Linking Meaning to Language: Linguistic Universals and Variation

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Abstract

To use natural language, speakers must map the participants in events or states in the world onto grammatical roles. There remains considerable disagreement about the nature of these so-called *linking rules* (Levin & Rappaport Hovav, 2005). In order to probe the nature of linking rules, we investigate verbs of psychological state, which demonstrate complex linking patterns both within and between languages. We find that the typical duration of the psychological state guides the application of linking rules to novel verbs in both English and Japanese, consistent with a universal constraint. Nonetheless, there are marked differences in the baseline preferences for the individual linking rules across the two languages. We discuss these findings both in terms of theories of exceptionless linking rules and accounts on which linking rules are governed by probabilistic biases as well as cross-linguistic variation.

Keywords: syntax; semantics; linking; UTAH; universal grammar; over-hypotheses.

The Linking Problem

To interpret *Mary broke the vase*, one must minimally identify the event described (*breaking*), the participants in that event (*Mary*, *vase*), and identify which participant played which role (*Mary* = breaker, not break-ee). This *linking problem* has received considerable attention both by theorists trying to correctly characterize the semantics-syntax links (see Levin & Rappaport Hovav, 2005, for review), and by developmental psychologists interested in how children discover these links (Bowerman, 1990; Pinker, 1984, 1989).

A key issue is identifying the right level of generalization for the *linking rules*. Many data points suggest linking rules are highly regular. Regularity is seen both within verbs and across verbs. Not just *Mary* but all breakers are the subject and not object of *break* (*John/the baby/the wind broke the vase/window/glass*). Similarly, in English the object of a transitive change-of-state verb is systematically the entity that changes state while the subject effects that change (*Mary broke/cleaned/opened the box*). These intuitions generalize to novel words. If interpretable, *The dax broke the blicket* must mean that the dax is the breaker and the blicket is broken. Adults and children prefer an interpretation on which *The bear pilked the horse* means the bear did something to the horse, not vice versa (Marantz, 1982; see also Pinker, 1989). Moreover, these patterns are sufficiently regular across languages to suggest that some (Pinker, 1984) or all (Baker, 1988) linking rules are innate.

However, there are numerous examples of apparent variation and exceptionality. An object moving from Mary's possession to John's can be described by *Mary gave/lent/sent the package to John* or *John received/took/obtained the package from Mary*. The same activity might be called *Mary chasing John* or *John fleeing Mary*. Many emotion verbs put the experiencer in subject position (*John feared/hated/loved Mary*), while others put the experiencer in object position (*Mary frightened/angered/delighted John*). Moreover, a relatively small number of languages appear to exhibit linking rules quite distinct from what is seen in languages like English (Dixon, 1994).

In the present study, we investigate linking rule regularity and variation within and across two unrelated languages with respect to one such problematic case: psych verbs.

Psych Verbs

Unlike change-of-state verbs, verbs of psychological state are highly variable in terms of their surface syntax. The experiencer of the mental state may appear as the verb's subject (experiencer-subject verbs: *Mary likes/hates/misses John*) or its object (experiencer-object verbs: *Mary surprises/confuses/angers John*). Both classes are seen in a wide variety of languages, though the subjects of experiencer-subject (ES) verbs can appear as dative subjects in languages that have such constructions (Levin, 1993). Interestingly, there appears to be some variation across languages in terms of which psychological states appear in which form: for instance, the apparent French equivalent to the ES psych verb *miss* is experiencer-object (EO; *manquer*; see also Croft, 1993).

Most authors have assumed there is no systematic semantic distinction between ES and EO verbs, and thus each verb must be marked for taking one linking rule or the other (e.g., Bowerman, 1990; Dowty, 1991; Jackendoff, 1990; Pinker, 1989). However, Pylkkanen (1999) finds that in Finnish, ES psych verbs describe individual-level predicates whereas EO psych verbs describe stage-level predicates.[1] Stage-level and individual-level predication differ in several ways; one relevant difference is that stage-level predicates can be narrowly bound temporally and physically (1), whereas individual-level states typically cannot be (2).

(1) a. John was sleepy yesterday in the kitchen.
b. John angered Mary yesterday in the kitchen.
(2) a. *John was tall yesterday in the kitchen.
b. *John hated Mary yesterday in the kitchen.

