

The Verb Mutability Effect: Noun and Verb Semantics in English and Japanese

Caitlin M. Fausey (cmfausey@psych.stanford.edu)

Department of Psychology, 450 Serra Mall, Bldg 420
Stanford, CA 94305 USA

Hanako Yoshida (hayoshid@indiana.edu)

Department of Brain and Psychological Sciences, 1101 East Tenth Street
Bloomington, IN 47405 USA

Jennifer Asmuth (asmuth@northwestern.edu)

Dedre Gentner (gentner@northwestern.edu)

Department of Psychology, 2100 Sheridan Rd.
Evanston, IL 60201 USA

Abstract

To what extent are the processing patterns for nouns and verbs universal across languages? Under conditions of semantic strain, English speakers tend to adapt the meaning of the verb to fit the noun in the sentence. We asked Japanese and English speakers to paraphrase simple sentences of the form “The noun verbed,” varying in semantic strain (e.g., “The blender talked”). We then assessed the degree to which speakers adjusted the default word meanings in their paraphrases by asking a new group of speakers to read the paraphrases and to guess (“retrace”) which word had occurred in the original sentence. As predicted, English speakers retraced more nouns than verbs, suggesting that verb meanings were adjusted to a greater degree than noun meanings in the paraphrases. However, the results for Japanese speakers did not differ between nouns and verbs. We discuss implications for the universality of a noun-verb mutability difference.

Introduction

Research has revealed important psychological differences in the acquisition and processing of nouns and verbs. This has been taken to be evidence of deep semantic differences between the two. But how universal are these differences? Languages appear to vary significantly in the salience and emphasis that verbs are given relative to nouns, and it is possible that the psychological noun-verb differences will also vary by language. This paper examines these issues, exploring cross-linguistic differences in noun-verb processing patterns.

Synthesizing linguistic and psychological research, Gentner (1981; 1982; Gentner & Boroditsky, 2001) has argued for a deep semantic distinction between nouns and verbs. Gentner has emphasized the following: (a) Verbs are more mutable than nouns, in that their meanings are adjusted more than noun meanings under semantic strain; (b) Verbs are poorer in memory—more difficult to recall and recognize—than nouns; (c) Verbs are more polysemous than nouns: at all frequency levels, verbs have a greater number of word senses than do nouns; (d) Verb meanings differ more cross-linguistically than do noun meanings; (e)

Verbs are more difficult to translate between languages than are nouns; (f) Verbs are less often borrowed across languages than nouns; and (g) Verbs are slower to be acquired by children (and in second-language learning) than nouns.

Gentner (1981) theorized that the first three phenomena are connected via *differential adjustability*. If verbs are more likely to undergo meaning adjustment during comprehension, they will of course be more mutable under semantic strain. This leads to poorer memory for verbs than nouns, because verb meanings as encoded have been contextually altered to suit the noun (Kersten & Earles, 2004). Finally, to the extent that similar verb adjustments occur repeatedly, verbs will accrue more meaning senses than nouns.

In this research, we asked whether the processing pattern of greater mutability for verbs than for nouns might be a semantic universal. As discussed below, a plausible case can be made in either direction: i.e., for a universal processing pattern, or for an English-specific pattern. Japanese is an interesting language to contrast with English with respect to the mutability of verbs, because there is reason to believe that verbs are more central in Japanese than in English. If indeed verbs are more central, we might expect them to be less mutable.

Arguments for verb centrality in Japanese. There are typological differences between Japanese and English that may render verbs more salient in Japanese than in English. For example, Japanese word order is SOV, placing the verb in the salient sentence-final position (Slobin, 1973), in contrast to the SVO order of English (which places the verb in a low-salience middle position). Another typological factor that may increase verb salience in Japanese is pro-drop: that is, the ability of a language to omit pronouns when the reference has been established or is obvious from context. In Japanese, for example, instead of saying “Watashi wa byōki desu” (“I am sick”), one can simply say “Byōki desu” (“Am/Is/Are sick”). Thus, a single verb can constitute a complete sentence: e.g., “Yatta!” (“I /we/ they did (it)!”). Researchers have theorized that speakers of pro-drop languages may experience verbs as more central (Choi

& Gopnik, 1995; Tardif, 1996). Further, cross-cultural variation in sensitivity to the context of utterances, as well as sensitivity to context more generally (e.g., Kitayama & Ishii, 2002), could lead to adult usage patterns in which nouns and verbs are treated differently across languages.

