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The Role of Meaning in Past-Tense Inflection:
Evidence from Polysemy and Denominal Derivation

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Abstract

Although English verbs can be either regular (*walk-walked*) or irregular (*sing-sang*), “denominal verbs” that are derived from nouns, such as the use of the verb *ring* derived from the noun *a ring*, take the regular form even if they are homophonous with an existing irregular verb: *The soldiers ringed the city* rather than **The soldiers rang the city*. Is this regularization due to a semantic difference from the usual verb, or is it due to the application of the default rule, namely VERB + *-ed* suffix? To gain a new source of insight into this debate, we compared the central senses of verbs to extended verbal senses and to denominal senses. In Experiment 1, participants rated the semantic similarity of the extended senses of polysemous verbs and denominal verbs to their central senses. Experiment 2 examined the acceptability of the regular and irregular past-tenses of the different verbs. The results showed that all the denominal verbs were rated as more acceptable for the regular inflection than the same verbs used polysemously, even though the two were semantically equally similar to the central meaning. Thus, the derivation of the verb (nominal or verbal) determined the past-tense preference more than semantic variables, consistent with dual-route models of verb inflection.

The Role of Meaning in Past-Tense Inflection: Evidence from Polysemy and Denominal Derivation

Past-tense morphology in English has been the focus of a spirited debate over the nature of cognition. Most English verbs form their past-tense by suffixing *-ed* to the verb, as in *talked*. However, irregular verbs, such as *sing*, *bear*, or *hit*, do not. Regular and irregular verbs have been dissociated in psycholinguistic paradigms, such as reaction time (Ellis & Schmidt, 1998; Prasada, Pinker & Synder, 1990) and neurolinguistic studies (Clahsen & Almazan, 1998; Marslen-Wilson & Tyler, 1997; Ullman, Bergida & O'Craven, 1997), strengthening the argument for a dual-mechanism model. Although most researchers would agree that irregular past-tense forms are handled by associative memory (Marcus et al., 1995; Pinker & Prince, 1988; Rumelhart & McClelland, 1986; Seidenberg & Bruck, 1990), the unresolved issue centers on whether regular past-tense forms are also stored in associative memory. That is, are all verbs inflected by an associative memory system (single-route), or is there also an explicit *-ed* rule that operates as the default for regular verbs?

Denominal verbs, verbs derived from nouns (e.g., *a bike* --> *to bike*), pose a potential challenge to single-route approaches. Denominal verbs often take the regular past-tense form even when the verb is phonologically identical to existing irregular verbs; e.g., *The soldiers ringed/*rang the city*. Bandi-Rao (2002), Kim et al. (1991, 1994), Kiparsky (1982), Pinker (1997), and Pinker and Ullman (2002, 2003) have argued that an irregular verb's root (*ring*) is marked in the lexicon as having an irregular past-tense form (*rang*). A novel denominal verb takes the regular past-tense form because it is headless or exocentric: Verbs with noun roots can't access the stored irregular form because nouns are not marked for tense, and thereby take the default inflection, *-ed*. A deverbal verb, a verb with a verb root (e.g., the extended sense of

the verb *ring*, as in *songs ring into the air*), takes the irregular inflection because it can access the stored irregular form. A single-route model that transforms phonetic input into phonetic outputs, such as the neural network implemented by Rumelhart and McClelland (1986), would inevitably fail to inflect denominal verbs such as *to ring the city* correctly because the model has no way of representing a particular verb as having been derived from a noun based on phonological information alone.

Harris (1992) and Shirai (1997) suggested a reply, based on semantics. They argued that the irregular past-tense form carries the meaning of the central sense (*The church bell rang*) or some of the meaning of the central sense (*Songs of freedom rang through the city*). Harris (1992, p. 102) states, "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." On this view, "speakers avoid irregular forms simply because they do not want to convey the meanings associated with those forms" (Shirai, 1997, p. 496), so denominals take the regular past-tense form (*The soldiers ringed the city*).