Thus, it may be that those psychological states which are deemed more likely to be bound in time and space are also more likely to be realized as EO verbs.

Interestingly, the psychological literature on emotional states typically distinguishes between *emotions* and *dispositions* (Ekman, 1999). The former are tied to specific physiological states and are brief in duration, whereas the latter are long-lived tendencies to feel or act in a particular way. Commonly-given examples of emotions are *surprise* and *anger*; frequent examples of dispositions are *love* and *hate*. Note that the former are EO verbs and the latter ES verbs.

Informal inspection of English psych verbs by the authors suggested that in fact ES verbs do typically describe dispositions thus defined while EO verbs typically describe emotions. This was further confirmed in an unpublished study in which naïve participants rated the states described by ES verbs as typically lasting longer than those described by EO verbs (Hartshorne, 2009).

In the present study, we investigate whether differences in the nature of the psychological state influence whether participants apply the EXPERIENCER→SUBJECT linking rule or the EXPERIENCER→OBJECT linking rule to novel psych verbs. We focus on the notion of duration: are long-lived psychological states (dispositions/individual-level states) more likely to be realized as ES verbs relative to short-lived psychological states (emotions/stage-level states)?

In order to investigate both linguistic universals and variation, we investigated the degree to which this proposed distinction guides generalization of linking rules in two historically unrelated and linguistically distinct languages: English and Japanese.

Experiment 1: English

Participants in Experiment 1 were introduced to novel transitive verbs describing psychological states for which there was no existing verb. To encourage participants to take the task seriously, the novel verbs were introduced as loanwords from Japanese. Half the verbs described long-lived psychological states; half described short-lived psychological states. For each verb, participants decided whether an ES structure or an EO structure was more likely to be "correct."

In English there is a preference for simple present tense verbs to be interpreted as generic statements (contrast *Bats frightened John* vs. *Bats frighten John*; see Carlson, 1988). As this may affect whether the novel psych verbs are seen to describe short-lived (event-like) or long-lived states, we tested separate groups of subjects using both simple present and past tenses (Experiments 1a and 1b). As ES verbs cannot be naturally used the progressive form (**John was fearing bats*), we used simple tense only.

Method

Participants

Forty native English-speakers participated in Experiment 1: twenty in 1a (18-60yo, M=25.3, SE=2.2) and twenty in 1b (18-39yo, M=23.1, SE=1.2). Participants, who were recruited outdoors on Harvard's campus, gave informed consent and were compensated with a small snack.

Materials

Sixteen Japanese nouns describing psychological states without clear English verbal equivalents were selected and turned into verbs, applying any necessary phonological accommodations. Eight were judged by the authors to be long-lived states (e.g. *tekitaishin: the feeling of rivalry; hankan: the feeling of being opposed to something or someone*) and eight to be short-lived states (e.g., *wabi: a sense of beauty of silence discovered in simplicity; tokimeki: the feeling of a heart beating because of encountering an attractive person or thing*). For each verb, an appropriate animate experiencer argument was chosen. The other argument was an inanimate *stimulus* of the emotion. Two sentences were constructed by placing the experiencer in either subject or object position (3). To further bias participants into conceiving of the long-lived states as long-lived states and short-lived states as short-lived states, the inanimate arguments for the former were themselves long-lived (e.g., *Harvard's basketball team; his company's*

[1] See also discussion of Pesetsky (1995) below.

policy) and the inanimate arguments for the latter were short-lived (*the unexpected rainbow; seeing the gorgeous necklace*). Four additional filler sentence pairs describing non-psychological events (*The ocean wave tsunamis the village* vs. *The village tsunamis the ocean wave*) were also constructed. Experiments 1a and 1b differed only in the tense of the verb: simple present in 1a and simple past in 1b.

Procedure

Participants were told that they would try to correctly use new Japanese loanwords. For each verb, they were given a definition and the two possible sentences. An example trial is shown below:

(3) Tekitaishin
The feeling of rivalry
a. Richard tekitaishins Harvard's basketball team.
b. Harvard's basketball team tekitaishins Richard.