Consistent with these ideas, child language researchers have found that caregiver-to-child speech in Mandarin, Korean and Japanese includes more verb types and tokens than such speech in English (e.g., Au, Dapretto & Song, 1994; Ogura, 2001; Tardif, 1996). Snedeker, Li, and Yuan (2003) suggested that the information available in extralinguistic contexts may support nouns and verbs equally for learners of Mandarin, but favor nouns for learners of English. Finally, Fernald and Morikawa (1993) found that Japanese mothers use fewer nouns than do American mothers in caregiver-to-child speech. In sum, verbs may be more important, and thus perhaps less mutable, to speakers of Japanese than to speakers of English.

The Verb Mutability Effect. We adapted a technique used by Gentner and France (1988) to study the combinatorial semantics of nouns and verbs. Gentner and France (1988) explored the phenomenon of meaning adjustment under semantic strain in English speakers. They asked English speakers to paraphrase simple noun-verb sentences, some of which were semantically strained (e.g., “The lizard worshipped”), while others were not (e.g., “The politician worshipped”). Not surprisingly, participants were able to paraphrase the low strain sentences without deviating far from the default meanings of the words. The question of interest was what people would do in response to a semantically strained sentence such as “The lizard worshipped.” Specifically, the question was whether the noun would be altered to fit the verb, as in “The hypocritical person went to church” or the verb to fit the noun, as in “The chameleon stared at the sun in a daze.”

Because directly rating the degree of meaning change across form class is problematic, Gentner and France used two indirect methods: a *double paraphrase task* and a *retrace task*. In the double-paraphrase task, a new group of English speakers was given the paraphrases generated in the paraphrase task and was asked to paraphrase them. The resulting double paraphrases were examined for the reappearance of original nouns (e.g., “lizard”) and original verbs (e.g., “worshipped”). Gentner and France found that 19% of original nouns, but only 4% of original verbs, appeared in the double paraphrases, suggesting that the original participants had altered the meanings of the verbs more than the meanings of nouns.

The second task used to assess change of meaning was a *retrace task*. Two new groups of participants were given the paraphrases generated by a set of original participants. One group was also given a list of the initial nouns (that is, the nouns of the stimulus sentences that the initial participants had paraphrased). The other group received the initial verbs. Their task was to guess which word had occurred in the original sentence. Gentner and France found that people correctly selected (“retraced”) the original nouns

significantly more often than the original verbs. Further, the greatest difference occurred for the semantically strained sentences, suggesting that verbs change meaning most when under high semantic strain (as opposed to simply having vague meanings). These findings suggest that the chief locus of meaning adjustment in noun-verb conceptual combination is the verb, rather than the noun, and that meaning adjustment is orderly, changing most in the most strained conditions.

Before embarking on the cross-linguistic comparison, we note an important qualification. The verb mutability studies to date have used primarily concrete nouns. In our recent research we have investigated a class of nouns we call “relational” nouns (e.g., *mother*, *barrier*), which have meanings centered around extrinsic relations with other concepts. Relational nouns are similar to verbs in that they can take arguments and assign a thematic role (e.g., *barrier* implies three arguments, a figure, something that blocks access, and a goal). Relational nouns have a rather “verby” quality, and indeed in English we have found evidence that relational nouns are more mutable than nouns referring to concrete entities (Asmuth & Gentner, 2005). In the present research we used concrete nouns in both languages.

Verb Mutability: A Universal Pattern? In this research we extend the above paraphrase methodology to ask whether the verb mutability effect holds cross-linguistically. There are reasons to speculate that this pattern might be universal. First, Gentner and France speculated that the verb mutability pattern may stem in part from the fact that verbs have a predicating function within the sentence, whereas nouns act as arguments of the predicate. Thus the verb’s role requires that it provide a relational structure that links the nouns of a sentence. A second line of reasoning in support of verb mutability as a universal arises from language acquisition research. If, as Gentner and Boroditsky (2001) claimed, nouns pick out highly coherent, easily individuated entities (and are therefore learned earliest across languages),¹ it might follow that nouns would be more stable than verbs in adult combinatorial semantics.