In a similar vein, Ramscar (2002) argued that semantic differences between the denominal and deverbal forms explain their different inflections: "The discovery that semantics can be (and is) used to resolve the homophone problem obviates the necessity of a rule in past tense inflection" (p. 47). The implicit suggestion is that a single-mechanism model could inflect denominal verbs regularly by adding a semantic layer without incorporating explicit rules. This argument from semantic difference may not take into account the ubiquitous phenomenon of polysemy, in which "unambiguous" words have a number of related senses (see Cruse, 1986, ch. 3; Lehrer, 1990, for reviews). Rather than each verb having one meaning, many verbs have

multiple senses. Furthermore, polysemous senses can be very different (Cruse, 1986; Klein & Murphy, 2002).

If there are large semantic differences within the normal uses of verbs, then the question arises about whether semantic differences can explain past-tense differences between denominal and deverbal forms. In some cases, a verb's senses do not seem strongly related. Take four uses of the verb *spring*:

1. Lambs *spring* about the pasture.
2. I will *spring* a surprise on Robyn.
3. Lewis never *springs* for drinks.
4. His pals will *spring* him from prison.

In (2), *spring* carries some but not all properties of the central sense in (1). However, the senses of *spring* in (3) and (4) do not obviously reflect semantic properties of the central sense of *spring* any more than the denominal sense of *spring*, "to install metal springs into a mattress" (see Experiment 1). What is of importance here is that there appears to be (in our judgment) a preference for the regular inflection for the verb *spring* in the denominal sense (*she springed the mattress*) but the irregular inflection in examples 1-4.

A further challenge to the semantic explanation comes from the fact that some denominal senses seem similar to the core senses, yet such verbs nonetheless take the regular inflection as in (5) and (6) (and see Kim et al., 1991; Lawler, 1989).

5. (a) The dress *cost* \$100.
(b) The electrician *costed* the job at \$100. ("to estimate *a cost*")
6. (a) Jack *shone* the flashlight on the floor.
(b) Jack *shined* his boots. ("to give the boots *a shine*")

The present experiments investigate the relation between a verb's meaning and its past-tense form. In particular, when senses of irregular verbs deviate significantly from the core meaning, do they tend to take on the regular past-tense? And when denominal senses are similar to the core verb meaning, do they take the irregular past-tense? Experiment 1 explored the semantic similarity of the deverbal and denominal forms to the core meaning, and Experiment 2 then tested whether the verbs took a regular or irregular past-tense, as a function of semantic similarity.

Experiment 1

Method

Participants. Twenty NYU undergraduates participated in the experiment. All were native speakers of English.

Materials. Eleven polysemous, irregular verbs were used in this study. They included four verbs used in both Kim et al.'s (1991) and Ramscar's (2002) experiments, *fly*, *spit*, *stand* and *shed*, plus *stick* and *ring* from Kim et al. Eight other verbs they used were eliminated because they lacked orthographic correspondences (e.g., *buy/bye*) or because they were not judged sufficiently polysemous (in a pretest) to test the effect of semantic difference, so we added four new verbs: *cost*, *bear*, *shine*, *catch*, and *spring*. For each of the 11 verbs, we identified three different forms: the central sense, an extended sense, and a denominal sense. The central and extended senses were generally identified from dictionary entries; the denominal forms were borrowed from prior experiments or were constructed by us. Context sentences were developed that picked out the desired senses, and then test sentences used the verb in that sense. We paired the extended and denominal senses with the central sense and asked subjects to judge how similar the meanings of the verbs were in each context. (Two sentence contexts were

prepared for each central sense so that one could be paired with the deverbal and the other with the denominal.) The verb was underlined in the test sentence and never appeared in the past-tense. See the appendix for the contexts and test sentences. Two versions of the questionnaire were constructed, differing only in which of the central sense sentences were paired with the denominal or extended sentences in the similarity rating.

