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Understanding English Past-Tense Formation:

The Shared Meaning Hypothesis

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Abstract

It has long been controversial whether language behavior is best described and explained with reference to the constructs of formal linguistic theory, or with reference to information processing concepts and the communicative goals of speakers. Recent work by Kim, Pinker, Prince and Prasada (1991) argues that the vocabulary of formal grammatical theory is essential to psychological explanation. They demonstrate that speakers' evaluation of the well formedness of past-tense forms is sensitive to whether novel verb forms are perceived to be extended from nouns or verbs. I show this pattern of preferences to be a consequence of semantic similarity between the novel sense of the verb and the irregular verb to which it is phonologically related. The data is consistent with the tenets of **functional grammar**: speaker' choice of one linguistic form over another is influenced by perceived communicative gain (Kuno, 1987; Bates & MacWhinney, 1989). The salient task in judging novel verbs phonologically related to irregular verbs is guarding against miscommunication. Dizzy Dean aside, that so few mortals have ever flown out to center field testifies to speakers' success.

Background

Over the last few years, the past-tense has become a virtual crucible for theories of linguistic representation (Rumelhart & McClelland, 1986; Pinker and Prince, 1988; MacWhinney & Leinbach, 1991). Recently, Kim, Pinker, Prince and Presada (1991) used speakers' judgments of the well-formedness of novel past-tense verbs (such as *high-sticked the goalie*) to support the psychological reality of formal grammatical theory. In the current paper, I follow in Kim et al.'s footsteps to probe the processes involved in creating a new lexical entry and extending words into new semantic territory.

If speaking of a person who performed a greater feat than astronaut Sally Ride, we are more likely to exclaim, "*She out-Sally-Rided Sally Ride!*" than "*She out-Sally-Rode Sally Ride!*" (Pinker & Prince, 1988). Similarly, the verb *to grandstand* (impress onlookers) sounds most natural with the past-tense form *grandstanded*, rather than *grandstood*. By contrast, new verbs derived from existing irregular verbs (such as *withstand*) sound more natural if they agree with the past-tense of the verb from which they are derived.

Kim et al.'s stated goal was to show that even so simple a system as English past-tense formation can not be adequately described without reference to the classic descriptive constructs of formal grammatical theory (FGT), such as lexical item, part of speech (noun, verb) and morphological structure. Consider the question of why the base ball sense of *fly* is regular, despite its semantic relation to the more frequent sense of *fly* (to move through the air or before the wind). The irregular marker on the original verb root *fly* is lost when the noun compound *fly ball* is created because only verbs can have irregularity markers (Williams, 1981). Thus, when a new verb is derived from *fly ball*, no irregularity marker is present, and the default past-tense formation rule applies, resulting in *The batter flied out twice to center field*.

To see if these principles stand up in the lab, Kim et al. constructed passages, such as those in (1) and (2), containing either an irregular verb, or a noun polysemous or homophonous to it. Novel semantic extensions of this noun or verb appeared in both the regular and irregular past-tense form, and raters were asked to rate the naturalness of each form on a scale of 1 to 7.

In 18 of 21 passages describing novel nominal and denominal verbs, the predictions of (FGT) were met: subjects preferred the regular past for verbs extended from nouns, and the irregular past for verbs extended from irregular verbs. As an example of the former, raters

From Kim et al. Example of a new verb extended from the noun *shrink:* (Naturalness ratings at right.)

(1) Sam is always acting like a shrink, psychoanalyzing half the people at the table. But last night we had Jonathan over, and he analyzed ALL the people at the table.

    He finally out-shrinked Sam.   3.8750   He finally out-shrank Sam.   2.5625

A new verb extended from the verb *shrink:*

(2) My wife Hilda was always washing the clothes at too high a temperature, shrinking them beyond recognition, but we hired a housekeeper who ruined six shirts in one load.