To test the possibility that the verb mutability effect is universal requires taking into account variations in the typological and input features of different languages. An obviously plausible alternative possibility is that the verb mutability effect varies cross-linguistically according to the degree to which a language is verb-salient. To investigate this possibility, we extended Gentner and France’s (1988) exploration of combinatorial semantics to speakers of Japanese.

Present Study

Our goal was to test whether the verb mutability effect would hold for Japanese speakers (and also whether the effect would be replicated with new materials in English). A

¹ Note that Ogura et al. (2006) reported that despite the increased proportion of verbs in Japanese caregiver-to-child speech, children still produced more nouns than verbs in early one-word utterances.

demonstration of verb mutability in Japanese would support the possibility that universal semantic differences hold between nouns and verbs in adult processing (as appears to be the case in language acquisition). Other possible patterns of results for adult Japanese speakers include: (a) Japanese speakers might show the reverse pattern from English speakers: a “noun mutability effect,” such that the locus of meaning adjustment is the noun (consistent with the verb-salience noted above); (b) Japanese speakers might show the same qualitative verb mutability effect as English speakers, but to a lesser degree. This possibility would argue for a universal noun-verb semantics that is moderated by language-specific factors; or (c) Japanese speakers might treat nouns and verbs similarly in a combinatorial semantics task. If Japanese speakers do not show the verb mutability effect, this will be evidence against the universality of noun-verb differences in adult processing. In addition, such a finding will call for theories that take into account the role of typological variation and extralinguistic contexts in meaning adjustment strategies.

Materials and Design

Noun and Verb Matrix. In Part A, participants paraphrased sentences of the form, “The noun verbed.” Sentences were composed using all possible pairs of 24 nouns and 24 verbs. Of the 24 nouns, 8 were human, 8 were animate non-human, and 8 were artifacts. Similarly, 24 verbs were divided so that 8 selected each type of subject noun (see Table 1 for examples).

The nouns and verbs of these sentences varied in compatibility with each other so that some sentences were easily understood while others were semantically strained. For example, the verb “talk” prefers a human subject, and so the sentence, “The mother talked” is acceptable. When paired with an artifact subject, as in, “The blender talked,” the sentence is semantically strained. Sentences belonged to one of three groups: (a) Matched, where the noun matched the argument specification of the verb (e.g., “The mother talked”), (b) Overmatched, where the noun exceeded the argument specification of the verb (e.g., “The mother kicked”; “kick” requires only that its subject be animate, and not necessarily human), and (c) Undermatched, where the noun failed to meet the argument specification of the verb (e.g., “The blender talked”). The undermatched sentences were semantically strained, required the greatest meaning adjustment in paraphrase, and provided a test for differential adjustment of nouns versus verbs in paraphrasing strategies.

Selection of Nouns and Verbs. The selection of noun and verb stimuli were guided by the following criteria: (a) Within each noun category (human, animate non-human, artifact), all verbs should accept all nouns as subjects, (b) All nouns and verbs should be low in ambiguity in English and in Japanese, (c) Each noun and verb should have similar meanings in English and in Japanese. Importantly, each noun and verb must fall in the same category (human, animate non-human, artifact) in English and in Japanese.

Table 1: Example stimuli.

	mother	pony	blender
talk	The mother talked.	The pony talked.	The blender talked.
kick	The mother kicked.	The pony kicked.	The blender kicked.
stop	The mother stopped.	The pony stopped.	The blender stopped.

English and Japanese stimuli. All English and Japanese nouns, verbs and sentences were direct translations of each other. Stimuli were prepared iteratively by the authors (who enlisted the intuitions of other native English-speaking and Japanese-speaking informants).

Design. The full 24-noun by 24-verb matrix was divided into four 6-noun by 6-verb matrices. Each of the 6x6 matrices consisted of two nouns and two verbs in each of three categories: human, animate non-human, and artifact (see Table 1). From these four 6x6 matrices, six sentence sets were constructed: Each set consisted of six sentences from each matrix, making a set of 24 sentences in which each noun and each verb appeared once and only once. Each sentence set contained an equal distribution of matched, overmatched, and undermatched sentences. Each participant received a randomized order of 24 sentences from one set. An equal number of participants received each of the sentence sets.