To ensure that denominal verbs were interpreted as denominals, the word appeared as a noun first and then as the denominal verb. When the denominal verb seemed novel, scaffolding sentences were provided to define the use, e.g., *farmers often refer to this act of storing the tractor in a shed as "shedding the tractor."* To ensure that our intended denominal uses were perceived as being denominal, we asked 40 NYU undergraduates to rate on a 0-to-7 point scale whether the verbs were used in a "verblike" (7) manner, or whether sometimes they got their meaning based on a related noun (0). The instructions were modeled on those of Ramscar (2002, p. 74). For every verb, the denominal use was rated as more noun-based than the central and extended senses. Overall, participants rated denominal verbs as being more "nounlike" ($M = 2.71$) than deverbal verbs with an extended sense ($M = 4.85$), $t(10) = 7.31$, $p < .001$, or the central senses ($M = 5.60$), $t(10) = 6.73$, $p < .001$. (Forty different subjects rated each verb use for its familiarity; we present these results in the General Discussion.)

Procedure. Subjects read, "your task is to judge how similar the meaning of the underlined verb in part (a) is to the meaning of the underlined verb in part (b). You are asked to rate on a 0-to-7 point scale where '0' means that the two underlined verbs do not share any meaning in common and '7' means that the two underlined verbs have very similar meanings. Please ignore the verb tense and focus ONLY on the meaning of the underlined verb..." Two examples were provided without ratings.

Results and Discussion

If denominal verbs, homophonous to existing irregular verbs, tend to receive the regular past-tense, then according to the semantic account of the regularization of denominal verbs, they would be more semantically different from the core meaning than the extended deverbal senses. However, the subjects rated the extended ($M = 2.20$) and denominal senses ($M = 2.19$) equally similar to the central senses. Figure 1 shows a scatterplot of the similarities, with central-extended similarity on the X-axis and central-denominal similarity on the Y-axis. It can be seen that although some denominal senses are very different from the central meanings (to form *a ring* or to put something in *a shed*), some are extremely similar to the core verb meaning (to put *a shine* on something, or to place something on *a stand*). Similarly, some deverbal forms are quite similar to the core meaning (*songs ringing out*) and some are very different (*to spit loud, angry phrases*).

These results indicate that subjects do not perceive denominal senses as generally being more different from the core meaning of a verb than deverbal uses are. By themselves, however, these semantic ratings do not reveal the relation between semantic distance and the past-tense form. It is possible that semantic distance still determines the past-tense form that will be used. Subjects could use the irregular form whenever semantic distance from the core is low—regardless of whether the verb is denominal or deverbal. Alternatively, the derivation might control their judgments. The second experiment tests this question by asking speakers to rate the acceptability of the regular and irregular inflections for the verbs in the extended and denominal senses.

Experiment 2

Method

Participants. Forty NYU undergraduates participated in this study. None had participated in the previous experiment. All were native speakers of English.

Materials and Procedure. The same 11 verbs and sentences from Experiment 1 were used, but with the crucial change that the verb occurred in the past-tense. Each item first presented the context sentence (see appendix) and then presented the test sentence with the verb in either the regular or irregular form. Subjects rated the verb on a 0-to-7 point scale, from "not acceptable" to "very acceptable." Then the test sentence appeared with the alternate verb form, and subjects rated this version. There were eight versions of the questionnaire, which varied in the order of rated forms (regular and irregular), the order of the verbs, and which central sense was tested.

Results and Discussion

While the semantic ratings were identical for the extended senses and denominals, the past-tense acceptability ratings were not. There was an overall preference for the irregular inflection, but the preference depended on the verb's derivation. Subjects preferred irregular inflection for deverbals (6.09) over denominals (4.29), $t(10) = 7.52, p < .001$. Indeed, this pattern was found in all 11 verbs. Subjects correspondingly rated the regular inflection higher for denominals (2.65) than for deverbals (1.23) for all verbs, $t(10) = 6.33, p < .001$. Figure 2 plots these ratings as a function of similarity of the verb types to the central meaning (from Experiment 1).

