the meanings* of nouns and verbs are responsible for the broader set of linguistic and psychological differences that have been noted. As Gentner has pointed out (1981, 1982), the most salient semantic difference is that nouns tend to name objects and entities, while verbs tend to name relations between objects. In this paper, we follow up on this explanation, addressing the question of whether differences can be noted between *more relational* and *less relational* words in general, regardless of their lexical class.

If in fact the constellation of differences between nouns and verbs stems from a difference in the extent to which their meanings are relational, we should see similar differences between sets of words which differ with respect to relationality regardless of syntactic class. Gentner and Kurtz (2005; see also Asmuth & Gentner, 2005) discuss just such a contrasting pair of word types: object nouns and relational nouns. Like verbs, relational nouns name relations between objects and entities, rather than the objects and entities themselves (which are named by object nouns).

Experiment 1

Although prototypically nouns refer to sets of entities characterized by their shared intrinsic properties, this is not always the case. Notably, some nouns denote sets of entities whose membership is determined by the relations in which they participate (Asmuth & Gentner, 2005; Gentner & Kurtz, 2005) rather than by the presence or absence of shared intrinsic properties. For example, an entity can be called a *bridge* if it connects two other entities or points, be they concrete or abstract. Failure to do this (imagine, e.g., a “bridge” floating in the air such that it is in contact with nothing), may preclude the use of *bridge* (particularly without qualification), regardless of whether the object physically resembles other bridges. Drawing on this distinction between types of nouns, Asmuth and Gentner (2005) found that relational nouns, like verbs, are more semantically mutable and harder to recognize in new contexts than are object nouns.

In Experiment 1 we sought to replicate and extend Asmuth and Gentner’s (2005) finding that relational nouns are more mutable than object nouns, considering both a different task from Asmuth and Gentner’s, and an additional language. We thus employed a back-paraphrase task like that used to study the semantic mutability of verbs relative to nouns (Gentner & France, 1988), run in both English and Spanish. The experiment was organized in two parts: a paraphrase task, in which participants were asked to rewrite a set of semantically strained sentences in their own words; and a back-paraphrase task, in which a new set of participants was given the paraphrases generated in Part 1 and asked to guess what the original sentences may have been.

If the verb mutability effect noted by Gentner and colleagues (Fausey et al., 2006; Gentner & France, 1988) is indeed due to a difference between object and relational

meanings, relational nouns should be more mutable, and thus less likely to be returned in the back-paraphrase task, than object nouns.

Part 1: Paraphrase

Participants 27 English speakers and 22 Spanish speakers volunteered or received course credit for their participation. The English speakers were students at the University of Louisiana at Lafayette; the Spanish speakers, at the University of Murcia, Spain. Data sets from three Spanish speakers and five English speakers were excluded because they failed to follow directions. The incomplete sets of responses of an additional seven English speakers were combined to create five complete sets of paraphrases, for a total of twenty complete sets of English paraphrases and nineteen complete sets of Spanish paraphrases.

Materials A set of ten object nouns, ten relational nouns, and ten verbs were chosen for this task. Each verb was paired with one object noun and one relational noun for a total of twenty intransitive sentences of the form “The noun *verbed*”. Care was taken to ensure that the action named by the verb was typical of neither the object noun nor the relational noun paired with the verb, thus ensuring that the sentences in both conditions would exhibit semantic strain. In addition, the materials were chosen with the goal of maximizing the faithfulness of the translations of the individual words between English and Spanish. Finally, the frequencies of the object nouns, relational nouns, and verbs did not differ significantly¹, as confirmed by a 2 (language) x 3 (word type) ANOVA, all *F*s < 1.5. Pairwise examination of the nouns occurring with each verb revealed that the object noun is more frequent in 5/10 English sets, and in 6/10 Spanish sets. The English nouns and verbs are presented in Table 1.