They were asked to choose the sentence they thought most likely to be correct. Four test forms were constructed as follows: the order of verbs was pseudorandomized such that the same condition (emotion/disposition) did not occur more than twice in a row. We counter-balanced whether the ES sentence or EO sentence was displayed first within each condition. The second form was made by switching the order of the sentences for each verb. Forms 3 and 4 were made by reversing the order of the verbs in Forms 1 and 2.

Results and Discussion

As predicted, participants were more likely to choose the ES frame for long-lived verbs than for short-lived verbs, in both Experiment 1a (M=62.5%, SE=4.3% vs. M=32.5%, SE=4.2%) and 1b (M=58.7%, SE=5.5% vs. M=33.1%, SE=5.0%).[2] The main effect of short-lived/long-lived was significant ($F1(1,38)=60.8$, $p<.001$; $F2(1,14)=6.2$, $p=.03$),[3] and this effect did not interact with tense (Fs<1). Thus, semantics guides the preferences of native English-speakers for certain verbal syntactic forms. Interestingly, although the past tense is more amenable to the description of events, participants were not more likely to choose the object-experiencer frame when the verb was presented in the past tense (Fs<1), perhaps because the inanimate arguments used for the short-lived verbs strongly implied events (e.g., *Seeing the gorgeous necklace tokimekis Mary*).

Thus, the underlying semantics of the sentence (the verb and/or inanimate argument) biased participants to choose a particular syntactic frame: ES for short-lived states and EO for long-lived states. In Experiment 2, we test whether this distinction is cross-linguistically relevant by turning to Japanese, a language historically unrelated to English.

[2] Means and standard errors here and elsewhere calculated by subject.

[3] Items analyses consider a given verb in present or past tense to be the same verb. Treating them as separate items does not affect the pattern of results.

Experiment 2: Japanese

Japanese is widely considered to be a language isolate, and its grammar is distinguished from that of English in a number of important ways (Tsujimura, 2007). First, Japanese is a scrambling language, allowing considerable word-order variation, with the basic order being Subject-Object-Verb, while in English the word order is rigidly Subject-Verb-Object. Second, unlike in English, the grammatical roles of noun phrases are overtly marked by particle suffixes: the subject is generally marked by *-wa*, and the direct object is marked by *-o*. Third, in the verbal domain, Japanese is a highly agglutinative language in which a verbal stem must at least bear a tense suffix and also may appear with a number of other suffixes expressing various grammatical functions. One such verbal suffix that is relevant for our purposes is the causative suffix *(s)ase-*. For example, *aruk-ase-* is the causative form of the verbal stem *aruk-* 'walk', meaning 'to make somebody walk'. This suffix is productive and can combine with almost all verbal stems.

Interestingly, while English contains more morphologically simple EO verbs (220) than ES verbs (44; Levin, 1993), our survey of Japanese found only 5 morphologically simple EO verbs, with the vast majority (74) ES.[4] Additional, morphologically complex, EO verbs can be formed in Japanese by adding the causative *–(s)ase-* affix to a ES verb:

(4) a. Taro-wa koomori-o kowagat-ta.
Taro-TOP bat-ACC fear-PAST
Taro feared bats
b. Koomori-wa Taro-o kowagar-ase-ta.
bat-TOP Taro-ACC fear-CAUS-PAST
Bats frightened Taro.

As in Experiment 1, we tested verbs in both the present and past tense. However, since in Japanese ES verbs are unnatural in simple tenses (*John-wa Mary-o nikum-u; John-TOP Mary-ACC hate-PRES), we used the more natural progressive form (John-wa Mary-o nikun-dei-ru; John-TOP Mary-ACC hate-PROG-PRES; "John hates Mary") for both verb classes. Note that with certain stative verbs the progressive morphology does not force a progressive meaning (e.g. the previous example does not mean "John is hating Mary").

Method

Participants

Forty native Japanese-speakers participated in Experiment 2: twenty in 2a (20-35yo, M=22.3, SE=2.8) and twenty in 2b (19-65yo, M=31, SE=3.3). Participants, who were recruited in public spaces around Tokyo, gave informed consent and were compensated with a souvenir pencil.

[4] Throughout this paper we consider only transitive verbs that take direct objects (*John fears/frightens Sally*). Future research will investigate intranstive verbs that take oblique objects (*John cares about/matters to Sally*).