In order to evaluate more specifically the determinants of past-tense preference, we performed a regression analysis with the Irregular minus Regular ratings for each verb as the dependent variable (a measure of relative preference for the irregular form), and the verb-noun and semantic distance ratings from Experiment 1 as predictors. The verb-noun ratings predicted

the verb preference ($B = .905$, $t = 2.12$, $p < .05$), but neither semantic distance nor its interaction with the verb-noun ratings did (all p 's $> .15$). Another analysis that included the familiarity ratings of the forms as well as verb-noun ratings and semantic distance also showed that verb-noun ratings predicted people's preference for the regular or irregular ($B = 1.449$, $t = 2.16$, $p < .05$), with none of the other factors reliably predicting ratings (p 's $> .35$). In short, the verb's perceived denominal status influenced the relative preference for the regular vs. irregular, but semantic distance did not, similar to the findings of Kim et al. (1991, Experiment 3), who compared metaphorical and denominal uses of verbs.¹

There could be several reasons why subjects generally preferred the irregular forms in these stimuli (albeit preferring them more for the deverbal forms). First, some of the denominal verbs used were novel and therefore, their derivational history may not have been as clear or as well encoded as the extended senses, all of which were familiar. Second, some of the items demanded a careful reading of the context sentences in order to interpret the verb as denominal in the test sentence; else the verb could be read as a more conventional deverbal. Finally, the verb *cost* in the denominal sense is not used frequently by college students, who may not have fully understood it. Five NYU faculty members we consulted (who likely have had experience in getting renovations *costed*) overwhelmingly preferred the regular inflection, whereas our undergraduate subjects preferred the irregular form.

General Discussion

The argument that denominal verbs take the regular inflection because they are semantically distant from the usual meaning of the verb is plausible, but it needs to explain the semantic similarity and variability of normal verb usage. If irregular denominal verbs share meaning with the core sense, then they should fail to take the regular inflection. If verbs are

polysemous, then semantic differences should create differences in past-tense forms among deverbal uses as well as among denominal verbs.

Our results showed that some verbs do in fact have very different senses, consistent with past observations about polysemy (Cruse, 1986; Klein & Murphy, 2002; Rice, 1992). The prior literature on polysemy does not suggest that different verb senses take different past-tenses, thereby raising questions about the semantic explanation for denominal verbs. Our results reveal that semantic difference does not have any apparent effect on the past-tense form. However, the derivation of the verb had highly significant effects on speakers' preference for the regular vs. irregular form. Thus, it seems unlikely either that speakers consciously choose a regular form to indicate a semantic difference with the usual, irregular form (as Harris and Shirai argue) or that semantic distance causes the verb not to activate its usual past-tense form. Our results suggest that denominal verbs do not take the regular inflection on the basis of the semantics of the verb. Rather, it is their exocentric nature that forces the default inflection. Thus, any explanation of the denominal verb data will apparently have to be sensitive to derivational information in some way.

An alternative explanation is that people have learned that the denominal forms are regulars, as Ramscar (2002) argued that American speakers have learned to say *flied out* in baseball. That is, *flied out* is memorized rather than generated by a past-tense rule. (However, this explanation fails to say why the convention is *flied out* rather than *flew out*, whereas the derivational account can explain this.) We obtained familiarity ratings of our verb uses and discovered that 9 of the 11 denominal verbs were rated were related below the midpoint of the 0-7 scale ($M = 2.5$, compared to means of 5.2 and 6.4 for the extended and central verb senses). Thus, it seems unlikely that their past tenses were memorized.

Alternatively, one might argue that the problem with the denominal verbs is that they were too unfamiliar and so were regularized for this reason, not because of their derivation. However, two of the denominal verbs were rated as familiar, *shine* ($M = 7.0$) and *stand* ($M = 5.0$). Both of these items showed the effect of greater preference for the irregular tense in the deverbal over the denominal versions, a difference of 2.64 for *shine* and 1.36 for *stand*—about the same as the 1.80 difference for all verbs. Thus, neither high nor low familiarity with the denominal verb seems to explain the results (and note that familiarity had no reliable effect in our multiple regression).