Part A: Paraphrase

Participants 24 English speakers and 24 Japanese speakers volunteered or received course credit for their participation. All participants were university students. In 5 cases, participants violated instructions by producing more than two paraphrases that included repetitions of original words, leaving more than two paraphrases blank, and/or writing patently silly responses. These participants were removed, and additional participants were recruited to replace these sentence sets.

Procedure Participants were asked to paraphrase a set of 24 sentences—that is, to restate the meaning of each sentence in their own words. They were told to imagine that they had overheard the sentence in passing and were trying to determine what a sensible person could have meant by it. Participants were told to avoid simply mechanically replacing each word in the sentence with a similar word without taking into account the meaning of the sentence as a whole; rather, they were asked to imagine a situation in which someone might have said the sentence, and come up with the most natural interpretation possible. Participants were instructed not to use pronouns in their paraphrases and not to repeat any content words from the original sentences.

Pilot testing revealed that Japanese participants sometimes produced paraphrases that did not restate the meaning of the sentence, but rather described the context in which someone might have said the sentence, while English

speakers sometimes took the route of replacing each word by a synonym. To minimize differences in interpretation of the paraphrase task, Japanese speakers were provided with several good and bad paraphrases that illustrated many of the misunderstandings revealed by piloting; English speakers were provided with an example of mechanistic synonym replacing (of both the noun and the verb) and were told not to approach the task in this way. With the exception of number of examples, the instructions were equivalent in English and in Japanese.

The paraphrases served as materials in the subsequent retrace task (see Table 2 for examples). The retrace dependent measure assessed the degree to which participants changed the meaning of nouns and the meaning of verbs in their paraphrasing strategies.

Table 2: Sample paraphrases of an undermatched sentence.

Original Sentence: The vase laughed. / 花瓶が笑った。

English paraphrases

The piece of crystal sparkled.

The piece of glass used to hold flowers giggled.

Japanese paraphrases

きれいな女の人デートに誘った。

(A beautiful lady asked for a date.)

花が曲がった。

(A flower bent.)

Part B: Retrace

In the retrace task, a new group of participants saw the paraphrases along with sets of original nouns or original verbs and tried to guess which word had occurred in the original sentence. To the extent that noun meaning is less altered than verb meaning in the paraphrases, it is easier to recover the original noun than the original verb in this retrace task.

Participants An additional 24 English speakers and 24 Japanese speakers volunteered or received course credit for their participation. All participants were university students.

Materials Retrace packets consisted of sentences, each accompanied by 12 word choices. Sentences were paraphrases generated by participants in the initial paraphrase task. Word choice sets consisted of a subset of nouns or verbs from the original matrices.

Design Packets of 96 paraphrases, each consisting of 24 paraphrases from each of four participants in the initial paraphrase task, were constructed. Half the retrace participants were given noun packets, in which a set of 12 nouns was placed beneath each paraphrase. The other half were given verb packets, in which a set of 12 verbs was placed beneath each paraphrase (see Table 3 for examples).

Table 3: Retrace packet examples. Here, the original sentence is “The blender talked.” The paraphrase is shown along with the set of nouns and/or verbs provided to raters.

Noun Packet

The juice spilled out of the mixer.

blender car vase pilot bird mouse
teacher bracelet artist panda boy turtle

Verb Packet

The juice spilled out of the mixer.

floated talked doubted moved decided endured
laughed stopped strayed helped listened drank

Paraphrases of any particular original sentence (e.g., “The mother talked”) never appeared more than once in a retrace packet. Of the 96 paraphrases in each packet, 48 were generated in response to sentences that had been constructed from two of the four 6x6 matrices, and the other 48 were generated in response to sentences from the other two. The order of matrix pairs was counterbalanced across participants, and the order of the paraphrases within a matrix-pair block was randomized for each participant.

The 12 word choices placed beneath each paraphrase corresponded to the matrix pair from which the paraphrases had been generated. The order of original nouns and original verbs within each 12-word set was randomized once and used for all participants.