    She actually out-shrinked Hilda.   2.5000   She actually out-shrank Hilda.   3.6875

Three exceptions to FGT predictions:

(3) Both boxers managed to land heavy blows... Tyson (*out-blowed* 2.81 / *out-blew* 3.00) his opponent and won ...

(4) Janet was fed up with Sam's recurrent flings with young women... After her fifth willing partner she had actually (*outflinged* 3.31 / *out-flung* 3.62) the guy.

(5) Pitcher Roger allowed the Orioles only three hits ... He (*three-hitted* 3.12 / *three-hit* 4.43) them for the second...

much preferred *He William-Telled the apple* to *He William-Told the apple* when the desired meaning was "He put an apple on his son's head, and tried to pull a William Tell." Subjects slightly preferred *He story-told the children for a solid two hours* to *He story-telled the children*, given the new verb *story-telling*.

Kim et al. point out that FGT can explain not only the 18 cases where the results were in the expected direction, but the three cases that are apparent partial counterexamples. Examples (3)-(6) show that raters still judged the irregular past tense form to be slightly more natural sounding despite the denominals *blows, flings,* and *hits*.

These ratings can be fit to the predictions of FGT if we imagine that raters may have *perceived* that the new usage was derived from the original irregular verb, rather than from the noun. Kim et al. call this addendum **the short circuit theory**, because the normal derivation from a noun is by-passed in favor of derivation from the root verb. Intuitively, raters are most likely to "short-circuit" if they perceive that the new verb retains some semantic similarity to the original. Kim et al. collected ratings of the similarity between each new verb sense and the central sense of the verb root. They found that the semantic similarity ratings for the three exceptions were significantly higher than the mean similarity ratings of the rest of the items, suggesting that this perception of similarity had led previous raters to represent the above three items as deverbal instead of denominal.

If semantic similarity explains raters' preferences in these three cases, one wonders what role it plays in the other cases. In the remainder of this paper, I propose that speakers use shared meaning when judging past-tense well-formedness. I use this account to explain *all* of KIm et al.'s data, embed it in a conception of speakers' processing costs and communicative goals, and generate predictions about how noun/verb category may interact with other aspects of the passage to influence ratings of past-tense well-formedness.

Representation and Function

Of the types of explanations scientists use, Kim et al.'s is "representational": the observed behaviors logically follow from mechanical operations on representational structures. We can call "functional" those theories in which observed behaviors logically follow from plausible theorems about organisms' goals in behaving in one way rather than another. For language, the plausible explanatory parameters are communicative efficacy and effort (Givon, 1979). But because behavior is ultimately causally related to mental structures, there is great interest in developing representational as well as functional explanations.

A frequent shortcoming of representational explanations is that the representational structures are motivated by the data the theorist aims to explain, and there may not be enough data left for an independent test of the explanatory framework. This is not a failing of Kim et al.'s work, as their account of novel past-tense formation appealed to independently motivated linguistic principles. However, because linguistics has historically emphasized representational rather than functional theories (Chomsky, 1957), there are few clues about why the system is set up the way it is. Why is the system set up so that nouns can't inherit and pass on irregularity markers? Why do speakers attend to derivational status when creating a lexical entry for a new verb?

In the next section, I motivate an account of novel past-tense formation that is both communicatively and representationally plausible.

The Shared Meaning Hypothesis

Hopefully the reader agrees that *She out-Sally-Rode Sally Ride!* is not the appropriate way to communicate, "She performed a greater feat than astronaut Sally Ride." The reason for this follows from the basic communica-

tive principle of refraining from knowingly misleading your listener: the new verb "out-Sally-Ride" has no semantic connection with the existing verb *ride*, and to use the past-tense verb *rode* would be incorrectly implying a connection.

I will call the following the **shared meaning hypothesis**:

> Speakers copy the irregular past-tense form of the original verb, rather than use *-ed*, to emphasize shared meaning between the new verb and the original irregular verb. Because *-ed* is the default past-tense and would be used with any completely novel lexical item, use of *-ed* is a strong signal that the meaning of the new word is distinct from that of the original irregular verb.