We do not attempt to account for all the now voluminous data on past-tense formation or to construct a theory that will resolve the somewhat inconsistent results in this area. Our conclusion is that semantic difference per se does not predict what past-tense form speakers will choose and that any attempt to rely on semantic difference must take into account the phenomenon of normal polysemy in verbs.

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Footnote

1. A reviewer questioned whether *shine* is really denominal even in our denominal contexts and therefore wondered whether the multiple regression would be similar if this item were removed. In fact, the results were noticeably stronger with *shine* omitted. In the full multiple regression, verb-noun ratings predicted regular vs. irregular acceptability more strongly, $B = 1.24$, $t = 3.04$, $p < .01$, but semantic distance and its interaction with verb-noun ratings still did not account for any variance, $ps > .50$. The second analysis, with familiarity, semantic distance, and verb-noun ratings again showed only a reliable effect of the last factor, $B = .81$, $t = 2.47$, $p = .025$. Thus, denominal status seems to be the most important factor whether *shine* is included or not.

Figure Captions

Figure 1. A scatterplot showing each verb on the dimensions of extended sense-central sense similarity (X-axis) and denominal sense-central sense similarity (Y-axis). 0 means that the two senses are not similar, and 7 means that the senses are very similar.

Figure 2. Mean ratings of semantic similarity and regular past-tense acceptability for deverbal (V) and denominal (N) verbs. 0 means the semantic similarity/past-tense form was “not similar”/“not acceptable,” and 7 means that the semantic similarity/past-tense form was “very similar”/“very acceptable.” Note that the acceptability of the regular past tense is greater for the denominal version for every verb.

Figure 1

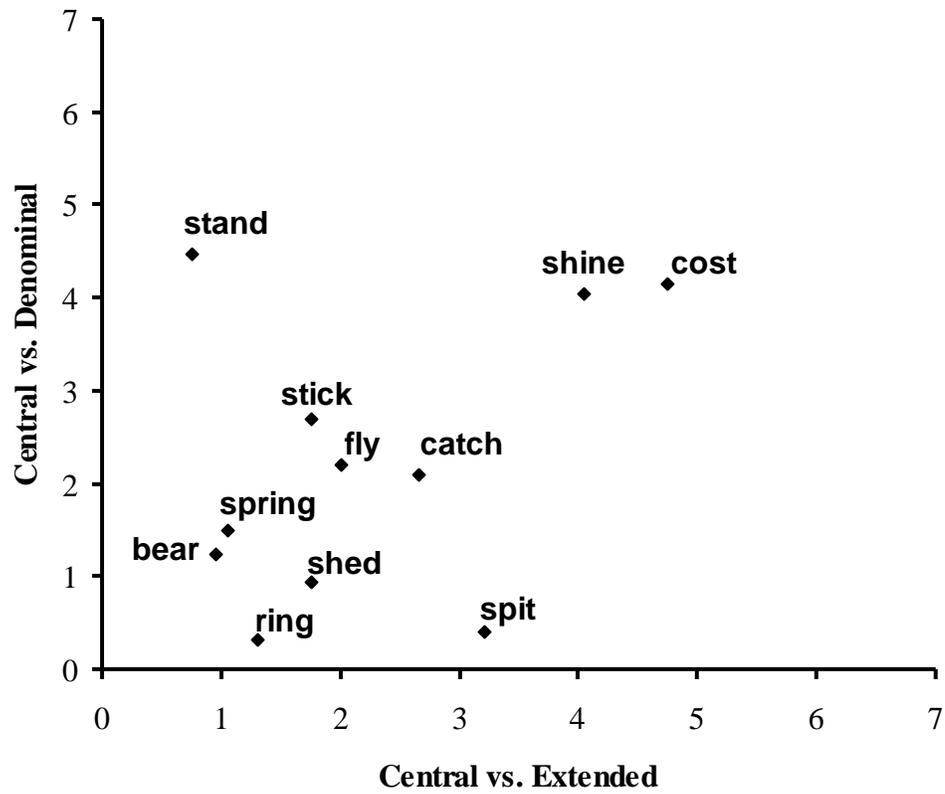
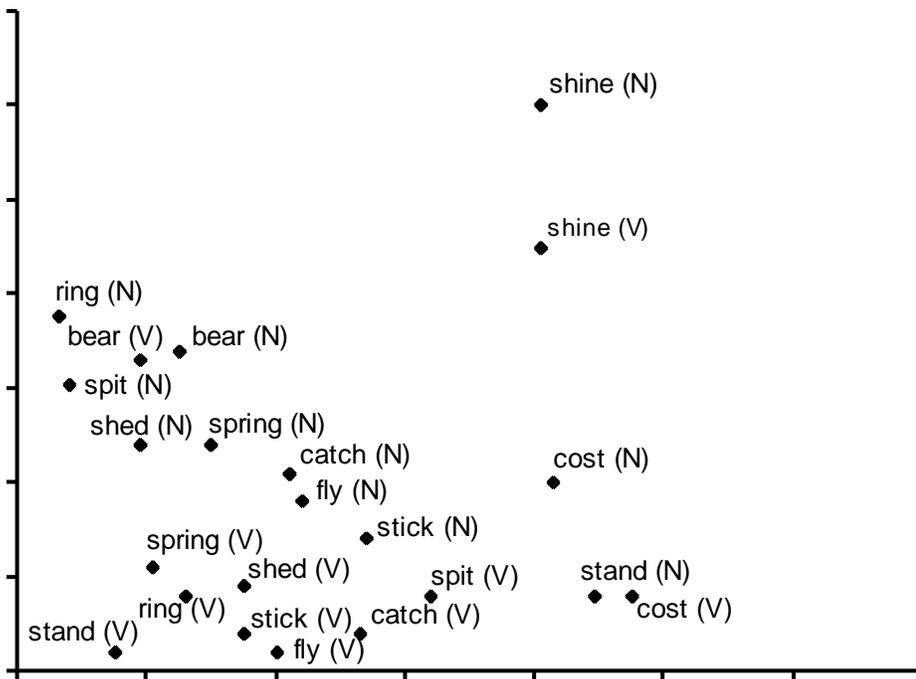