Table 1: English nouns and verbs used in Experiment 1

Object nouns	Relational nouns	Verbs
Lizard	Barrier	Dress
Mouse	Carnivore	Ring
Lion	Bridge	Soften
Dog	Goal	Break
Cat	Shield	Relent
Table	Surprise	Die
Television	Weapon	Worship
Computer	Map	Shiver
Book	Trap	Complain
Vase	Tool	Flicker

Procedure The twenty sentences from Experiment 1 were combined with an additional ten sentences (see Experiment 2). Separate random orders of the thirty sentences were prepared for each participant and arranged in booklets.

¹ English frequency data was taken from Francis & Kučera (1982); Spanish data from www.elcorpusdelespanol.org.

As in earlier studies (Fausey et al., 2006; Gentner & France, 1988), participants were told to imagine that they had overheard the sentences in the booklet and to restate each sentence in their own words, taking care not to repeat any of the words in the sentence. Special attention was paid to the repetition of the target nouns, verbs, and prepositions; participants were asked to rephrase sentences in which these words were repeated². Participants were told that there were no right or wrong answers, and that our interest was in understanding what they thought that the sentences meant. The resultant paraphrases were then used as materials in Part 2.

Part 2: Back-paraphrase

Participants 20 English speakers and 19 Spanish speakers from the same populations as in Part 1 volunteered or received course credit for their participation; none had participated in Part 1. Data from one English speaker was excluded due to failure to respond to all of the sentences.

Materials The sets of paraphrases produced in Part 1 comprised the booklets for Part 2.

Procedure Participants were given booklets including one paraphrase for each of the original sentences. They were told the sentences were paraphrases of sentences, and asked to write out what they thought the original sentences were.

Results

As predicted, Experiment 1 replicated previous results showing greater semantic mutability for verb meanings than for noun meanings, and extended this result to an additional language, Spanish. Across both kinds of sentences and both languages, the original nouns appeared in the back-paraphrases more often than the verbs with which they were paired (Figure 1), $F(1,72) = 69.15, p < .0001$.

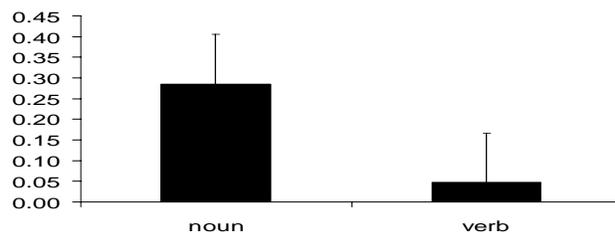


Figure 1: Rate of return of nouns and verbs averaged across both sentence types and both languages.

² In line with our prediction of greater mutability for more relational words, one might expect the paraphrase task to be harder for object noun sentences than relational noun ones. There is limited support for this: of the unusable sentences in English, 46 were object noun sentences (32 due to nouns; 14, to verbs) and 28 were relational noun sentences (20 due to nouns; 8, to verbs). Similarly, the only Spanish sentence not fully paraphrased was an object noun sentence (*El libro se quejó* 'The book complained'). We thank an anonymous reviewer for suggesting this analysis.

Furthermore, we found an effect of type of noun on the rate at which content words reappeared in the back-paraphrases, whereby participants in both language groups were more likely to reproduce the original content words in sentences involving object nouns ($M = .22$) than in sentences involving relational nouns ($M = .12$), $F(1,72) = 12.50, p = .001$. Of particular interest was the interaction between the two factors ($F(1,72) = 16.76, p < .0001$), suggesting that the effect of sentence type was entirely due to the differing rates at which object nouns and relational nouns reappeared in the back-paraphrases (Figure 2). As predicted, we found that object nouns returned more often than relational nouns, while there was no difference in the rate at which verbs in the two types of sentences returned.