Because 21 of Kim et al's 29 novel denominal verbs were **homophones** of existing irregular verbs, while *all* of their deverbal verbs were transparently semantically related to existing irregular verbs, this simple version of the shared meaning hypothesis (SMH) accounts for a good part of their data simply by making identical predictions to FGT in these cases. However, the SMH may be able to more closely match the naturalness ratings because both felicity ratings and the degree of shared meaning are continuous, while FGT divides the world of naturalness judgments into two categories.

Below I list some different types of meaning distortions, and describe communicative reasons why speakers will emphasize shared meaning in some cases while disavowing it in others. The SMH can then be further tested by seeing whether past-tense naturalness judgments correlate with these predictions of relative meaning emphasis or disavowal.

The Costs and Benefits of Meaning Extension

If we view speakers' task as one of **minimizing processing costs while maximizing communicative impact** (loosely following Givon, 1989 and others), then we can begin to characterize the costs and benefits of using a new word. Humans, like all animal species, grow accustomed to the commonplace and dishabituate to novelty. The new word has the impact of novelty. But using a novel word has two costs: (a) the encoding cost of inventing a phonological string that the speaker and listener will be able to remember and access later, and (b) the risk of failed communication. (An advantage of polysemy is that it obviates the first problem; Harris, 1992.) In any type of meaning extension, the speaker needs to ensure that the new sense is sufficiently connected to the old sense, but that meaning elements are not incorrectly transferred from the original sense to the new sense. Below I list some types of meaning extensions for which connection of meaning or disavowal

might be more or less important.

i. **Metonymy**. New usage picks out one aspect of the meaning conveyed by the original usage. This is typically employed by speakers to reduce processing costs, as the conventional meaning is salient in the discourse or extralinguistic environment, and is thus easier to access than the lexical item that conventionally codes for the intended concept (Deane, 1989). Because metonymy is usually used with contextual support, the risk of comprehension failure may be minimal. **Prediction: emphasize shared meaning**.

ii. **Metaphor**. New usage builds on abstract relations present in the original. The partial mapping of elements is usually thought to be determined by conceptual factors such as highest structural match (Gentner, 1989). This suggests a reason for *not* using a linguistic device to disavow identity between the original meaning and the intended meaning: the intended meaning builds on the original meaning, and may do so in ways that require the original meaning to be available for processing for a significant time period. **Prediction: emphasize shared meaning**.

iii. **Inclusion**. New usage completely contains original usage, but adds to it. **Prediction: emphasize shared meaning**.

iv. **Concatenative compounding**. Like inclusion, but two existing words are joined together, so that the resulting form may be different (as in *oversleep*). Prediction: emphasize shared meaning.

v. **Aspect change**. Central to a verb's meaning is whether it describe an abstract, atemporal relation, or a process. If a process, the verb can refer to a punctate or temporally extended event. Example: *I told the children a story yesterday* (completive aspect). *I story-told the children for two hours* (durative aspect). **Prediction: Mixed.** Aspect is basic to verb meaning, and is part of listeners' automatic inferences about an event described with a certain verb. Therefore, if the new meaning conflicts with the aspect of the original, the speaker might want to disavow a meaning connection. On the other hand, there are verbs in English that have malleable aspect, and many verbs can sound felicitous with a different aspect if the context is right (Langacker, 1987).

vi. **Argument structure change**. Arguments of the original verb are incorporated into the meaning of the new verb or dropped completely. Example: Basic meaning of *fly* assigns to its subject the agent or experiencer of flying (moving through the air). The *base ball* meaning of *fly* incorporates the sense of a ball moving through the air, and assigns to its subject the causative role (initiator of the ball's flight). **Prediction: Mixed, but some meaning disavowal likely.** Maintaining predictable argument

structure decreases processing costs: the nouns in a clause can be rapidly assigned the semantic roles defined by the verb, giving the listener has a quick way to find out who is doing what to whom (Bates & MacWhinney, 1987). This rapid (and perhaps automatic) argument assignment is intuitively one good reason to disavow, with whatever devices are at hand, the image of the batter sailing through the sky.