Figure 2



11. When detectives investigate a crime, they carefully examine the suspect's story and crosscheck it several times to see if the story rings true.
Even though John's story is long and complex, the detectives think that John's story rings true, based on consistency.

Semantic distance = 1.30

Reg = 0.84; Irreg = 6.36

C. Central Senses of Verbs

- 1.a. One thing that I detest the most is to lay my fingers on a piece of old gum sticking onto the underside of my chair. Paul thinks it's fun to stick gum on my desk and chair.
In an attempt to teach Paul a lesson, I will stick a large piece of gum onto the underside of Paul's shoes.
- 1.b. When Amy and John send Christmas cards, their children like to stick stamps on envelopes.
This Christmas, John has bought self-adhesive stamps. The children stick stamps on over a hundred envelopes but they don't think the self-adhesive stamps are half as much fun as licking stamps.
- 2.a. Designer clothes are expensive and they are rarely on sale. A silk jacket can cost anywhere between \$300 and \$500.
Today, at the annual sale, I found a silk jacket that costs \$150, and I immediately bought two jackets.
- 2.a. Living in Manhattan can be expensive. A one-bedroom apartment in Greenwich Village costs about \$2,500.
I would much rather live in New Jersey where a one-bedroom apartment costs half the amount.
- 3.a. These Bedouins in the Sahara desert gather dates from hundreds of palm trees. When they travel to the next town to sell the fresh dates at the market, they use camels to bear the heavy sacks.
Today, Bedouins place several heavy sacks on the camels. The camels bear the weight of the sacks but walk very slowly.
- 3.a. Hikers going down the Grand Canyon bear heavy backpacks because they know that the only ranch down in the canyon is closed.
Since no drinking water is available in the canyon, the hikers who are going down today bear several bottles of water in their backpacks.
- 4.a. In southern France hunters set up special traps to catch rabbits. They catch more rabbits in the spring than in the winter.
Today, Jean-Jacques sets several traps because the weather is nice and warm. He will probably catch several rabbits.
- 4.b. My dog loves to play Frisbee in the park. I love the way he lifts himself into the air and catches the Frisbee with his mouth.