Materials and Procedure

Materials and procedure were modeled closely on Experiment 1. Participants were introduced to novel English-derived loanwords in Japanese (long-lived: reverence, greed, phobia, envy, credence, affection, loathing, pride; short-lived: déjà vu, anguish, grief, jolt, nostalgia, trepidation, glee, chagrin). Loan words in Japanese can be made using the semi-productive verbalizer *-r-* (e.g., *gugu-r-u*: 'to google') or the light verb *suru* (e.g., *enzyoi-suru*: 'to enjoy'). While the latter is more productive, it often carries an explicitly causative meaning, particularly when applied to states. Since our goal was to avoid explicit morphosyntactic markers of meaning (with any concomitant argument selection biases), we used the more neutral *–r-*.

Again, care was taken to ensure that the loanwords did not approximate any extant Japanese monomorphemic words (e.g. *hatred* was avoided, since Japanese already contains *nikum-u*, which means *to hate*). As in Experiment 1, long-lived psychological states were paired with long-lived inanimate arguments (e.g., *the mountain*; *the theory of evolution*) and short-lived psychological states with short-lived inanimate arguments (e.g., *news of her brother's accident; seeing the foreign town*). The four filler verbs were existing English-derived psych verbs.

Experiments 2a and 2b differed only in that the verbs were in the present-progressive in 2a and in the past-progressive in 2b. Two of the filler verbs in 2a were problematic and were replaced in 2b. An example trial for a short-lived verb from Experiment 2b are shown below:

guriifu (grief): deep sorrow (especially that caused by someone's death)
a. Tooru-wa aiken-no shi-o guriifu-t-tei-ru
Toru-TOP pet.dog-GEN death-ACC grief-V-PROG-PAST
Toru grieves the pet dog's death.
b. Aiken-no shi-wa Tooru-o guriifu-t-tei-ru
pet.dog-GEN death-TOP Toru-ACC grief-V-PROG-PAST
The pet dog's death grieves Toru.

Results and Discussion

Like English speakers, Japanese participants were more likely to select the ES interpretation for the long-lived verbs than for the short-lived verbs in both Experiments 2a (M=90.6%, SE=1.0% vs. 73.7%, M=0.9%) and 2b (M=73.1%, SE=0.9% vs. M=55.6%, SE=0.9%). The overall main effect of short-lived/long-lived was significant ($F1(1,38)=28.6$, $p<.001$; $F2(1,14)=16.8$, $p=.002$) and did not interact with tense ($Fs<1$). Unlike in English, there was a significant main effect of tense, with ES interpretations more likely in present tense than past ($F1(1,38)=6.3$, $p=.02$; $F2(1,14)=21.5$, $p<.001$).

These results suggest that linking rules in Japanese, as in English, are sensitive to the duration of the psychological state. Interestingly, however, Japanese participants were overall more likely than English speakers to choose the ES frame (M=72.5%, SE=3.5% vs. M=46.7%, SE=2.8%; $t1(78)=5.8$, $p<.001$; $t2(30)=3.5$, $p=.001$). This could show a broad preference for the EXPERIENCER→SUBJECT linking rule in Japanese. Alternatively or in addition, Japanese participants may have been sensitive to the fact that the novel verbs were all morphologically simple, and nearly all morphologically simple psych verbs in Japanese are ES (see above). EO verbs are typically formed with the addition of the causative affix *-(s)ase-*. We tested whether participants would be more likely to choose the EO form for *–(s)ase-* affixed verbs in Experiment 3.

Experiment 3: Causative Psych Verbs in Japanese

In Experiment 3, we tested whether Japanese participants would choose EO frames for *–(s)ase* affixed psych verbs.

Method

Participants

Twenty participants (19-34yo, M=22.5, SE=1.3), recruited in public spaces around Tokyo, gave informed consent and were compensated with a souvenir pencil.

Materials and Procedure

Materials and procedure were identical to Experiment 2b, except all verbs were causativized by the addition of the *-(s)ase-* affix and presented in the present progressive (guriifu-r-*ase*-tei-ru).