vii. **Denominalization.** One of the strengths of FGT was that is explained the circumlocutive route traveled by an irregular verb, made into a noun, made into a regular verb. It is difficult to make an irregular verb undergo these stages without the eventual meaning differing in aspect and argument structure. **Prediction: disavow shared meaning.** If the meaning *isn't* very different, then the listener may assume the verb is simply the original irregular.

viii. **Homophony.** Although the new meaning may been have extended from the original at one time, there is now very little similarity in meaning left. The two words are likely to be treated as homophones by speakers. **Prediction: Disavow meaning connection.**

Listeners obtain two types of information from the speech signal. **Grammaticized information** is coded by grammatical devices, such as when the duration of an event is signaled by *-ing*, or when the supporting nature of an event is signaled by encoding the event with a subordinate clause. **Inferences** accrue by integrating the linguistic message with non-linguistic material. If we assume that the purpose of grammaticized information is to facilitate processing (Givon, 1989), then meaning distortions involving grammaticized elements (such as aspect and argument structure) are most likely to be disavowed by a linguistic device, such as using the *-ed* past tense.

Analysis of Past Tense Ratings

To test whether the SMH hypothesis can make more fine grained predictions that FGT, Kim et al's 74 passages (37 deverbal, 37 denominals) were categorized according to what meaning relation they had to Webster's entries for the phonologically similar irregular verb.

The categories were defined as follows:

Known/metaphorical. Passage meaning is listed in the on-line version of Webster. All of Kim et al.'s 16 metaphorical deverbals fell into this category. For example, Webster's defines *write off* as *to take off the books: CANCEL*. One of the definitions of *to fly* is *to assail suddenly and violently*, which is similar to Kim et al.'s metaphorical item *he flew off the handle*. Because these are essentially dead metaphors, I am calling them "known."

Concatenative compounds. Passage meaning fully includes a meaning of an irregular verb listed in Webster. Of the 15 passages that fell into this category, all were deverbals.

Argument conflict. Passage meaning is transparently semantically related to an existing irregular, but the semantic role filled by the subject of the new verb is different from that of the existing irregular verb. Of the 14 passages in this category, 6 were deverbal passages, and 7 were denominal. Denominal examples include *I immediately drinked him* (I caused him to be supplied with drinks such that he probably drank a lot) and *Janet out-flinged Sam* (had experiences that led to a state of affairs in which she had more extra-marital affairs than Sam). (It's insightful to see how long a paraphrase one must construct in order to include the original irregular verb -- couldn't achieve this with *fling*.) Deverbal examples include *I'm shaked-out* (I'm experiencing fatigue from the action of shaking) and *He "knew" me once too often* (he has the experience of bumping into me and saying "Don't I know you?").

Homophones. 29 passages were categorized as having no semantic relation to the irregular verb to which they were phonologically similar if they were derived from a proper name (*William-Telled the apple, out-Big-Sleep the Big Sleep*), had spelling differences (*reeded the posts* vs. *read the Captain's mind*), or had very significant and clear meaning differences (*ringed the city*).

The passages were not further divided into a class of aspect change to avoid cross-cutting the other categories. None of the known/metaphorical items involved an aspect change, while many of the novel items did. Aspect change is not a meaningful question for the homophones, since they are already maximally different from their homophonous irregular verb.

Results. Table 1 compares past tense ratings for each of the categories, showing that, as predicted by the SMH, speakers judge irregular past tense forms favorably if the meaning of the new verb incorporates the meaning of an existing irregular, and judge regular past tense forms favorably in the absence of shared meaning, while cases of argument structure conflict yielded intermediate ratings for both deverbals and denominals.