Right now, you can see my dog playing with my friend, Michael. As the Frisbee spins high into the air, my dog leaps up with all his four paws in the air and gracefully catches the Frisbee.

- 5.a. Sarah is having a hard time feeding her baby broccoli puree. Each time she puts a spoonful into the baby's mouth, he spits it out.
Today, Sarah tries to feed the baby some pureed spinach. But the baby spits the food out again.
- 5.b. Wine connoisseurs taste the wine but they do not swallow it even if they think the wine is of excellent quality. They spit the wine and then taste the next sample.
Monsieur Vincent is a world-renowned wine connoisseur. Today, as he tastes this twenty-year-old French wine, he swallows a very small quantity of the wine and spits the rest into a tall glass container.
- 6.a. People often tell us that as you drive along the country roads in the central woodlands of New Jersey, there is a good chance that you will see a deer spring across the road.
We have been driving for two hours now. Finally we see a huge deer spring gracefully across the road and disappear swiftly into the woods.
- 6.b. These French soccer fans get very serious when France plays in the world cup finals. Each time the French team strikes a goal, the fans spring from their chairs with joy to cheer for their team.
In spite of his heart condition, I know that when Jacques hears the news that France has won the world cup title, he will spring from his chair like a child.
- 7.a. In the fall season, the leaves of maple and oak trees take on dramatic hues in New Hampshire. Unfortunately, this peak season lasts just a few days before the trees begin to shed their leaves.
The peak season for fall colors is just over in New Hampshire. But tourists are still here to take pictures of these trees as they shed their colorful leaves.
- 7.b. Most reptiles shed their old skin and grow a new one during the early spring. This new skin is rich in green and brown tones that help the reptile camouflage itself better during the spring and summer months.
The school children, who are visiting the reptile center at the zoo, are getting a chance to watch a boa constrictor as it sheds its entire skin.
- 8.a. After two days of incessant rain, the sun has finally broken through the clouds. I like it when the sun shines brightly. I can go to the beach and relax.
It is cloudy this morning, but if the sun comes out and shines, I will take the children to the beach.
- 8.b. Although Venus is a planet, it is called the evening star because it shines so brightly. This evening, the night sky is very clear and Venus shines so brightly that I almost mistook it for Sirius, the brightest star in the southern constellation.
- 9.a. I am fascinated by the peculiar habits displayed by some birds. For instance, cranes can stand on one leg and still sleep standing upright.
I try to imitate the cranes. I stand on one leg, but I lose my balance in fifteen seconds.

- 9.b. Students are expected to stand up when they are asked to recite the Pledge of Allegiance at school.
Today, several high-school students stand up and leave the classroom before the Pledge of Allegiance is recited as they object to the word "God" in the Pledge.
- 10.a. Each winter, thousands of Siberian cranes fly south in search of warmer places to breed. During the migratory season, tourists in southern China watch as thousands of cranes fly south.
- 10.b. The Kennedy family is planning to charter a large plane. Their guests will fly to Tahiti, a tropical island in the Pacific, for their daughter's wedding.
Their guests will first make a stop at Los Angeles and then fly directly to Tahiti.
- 11.a. My dad has installed a hi-tech doorbell in our new house. When a visitor rings the bell, a written message pops up on the computer screen as well.
This new doorbell is very convenient because if you are working on your computer with your headphones on, you will still be able to know when the doorbell rings.
- 11.b. I am not sure to call this a coincidence or a trick, but each time I sit down to eat my dinner, the phone rings but stops just before I pick up the receiver.
Tomorrow, I will install a caller-ID. Now if the phone rings again, I will be able to trace the call.