Results and Discussion

As in Experiment 2, Japanese participants were more likely to choose the ES interpretation for the long-lived verbs than the short-lived verbs (M=33.1%, SE=5.2% vs. M=21.2%, SE=3.5%; $t1(19)=2.41$, $p=.03$; $t2(14)=2.83$, $p=.01$). As predicted, participants were overall much less likely to choose the ES interpretation relative to Experiment 2a (M=27.2%, SE=3.7% vs. M=80.6%, SE=3.6%; $t1(38)=10.3$, $p<.001$; $t2(15)=20.5$, $p<.001$). Thus, the preference for the ES interpretation in Experiment 2 was not due to a global preference for EXPERIENCER→SUBJECT linking, but rather was specific to the verb form used (monomorphemic).

General Discussion

In order to discuss events and states, speakers must map the participants in the event or state onto grammatical roles. There remains considerable disagreement about the nature of these mappings or linking rules (Levin & Rappaport Hovav, 2005). Linking rules are typically defined in terms of features of the arguments such as agentivity or causativity (Dowty, 1991; Pesetsky, 1995; Pinker, 1984; 1989) or aspects of the predicate such as stativity and telicity (Hooper & Thompson, 1980). In this paper, we present evidence that in the case of psych verbs, linking rules are sensitive to duration of the psychological state: if the state is short-lived, the EXPERIENCER→OBJECT rule is more likely to apply; if the state is long-lived, the EXPERIENCER→SUBJECT rule

applies. This distinction appears in both English and Japanese, historically unrelated and grammatically distinct languages. Coupled with the fact that the this distinction may also characterize existing verbs in Finnish (Pylkannen, 1999) and Mandarin (Hartshorne, 2009), which are unrelated to each other or to English or Japanese, these results suggest this distinction *could* be universal across languages.

Causes, Stages and Emotions

The data in this paper demonstrate that the mapping from semantics to syntax for psych verbs is governed at least in part by the meaning of the verb. Although we discussed our manipulation in terms of the expected duration of the psychological state, that may not be the correct distinction.

Our experiments above were partly motivated by the distinction in the psychological literature on emotion between emotions and dispositions. Since one of the defining distinctions between emotions and dispositions is their duration, this distinction is fully confounded with our short-lived/long-lived distinction.

Similarly, we noted that Pylkkanen (1999) argues that Finnish ES verbs are individual-level predicates and Finnish EO verbs are stage-level predicates. Stage-level and individual-level predicates are usually defined in terms of the genericity of predicates—typically formalized as whether the predicate refers to a single event or quantifies over many events (Carlson, 1988). Genericity can be diagnosed by linguistic tests such as the permissibility of the progressive (see Pylkkanen, 1999). As noted above, at least one of the linguistic tests has apparent semantic consequences. One distinguishing factor of EO predicates is that they can be bounded by brief temporal durations, making the notion of *stage-level* similar to our notion of *short-duration*. Whether the two can be de-confounded is a question for future research.

Note that while it may be that *stage-level*, *short-lived* and *emotion* may simply be three ways of capturing the fundamental distinction that influences the semantic-syntactic mapping, the same may not be true for the other semantic distinction that has been suggested in the literature: Pesetsky (1995) presents linguistic analyses suggesting that EO verbs encode caused events, while ES verbs do not. Intuitively, brief states like emotions seem related to changes of state, which is a necessary component of *cause*, perhaps suggesting a way of integrating the notions.[5] Relatedly, Pylkkanen (1999) argues causally-affixed Finnish psych verbs either describe events or stage-level (rather than individual-level) states, providing another potential association. Nonetheless, the associations here are tenuous. Whether *cause* is a factor in the semantics-syntax linking rules for psych verbs – and, if so, whether it is a factor independent of the one(s) described above – remains a question for future research.

Universals

There have been several proposals suggesting that linking rules are universal, innate and exceptionless. Baker proposes his Uniformity of Theta Assignment Hypotheses (Baker, 1988), which posits a simple, exceptionless, many-to-one rules linking semantics roles (AGENT, EXPERIENCER) to syntactic position (SUBJECT, DIRECT OBJECT), at least at the level of deep structure. Pinker (1984) argues that linking rules may be innate. Such claims not only greatly simplify linguistic theory, but they also simplify the job of the language learner.