Semantic Similarity Ratings

The row in Table 1 labeled "semantic similarity" contains mean ratings of the degree of similarity holding between Kim et. al's passages and the closest dictionary entry for the relevant irregular verb. 32 Boston University undergraduates compared present-tense-only versions of Kim et al.'s passages to phrases taken from the dictionary. Subjects checked a box marked "unrelated"

Table 1

| | Homonyms | | Arg Conflict | | Inclusion | |
	known	novel	denom	deverb	concat	known
Regular	4.41	4.17	3.83	2.86	1.90	1.95
Irreg	1.67	2.23	2.87	4.0	4.45	6.50
Semantic						
Similarity	5.56	5.14	3.18	2.58	2.12	2.06
Total Items	8	21	8	5	16	16

or placed a hash mark through a scale extending from "closely related" (translated as 1) to "weakly related" (translated as 5). "Unrelated" judgments were coded as a 6. The rank order of the ratings match the predictions made in the previous section.

The correlation between Kim *et al.*'s ratings of past tense well-formedness and the ratings of similarity are summarized in Table 2. The data was fit separately for ratings of regulars and irregulars by multiple regression with four predictors: **derivational status, semantic relatedness,** and two indicator variables: **homonym/ polyseme** (argument conflict cases coded as polysemes of an existing irregular), and **known/novel.** The *t* statistics are the results of partial correlation analysis and show which variables make additional significant contributions after the previous variables have been taken into account.

For the irregular ratings, although derivational status is the predictor most highly correlated with well-formedness ratings, it was not significant when other variables are taken into account. A scatterplot of the irregular ratings (Figure 1) suggests that the variable of known/novel adds with the variable of semantic similarity to render derivational status insignificant. Data points deviating from the linear relationship between well-formedness rating and similarity rating are known deverbals and

Table 2
Predicting Regular Ratings

Variable	r	t(69)	p
derivational status	.78	2.52	0.01
semantic similarity	.71	1.95	0.05
homonym/polyseme	.74	0.64	> .50.
known/novel	.05	1.40	> .15.

Predicting Irregular Ratings

Variable	r	t(69)	p
derivational status	-.76	1.64	0.11
semantic similarity	-.74	2.90	0.005
homonym/polyseme	-.75	1.31	> .15
known/novel	.25	3.40	0.001

novel denominals, with the known items having inflated ratings and the novel items having depressed ratings.

Including in the multiple regression an interaction term for *either* **known X derivational status** or **known X similarity** had the effect of increasing the multiple-R from .83 to .87, increasing the *t* value of *all* other predictors, including derivational status, $t(68)=2.1$, $p < .05$; and semantic similarity, $t(68)=3.5$, $p < .0001$.

For regression on regular ratings, the same interaction term was significant, $t(68)=2.07$, $p < 0.5$ and its inclusion increased multiple-R from .80 to .82, but known/ novel variable alone was *not* significant.

Summary. Contrary to Kim et al's assertions that semantic aspects don't predict well-formedness rating, if known/novel status is taken into account, semantic similarity is a *better* predictor than derivational status (for the irregular ratings).

A Representational Hypothesis

Two ideas will be useful in developing a representational account of what it means to share or disavow a meaning relation. (1) Lexical items do not contain direct pointers to conceptual structure. Words are *conventionalized* form-meaning associations and thus include horizontal co-occurrence statistics, abstractions over which yield argument-structure relations (Langacker, 1987; some ideas about connectionist implementation in Harris, 1991). (2) The "principle of least effort" (Zipf, 1949) applied to meaning extension suggests that new senses "inherit" the meaning associations of the verb from which they are extended, including any association with an irregular past tense. With time, a dead metaphor (such as "I blew him off") may have little meaning relation with the basic sense of blow, but its irregular past has become habitual.

