LETTERS

edited by Jennifer Sills

Protecting Invaders for Profit

HUMANS HAVE SPREAD SPECIES TO NONNATIVE ENVIRONMENTS FOR generations. In turn, these species can become invasive, threatening native species. There has been much discussion about the best way to control invasive species and protect native species (*1*). However, one point has been overlooked: In some cases, human commercial activity values invasive species more than the native species, and dangerous behavior ensues. For example, trout (e.g., *Salvelinus sp.*) and red deer (*Cervus elaphus*) were introduced to Argentina and Chile from the United States and Europe about 100 years ago for fishing and hunting purposes. Today, these species are invasive, but they represent an economic resource for tourism and sport (*2*, *3*). Because of their commercial value, the Argentinean and Chilean governments maintain healthy populations by setting restrictions on hunting and fishing seasons and the number of fish allowed per day. Similarly, the Argentinean government allows local people to profit by hunting and selling the invasive hare (*Lepus europaeus*) by millions to Europe (*4*). In Patagonia, many farmers hunt or poison native guanacos (*Lama guanicoe*) to avoid competition with nonnative livestock or red deer. Some nonnative species are even advertised as "typical" in the countries where they are introduced. As a result, the citizens of southern South America do not consider invasive species a problem (*5*).

Native species at risk. Farmers in Patagonia hunt guanacos to protect nonnative deer.

It is impractical to eradicate some invasive species. However, by valuing them more than native species, we are promoting their expansion and endangering the native species. The discussion about invasive species must focus on the prevention of their social and commercial overvaluation. We must also educate both local communities and governments about the importance of maintaining and recovering native species populations. In the long run, the negative consequences of species introductions are greater than their short-term commercial benefits (*6*).

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Culturomics: Statistical Traps Muddy the Data

IN THEIR GENERALLY WORTHWHILE DISCUSsion of developments in the English language ("Quantitative analysis of culture using millions of digitized books," Research Article, 14 January, p. 176), J.-B. Michel *et al*. fall into two common traps. First, they assume that the total number of words published in English is a meaningful statistic. Although this figure seems impressive—and has traditionally been used to validate English speakers' belief that their language is exceptional [e.g., (*1*)]—it primarily reflects the large number of English speakers and their relatively high per capita publication rates. The statistic has little to do with the number of words available to an individual English speaker. Second, the authors claim that the English lexicon "is enjoying a period of enormous growth" and that "the size of the language" has grown "by over 70% during the past 50 years." However, they are not measuring the English lexicon directly; they are measuring the written record of the English lexicon. These two concepts should be kept distinct. If the fossil record shows more dinosaur footprints in one period than another, it does not necessarily mean that there were more dinosaurs—it may be that there was more mud.

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Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the past 3 months or matters of general interest. Letters are not acknowledged upon receipt. Whether published in full or in part, Letters are subject to editing for clarity and space. Letters submitted, published, or posted elsewhere, in print or online, will be disqualified. To submit a Letter, go to www.submit2science.org.

Culturomics: Periodicals Gauge Culture's Pulse

FROM THE PERSPECTIVE OF AN ARTIST who mines digital information to understand shifts in temporal culture, the analysis of Google books and the initial description of trends in our culture by J.-B. Michel *et al*. ("Quantitative analysis of culture using

millions of digitized books," Research Article, 14 January, p. 176) is an important step forward in using current digital techniques as a window into history. Although Michel *et al*.'s study was rigorous, the selection of books has certain drawbacks. First, the sample reflects not all published books, but only those that Google or their partners deemed worthy of digital reproduction. Second, and more important, books are inherently more distant from the pulse of a culture than periodicals, in particular newspapers. Book publishing has a substantial lag time to print; periodicals are closer to real-time. Furthermore, as we move further away from news media, we see a shift toward greater analysis, filtering, and a narrowing of subjects. For these reasons, analyses of culture based on the written record should include a wide variety of texts. One of the ultimate challenges to this type of research is representing information in a manner that is effective and relevant to viewers within our culture.

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Response

WE THANK MORSE-GAGNÉ AND SCHWARTZ FOR their Letters, and we are happy to have the opportunity to clarify.

Morse-Gagné questioned whether the size of the English lexicon is a meaningful statistic and points out that such measures are usually associated with rather dubious attempts to prove the superiority of the English language. We share her concern. The concept of a "word" is a fuzzy notion, and ambiguities in how it is defined invariably affect the results of any lexical census. Yet the size of the English lexicon remains a perennial question, and a working definition is needed if we hope to address whether and how our vocabulary is growing. As such, we dealt with the question as best we could: We explicitly defined the notion of "word" as a meaningful string of alphabetic characters that is free of typographical errors and that appears in the text of published books with a frequency greater than one part per billion. Crude though it may be, this approach avoids many of the subjective judgments associated with other attempts to measure the size of the lexicon. We agree with Morse-Gagné that the resulting count of over a million words should not be used to justify anglophilic chauvinism.