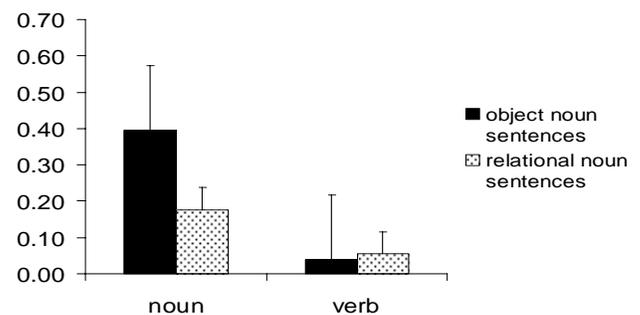


Figure 2: Rate of return of nouns and verbs in the two types of sentences, averaged across language

Discussion

In Experiment 1 we asked whether the verb mutability effect noted by Gentner and her colleagues (Fausey et al., 2006; Gentner & France, 1988) might generalize to a relational mutability effect, whereby words referring to relational categories are more mutable than words referring to object categories, regardless of lexical category. Our results support this analysis: relational nouns were returned less often in a back-paraphrase task than were object nouns, suggesting greater semantic mutability. Because in both cases the words in question were nouns, this difference is not explainable by a difference in syntactic category³. Further, this difference can not be explained by a difference in breadth of meaning. Taking synonymy relations as indicative of breadth of meaning, we asked how many WordNet synsets the English nouns in our study participated in. We found that, in contrast with the mutability results, the relational nouns participate in more synsets ($M = 4$) than do the object nouns ($M = 4.8$)⁴. We thus conclude that the

³ Despite this, it is possible that syntactic category per se also results in differences in mutability, as seen in the differing rates of return of nouns and verbs. As this is not the focus of the current experiments, we leave this issue to future research.

⁴ Breadth of meaning may be involved in the Spanish results, as the Spanish relational nouns had more synonyms ($M = 10.6$) than

observed difference is likely due to the semantic difference between more relational and less relational meanings.

Experiment 2

In Experiment 2 we sought to extend the findings from Experiment 1 to a second relational contrast: verbs and spatial prepositions. Like verbs, spatial prepositions occur in a wide range of contexts (e.g., Brugman, 1988; Herskovits, 1986), suggesting breadth of meaning. In order to compare the mutability of verbs and prepositions, we sought verbs that commonly co-occur with prepositions, yet are semantically compatible with only a subset of the available prepositions.

Because they describe motion along a particular path in space, path verbs provided just such a set. To ensure that our sentences would be semantically strained, we paired each path verb in our set with a spatial preposition which names a path or location different from that lexicalized in the verb.

As in Experiment 1, we employed a back-paraphrase task (Gentner & France, 1988) in both English and Spanish. If, as Gentner suggests (Gentner, 1981; Gentner & Boroditsky, 2001), spatial prepositional meanings are indeed more relational than verbal meanings, we should expect to see that spatial prepositions are more mutable, and thus less likely to be returned in a back-paraphrase task, than are path verbs.

Part 1: Paraphrase

Participants The participants in Part 1 of Experiment 1 also served as participants in Part 1 of Experiment 2.

Materials A set of ten path verbs and ten prepositions was chosen for this task. Each verb was paired with an incompatible preposition to form an intransitive sentence. In order to ensure that any changes in the verbs and prepositions under paraphrase were due to their semantic incompatibility, English sentences were presented with animate pronouns as subject (half *he* and half *she*), and Spanish sentences were presented without overt subjects. As in Experiment 1, the sentences were all in the past tense, and the materials were chosen with the goal of maximizing the faithfulness of the translations of the individual words between English and Spanish⁵. The English verbs and prepositions are presented in Table 2.

Procedure The procedure was the same as in Part 1 of Experiment 1: participants were given a set of sentences, asked to imagine that they had overheard the sentences, and then to rewrite them in their own words.

did the object nouns ($M = 2.4$) (based on a count of synonyms in www.elcorpusdelespanol.org). We leave resolution of this language difference and its ramifications for future research.

⁵ Due to the extremely high frequency of prepositions, word frequency could not be balanced in this experiment.