However, such theories have been challenged by apparent variation in the application of linking rules in some domains, such as psych verbs. The data presented here suggest a solution to this problem compatible with exceptionless linking rules: a rigid, innate linking rule that maps EXPERIENCER→SUBJECT for long-lived psychological states and EXPERIENCER→OBJECT for short-lived psychological states. Whether such rules apply beyond English and Japanese (and perhaps Finnish and Mandarin) remains an empirical question. This may suggest that other such cases of variation may similarly be resolved by closer inspection of the semantics (see also Pesetsky, 1995, for discussion). While this is an intriguing possibility, it is not the only possible conclusion (see below).

Variation

Despite the potentially universal sensitivity of linking rules to psychological state duration described above, Japanese and English speaking participants showed a striking difference in their baseline preference for the two argument mappings: Japanese participants were over 50% more likely than English-speakers to chose the ES form. At least three explanations for this cross-linguistic variation are possible.

First, although stimuli for the English and Japanese studies were constructed in an identical manner, the stimuli were not identical (the *different-stimuli hypothesis*). It may be that the semantics of the Japanese stimuli were biased in favor of the ES mapping; perhaps the short-lived verbs were less short-lived than those in the English study. Although such a possibility is difficult to rule out with certainty, the relative size of the effect limits the likelihood that poor stimulus selection explains the effect. Moreover, the discrepancy was highly consistent across stimuli: all but one of the short-lived English verbs in Experiment 1a had more EO attributions than *any* of the short-lived Japanese verbs in Experiment 2a. Similarly, all but one of the long-lived English verbs in 1a had more EO attributions than *any* of the long-lived Japanese verbs in 2a (the comparison for 1b and 2b is similar).

A second possibility is that linguistic differences between Japanese and English led the participants to construe the

[5] Consistent with this possibility, an additional experiment using novel Japanese psych verbs created with *–suru*, which typically gives rise to a causative interpretation, found that Japanese participants overwhelmingly chose the EO reading.

meanings of the novel verbs differently (the *different-construal hypothesis*). There are a number of reasons this might happen. For example, Pesetsky (1995) has argued that only EO verbs describe caused events. Japanese can mark verbs overtly as causal with the *–(s)ase* affix, and in fact there are only a handful of EO verbs lacking the causal affix. In Experiment 2, the verbs presented to the Japanese participants lacked the causal affix. These participants may then have made the inference that the verbs do not describe caused events, leading them to choose the ES reading. Since English does not explicitly mark verbs as causal or not, the English-speaking participants faced a more ambiguous inference problem.

Note that the *different-stimuli hypothesis* and the *different-construal hypothesis* are both consistent with rigid, exceptionless linking rules. The English and Japanese participants apply the linking rules in the same way; they simply disagree as to the meanings of the verbs. Another possible conclusion is that linking rules are constrained by universal biases but allow some cross-linguistic variation in their exact formulation (the *soft-universals hypothesis*). Imagine that based on the available cues Japanese and English speakers arrive at the same guess about the underlying semantics. They may still show different baseline preferences if argument mappings are probabilistic.

Our data provide evidence for a universal bias in argument mappings, however, they do not show that such mappings have to be either exceptionless or deterministic. Instead, semantics-to-syntax mappings for arguments could themselves be probabilistic and influenced by both soft universals and language-specific factors.

For example, as discussed above, unmarked psych verbs in Japanese are overwhelmingly ES while the opposite is true (to a lesser degree) in English (see above). Suppose that in addition to universal (and presumably innate) biases, mappings are also influenced by similarity to other verbs. In such a scenario, the baseline statistics of psych verbs in the two languages would predict the baseline difference in performance.

Models that allow for within-language, across-item generalizations of this form have a long history in both generative linguistics (where they often take the form of *parameter-setting* models) and non-generative approaches such as construction grammar. Recent work in computational modeling has shown how such systems can be expressed by hierarchical Bayesian models. These models encode the across-item generalizations as *overhypotheses*—hypotheses about hypotheses (see e.g. Perfors, et al., *in press*).

It remains for future work to determine whether cross-linguistic differences are better attributed to variation in how speakers of various languages construe situations, to probabilistic linking rules, or to some combination of both.

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