Procedure Participants were told that the sentences they would read were paraphrases generated by other participants and that their job was to figure out which words had been used in the original sentences. Participants were told that a set of words would appear below each paraphrase and were asked to circle the word that was most likely to have been in the original sentence. The instructions emphasized that there were no restrictions on the number of times they could select a particular word and that they might feel that some words go with many of the paraphrases whereas others go with none. These instructions, plus the large number of sentences, were intended to prevent participants from adopting strategies (e.g., process of elimination) that might inflate or otherwise distort their accuracy in the retrace task.

Results

The dependent measure of meaning preservation was the proportion of correct selections of the original noun or verb; that is, the proportion of correct retraces. All reported effects were significant at the $p < .05$ level, and unreported effects were not significant. Results for matched and overmatched noun-verb pairs were collapsed to compare performance differences between the semantically strained undermatched pairs and semantically unstrained pairs.

Overall analysis. A 2 (Form Class: Noun, Verb) by 2 (Semantic Strain: Strained, Unstrained) by 2 (Language: English, Japanese) Analysis of Variance (ANOVA), in

which language and form class varied between-subjects and semantic strain varied within-subjects, revealed three significant main effects as well as the three-way interaction.

Overall, English speakers retraced a greater proportion of words ($M = 72.9\%$, $SE = 2.0\%$) than did Japanese speakers ($M = 44.7\%$, $SE = 2.0\%$), $F(1,44) = 103.58$. Note that Japanese speakers performed well above chance (8.3%), and that this main effect is best interpreted in light of other patterns reported below (as discussed below).

Overall, nouns ($M = 62.8\%$, $SE = 2.0\%$) were retraced better than verbs ($M = 54.7\%$, $SE = 2.0\%$), $F(1,44) = 8.54$. Also, words from unstrained sentences ($M = 64.6\%$, $SE = 1.2\%$) were retraced better than words from strained sentences ($M = 52.9\%$, $SE = 1.9\%$), $F(1,44) = 62.39$.

The two-way interaction between form class and language, $F(1,44) = 4.92$, as well as the three-way interaction among strain, form class and language, $F(1,44) = 4.37$, were significant, and so post-hoc analyses of only English speakers and only Japanese speakers were conducted.

English. A 2 (Form Class: Noun, Verb) by 2 (Semantic Strain: Strained, Unstrained) ANOVA, in which form class varied between-subjects and semantic strain varied within-subjects, revealed a significant main effect of form class, such that English speakers retraced a greater proportion of nouns ($M = 80.0\%$, $SE = 2.9\%$) than verbs ($M = 65.8\%$, $SE = 2.9\%$), $F(1,22) = 11.81$.

This analysis also revealed a main effect of semantic strain, such that English speakers retraced more words in the unstrained ($M = 78.3\%$, $SE = 1.7\%$) than in the strained condition ($M = 67.4\%$, $SE = 2.9\%$), $F(1,22) = 22.63$.

The interaction between form class and strain reached significance, $F(1,22) = 5.86$. Planned comparison t-tests revealed that English speakers correctly retraced significantly more nouns than verbs at both levels of semantic strain (Unstrained: $t(22) = 2.61$, Strained: $t(22) = 3.41$), and this difference was particularly pronounced in the strained condition (see Figure 1).

Japanese. An identical analysis of retrace behavior of Japanese speakers revealed a significant main effect of semantic strain, such that Japanese speakers retraced more words in the unstrained ($M = 50.9\%$, $SE = 1.8\%$) than in the strained condition ($M = 38.4\%$, $SE = 2.3\%$), $F(1,22) = 44.24$, and no other main effects or interactions (see Figure 2).

Discussion

English speakers correctly retraced a greater proportion of nouns than verbs. This finding is consistent with prior findings (Gentner & France, 1988; Reyna, 1980), and suggests that when English speakers interpret and paraphrase noun-verb conceptual combinations, they preserve noun meaning to a greater extent than verb meaning. Further, English speakers found it most difficult to correctly retrace nouns and verbs in paraphrases generated from semantically strained sentences (the undermatched condition).