Table 2: English stimuli used in Experiment 2

Verb	Prepositional phrase
Arrive	Over the room
Escape	Under the park
Return	In the house
Rise	Against the chair
Fall	In the door
Enter	Around the room
Descend	Outside the building
Exit	To the cage
Approach	Between the trees
Cross	Toward the street

Part 2: Back-paraphrase

Part 2 of Experiment 2 was identical to Part 2 of Experiment 1. The paraphrases generated in Part 1 were assembled into booklets, along with the paraphrases from Experiment 1, and participants were asked to try to figure out what the words had been in the original sentences.

Upon examining the data from Part 2, it was found that the original preposition appeared in a high proportion of the initial English paraphrases (from Part 1) for two of the sentences (*She exited to the cage*, and *He fell in the door*). As a result, these two sentences were removed from the analysis in both language samples.

Results

As predicted, we found a difference in the rate at which path verbs and spatial prepositions were returned in the back-paraphrase task. In both languages, the original verb reappeared more often than the preposition with which it was paired (Figure 3), suggesting greater semantic mutability for spatial prepositions than for path verbs. This result was confirmed with a 2 (language: Spanish or English) x 2 (word type: verb or spatial preposition) ANOVA, $F(1,28) = 9.94, p < .005$.

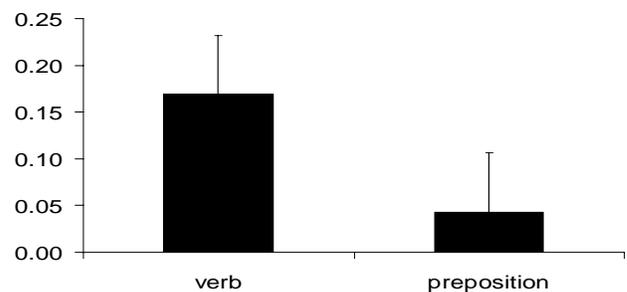


Figure 3: Rate of return of path verbs and spatial prepositions, averaged across language

There were no other significant effects or interactions.

Discussion

Following up on Gentner's (1981; Gentner & Boroditsky, 2001) suggestion that the meanings of spatial prepositions are more relational than the meanings of verbs, Experiment 2 built upon the result from Experiment 1 by examining the differential mutability of path verbs and spatial prepositions. When presented in semantically strained intransitive sentences describing motion events, path verbs were found to be more likely to reappear in back-paraphrase than were spatial prepositions, suggesting that the path verbs are less mutable. This result generalizes the relational mutability effect across the object-relation continuum proposed by Gentner (1981; Gentner & Boroditsky, 2001).

General Discussion

Linguistically and psychologically, it has long been noted that there are many differences between nouns and verbs. In the present paper, we consider one difference, breadth of meaning as evidenced by semantic mutability. We asked whether the noun and verb mutability effects reported for English (Fausey et al., 2006; Gentner & France, 1988) might represent the effects of the relative positions of the words tested along a proposed object-relation continuum (Gentner, 1981; Gentner & Boroditsky, 2001) by testing additional positions along the continuum: the position of relational nouns relative to object nouns, and the position of spatial prepositions relative to path verbs. In both cases, we found evidence for the influence of such a continuum on the semantic mutability of words. Furthermore, we extended the examination of these effects into an additional language, Spanish, suggesting that the effects that have been reported are not due to peculiarities of the English language.

Our results from Experiment 1 both replicate and extend previous findings: under semantic strain, nouns were less mutable than verbs, and, within the noun category, relational nouns were more often semantically adjusted than object nouns, in both English and Spanish. Unlike nouns and verbs, relational nouns and object nouns belong to the same lexical category (i.e. both are nouns). However, like nouns and verbs, relational nouns and object nouns differ with respect to where they fall on the object-relation continuum. Thus, the greater mutability of relational nouns relative to object nouns provides support for the conjecture that the verb mutability effect (Fausey et al., 2006; Gentner & France, 1988) is due to a semantic, rather than a lexical category, difference.

Experiment 2 extended the evidence for the effect further along the object-relation continuum: English and Spanish speakers were more likely to preserve the meanings of path verbs than of spatial prepositions in situations involving semantic strain, as shown by the higher rate of returning verbs.