We disagree with Morse-Gagné's argument that our measurements of lexical size are consequences of the number of English speakers and their publication rates. Our methods require each word to appear with a frequency of greater than 1 part per billion in the corresponding time period. (Each time period is represented by many billions of words.) Thus, to use Morse-Gagné's analogy, our count of "dinosaur footprints" included careful

CORRECTIONS AND CLARIFICATIONS

Review: "Homoplasy: From detecting pattern to determining process and mechanism of evolution" by D. B. Wake *et al*. (25 February, p. 1032). In the legend to Fig. 1B, the third sentence should have read: "One mode (which has evolved in two independent lineages) elongates individual vertebrae (II); the alternative mode adds vertebrae (III) (*48*)." In the legend to Fig. 3, the fourth sentence should have read: "The phylogeny of Zingiberales indicates the relationships of the eight families with important character transitions (*34*)." The fifth sentence should have read: "For each family, the organs characteristic of each whorl are indicated: green, sepal; orange, petal; yellow, fertile stamen; light orange, petaloid stamen/staminode; blue, carpel." The ninth sentence should have read: "(c and d) Monocostus (Costaceae) flower with distinct sepal and petal whorl organs, fused outer and inner petaloid staminodes forming the labellum, and (d) a single fertile petaloid stamen from the inner stamen whorl."

Perspectives: "Life on low flame in hibernation" by G. Heldmaier (18 February, p. 866). In the fourth paragraph, the basal metabolic rate of bears was incorrect. The correct figure is 0.276 ml O_2 g^{-1} $hour^{-1}$.

Editors' Choice: "Extinction's cause and effect" by N. S. Wigginton (4 February, p. 512). The field heading should have been Paleontology rather than Archaeology.

News Focus: "The Human Genome (patent) Project" by S. Kean (4 February, p. 530). Affymetrix was misidentified. The company does not provide diagnostic services. It provides microarray and clinical application technologies, such as gene chips, for diagnostics work. The story should also have noted that Affymetrix customers, not Affymetrix itself, must clear legal rights for any gene patents when using Affymetrix products.

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News Focus: "Going the distance" by E. Pennisi (28 January, p. 395). The researcher in the picture (left) on page 395 was incorrectly identified. He is Anders Kvist, who worked extensively with Blue, the bird who flew 16 hours in a wind tunnel.

News of the Week: "New high-tech screen takes carrier testing to the next level" by J. Couzin-Frankel (14 January, p. 130). A caption incorrectly states that Lesch-Nyhan syndrome, a rare childhood disease, occurs when both parents carry the mutated gene. In fact, the syndrome is an X-linked disorder, so only the mother needs to be a carrier.

controls for the preponderance of mud.

Schwartz notes that our reliance on book data might influence our results. We agree that it will be important to expand our data beyond books, as we emphasized in the final section of our paper. However, digitization at the culturomic scale—all books, all newspapers, all magazines, all manuscripts—remains in its infancy. We chose to study books because they are one of the few types of materials for which comprehensive data is available. If thoughtful scholars like Morse-Gagné and Schwartz continue to lend their voices and pens to the cause, future scholars will have a wider array of options.

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Longer Trips Possible for Human Missions

IN HIS NEWS FOCUS STORY "NASA WEIGHS asteroids: Cheaper than moon, but still not easy" (18 February, p. 841), R. Kerr discusses NASA's search for destination near-Earth asteroids (NEAs) and the hope that a suitably sized candidate NEA, which can serve as a "stepping stone" for humans to continue to explore space, can be found by the mid-2020s.

NASA faces these obstacles because of overly severe mission constraints. For example, longer trip durations should be considered. Four cosmonauts have spent a year or more at a time in Earth orbit, and there are experiments in progress, such as Mars500, to explore the physiological and psychological aspects of long-duration space voyages. Programmatically, Earth-to-NEA round-trip duration times of 12, 18, or 24 months make sense if we are serious about preparing for trips to Mars and beyond.

Of course, it will take hard work and significant new research to generate the confidence required to send humans on such trips and expect them to return intact. Fortunately, we already have two major assets: Russian/Soviet experience in long-duration space flight, and the International Space Station, which was originally conceived for exactly this purpose.

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