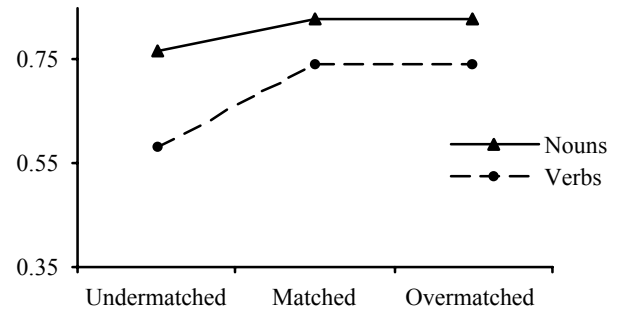


Figure 1: English retrace performance.

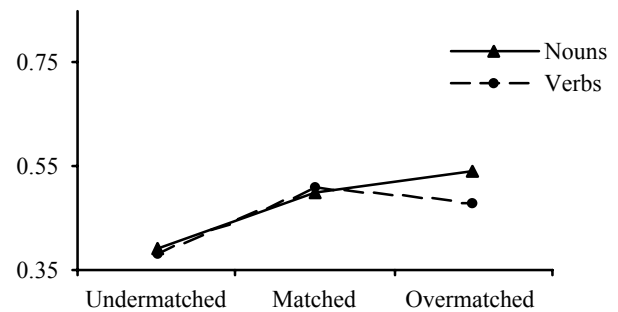


Figure 2: Japanese retrace performance.

In this semantically strained condition, the relative ease of correctly retracing nouns over correctly retracing verbs was especially pronounced. Japanese speakers did not show this verb mutability effect and instead correctly retraced approximately the same proportion of nouns and of verbs at all levels of semantic strain.

Interestingly, English speakers were better able to identify the words from which paraphrases had been generated than were Japanese speakers.

General Discussion

Nouns and verbs in English differ in many striking ways. Among other differences, nouns are less mutable, more memorable, and more easily acquired than verb meanings (Gentner, 1981). To what extent are these deep differences between nouns and verbs universal across languages?

The present study focused on mutability. We examined meaning adjustment strategies of English and Japanese speakers. Our results bear out previous findings for English: under semantic strain, speakers adjusted verb meanings more than noun meanings, suggesting that the verb was adapted to fit the nouns. In contrast, Japanese speakers showed no difference between nouns and verbs in degree of adjustment. These results suggest that the strength (and perhaps the very existence) of the verb mutability effect varies across languages.

Before accepting this conclusion we should note that there are several factors that may influence the patterns in our data. While Japanese speakers retraced original words above chance, and were sensitive to differences in semantic strain, overall they were considerably less accurate in the retrace task. This suggests that Japanese speakers may have adopted a different meaning adjustment strategy from English speakers. For example, our preliminary examination suggests that the Japanese paraphrases were more abstract than the English paraphrases, and more likely to contain conventional metaphors, such as “old man” as a paraphrase for “tortoise.” Another pattern suggested by the data is that English speakers may have used more close synonyms (especially for nouns) than did Japanese speakers. Future analyses will investigate whether there are cross-linguistic differences in the availability of synonyms for nouns and verbs, such that English speakers easily access synonyms for nouns but less so for verbs, while Japanese speakers find few synonyms for both nouns and verbs.

There could also be cross-cultural differences in communicative style that lead Japanese speakers to approach the task differently. For example, Japanese participants were more likely to describe the situation in which the sentence might be said rather than directly paraphrase its meaning than were English speaking participants. Although such responses were filtered out of our retrace task, they are indicative of different response strategies between the two groups.

To further provide insight into adult processing of nouns and verbs in multiple languages, future studies will aim to more rigorously control aspects of the paraphrase-retrace paradigm (e.g., word frequencies of translation equivalents and existence of synonyms in the two languages), and to employ alternative measures of semantic processing.

Investigations of linguistic universals and differences can yield important insights into issues of semantic representation. Despite some evidence for a universal advantage for nouns over verbs in acquisition (e.g., Gentner & Boroditsky, 2001), our results provide no evidence for a universal difference in sentence processing. The verb mutability effect may be specific to English and closely related languages.

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