Looking at the rates at which the verbs returned in the two experiments, we note that the verbs were more likely to return when paired with incompatible prepositional phrases (E2) than when paired with incompatible subject nouns

(E1).⁶ While we cannot directly compare across the two experiments, this difference raises issues to be addressed in future research. Though there is a clear semantic difference between the verbs used in the two experiments, we think it is likely that our results are driven by the diverging degrees of relationality between the words accompanying the verbs. Concretely, in Experiment 1, verbs were paired with nouns, which are less relational, whereas in Experiment 2, they were paired with prepositions, which are more relational. According to the Relational Mutability Hypothesis, the meaning of the more relational word will change to accommodate the less relational word in situations of semantic strain (Gentner, 1981). Thus, it is to be expected that the verb meanings will be more stable when paired with an incompatible preposition than when paired with an incompatible noun.

In addition to extending previous findings beyond the comparison of nouns and verbs, the current study extends the relational mutability effect into Spanish, which is typologically distinct from English. First, Spanish is a pro-drop language (i.e. a language in which it is possible to omit pronominal subjects from sentences), which may result in a more central role accorded to the verb (Choi & Gopnik, 1995; Tardif, 1996; see also Fausey et al 2006) due to the fact that the verb is the only necessary element. Second, path verbs (like those used in E2) are more frequent in descriptions of motion events in Spanish than in English (Aske, 1989; Slobin, 1996; Talmy, 1985), which may make them more lexically available and hence more likely to appear in back-paraphrases. Third, the distributed semantics of the two languages differ: Spanish overtly distributes spatial relational meaning into spatial prepositions and verbs (Sinha & Kuteva, 1995), with the result that Spanish spatial prepositions are relatively broad in meaning (Aske, 1989; Slobin, 1996), whereas verbs carry much semantic weight regarding localization of the event and give the specificity necessary for comprehension. This situation is what one might expect given that Spanish is a verb-framed language (Talmy, 1985). In contrast, English tends to restrict the overt expression of spatial relational meaning to a single word within the sentence, either the verb or the preposition, but not both at the same time (Sinha & Kuteva, 1995). Further, as English is a satellite-framed language (Talmy, 1985), the expression of path and spatial location is most likely to occur in the preposition. All of these facts together suggest that greater importance may be accorded to the verb in Spanish than in English, with the result that Spanish verbs may be less mutable (cf, Fausey et al., 2006). Despite these cross-linguistic differences, we observed the predicted relational mutability effect in Spanish, suggesting that the object-relation continuum may play a similar role in the two languages.

While the results presented here support the conjecture that mutability under semantic strain is related to relationality of meaning, they raise the question of whether other semantic features may also play a role. For example,

⁶ We thank an anonymous reviewer for pointing this out.

Asmuth and Gentner (2005) suggest that the degree of concreteness or abstractness of relational nouns may have an effect on their potential mutability under semantic strain. For instance, “bridge” and “tool” might be seen as more concrete than “surprise” or “goal”; might they also be less prone to shifts in meaning under semantic strain?

Finally, we have considered here only one semantic consequence of the object-relation distinction: mutability under semantic strain. However, Gentner (1981, 1982; Gentner & Boroditsky, 2001) has identified a family of semantic differences between verbs and nouns, including breadth of meaning, variability across languages, translatability, memorability, and ease of acquisition by children and second language learners. We leave to future research the question of whether these effects can be extended along the object-relation continuum.

Conclusion

The two experiments reported in this paper present evidence that the differences noted between nouns and verbs (Fausey et al., 2006; Gentner, 1981, 1982; Gentner & Boroditsky, 2001) may be due more generally to the distinction between more relational and less relational meanings. In addition, these results extend the investigation to a typologically distinct language, Spanish, in which the same effects were noted. Further investigations into the object-relation continuum across languages can shed light on the generality of the effects noted here while refining our understanding of the nature of the object-relation continuum in language.

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