When an irregular verb is extended to become a noun, its association with the irregular form decays due to disuse. If it is *immediately* made into a new verb (as in psychology experiments), we are likely to see the type of indecision displayed in the 8 passages of this type constructed by Kim et al.

Conclusion

Drawing upon the ideas of functionalist grammarians, different types of meaning extension were categorized according to whether the speaker would need to emphasize or disavow shared meaning. Homophony and argument-structure changes were proposed to be the cases most likely to lead to incorrect inferences. Analysis of Kim et al's data showed that *-ed* form was judged more

felicitous in these cases than cases of compounding and metaphoric extension. Semantic similarity ratings corroborated and extended these findings. It is concluded that accepting the psychological reality of linguistic constructs doesn't mitigate the importance of functional explanations of these abilities.

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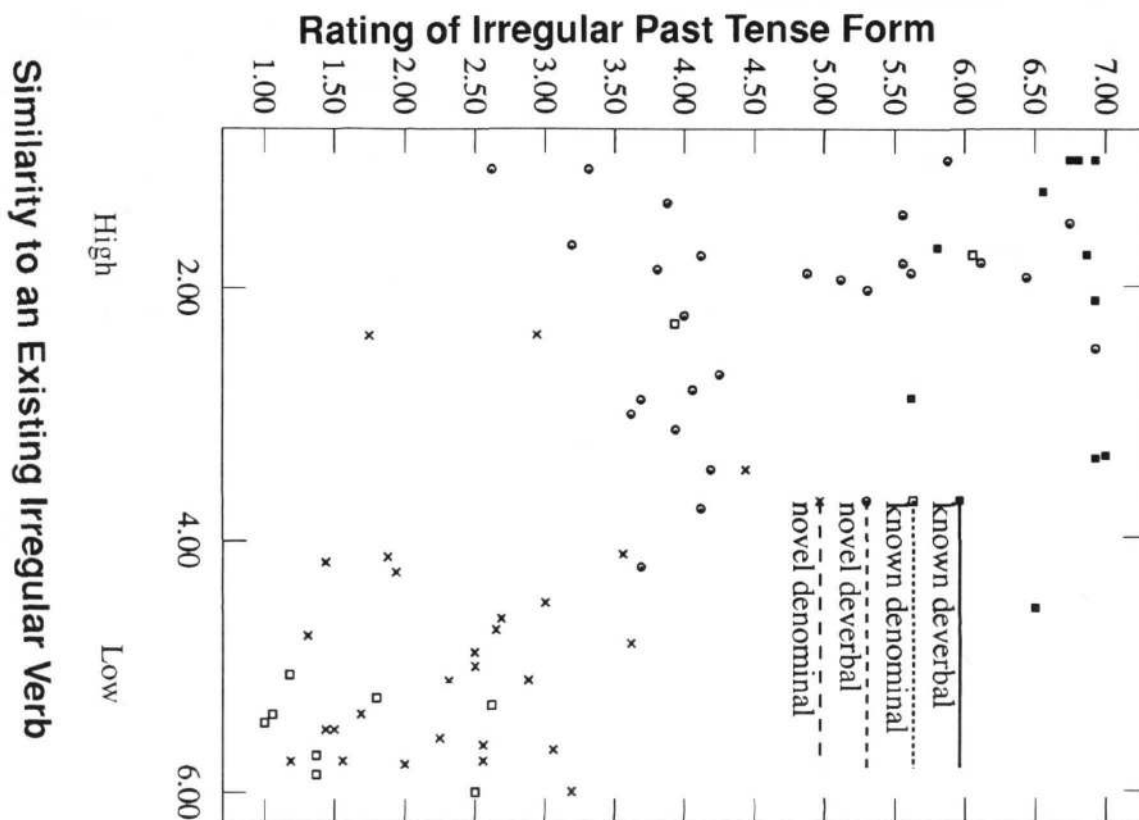Zipf, G.K. (1949) *Human behaviour and the principle of least effort*. Cambridge, MA: Addison-Wesley Press

Figure 1