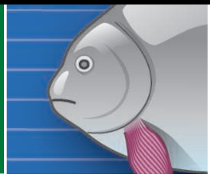

LETTERS

edited by Jennifer Sills

Time for DNA Disclosure

THE LEGISLATION THAT ESTABLISHED THE U.S. NATIONAL DNA INDEX SYSTEM (NDIS) IN 1994 explicitly anticipated that database records would be available for purposes of research and quality control "if personally identifiable information is removed" [42 U.S.C. Sec 14132(b)(3)(D)]. However, the Federal Bureau of Investigation (FBI), which controls the database, has published no research derived from NDIS and has declined to disclose these records to academic scholars. The National Research Council recently noted that "methods developed in crime laboratories to aid in law enforcement" would benefit from the contributions of academic scientists (*1*). We believe the time has come for the FBI to release anonymized NDIS profiles to academic scientists for research that will benefit criminal justice.

Disclosure of NDIS profiles would allow independent scientists to evaluate some of the population genetic assumptions underlying DNA testing using a database large enough to allow more sensitive evaluation of population structure. The publicly available population databases used to date for statistical estimation of the frequency of DNA profiles are relatively small ($N \approx 1000$), consisting of convenience samples analyzed over a decade ago (*2*, *3*). In contrast, NDIS has grown to over 7 million complete 13-locus short tandem repeat (STR) genotypes (*4*). Analysis of these data would allow more powerful tests of independence within and between loci, as well as assessment of the efficacy of the theta factors used to compensate for population substructure. (To the extent the data are identified by state, analysis of NDIS data could also yield important information about the most appropriate geographic scaling for allele frequency estimates.)

The large sample size also allows real-world tests of propositions that previously have been addressed only by simulation. For example, it would allow tests of the frequency with which three-person mixtures could produce profiles consistent with two contributors (*5*); kinship analysis could allow assessment of how match probabilities are affected by the number of close relatives in the database (*6*, *7*); and multivariate analysis could be used to evaluate the extent to which DNA profiles cluster due to identity by descent. As studies of smaller databases have shown, researchers need not know a priori the precise number of relatives in the database, nor their ethnic/racial background, to perform these assessments (*6*, *8*). Indeed, scholars who have examined smaller databases have called for examination of national databases (*6*, *8*, *9*). Access to the anonymized 13-locus genotypes would allow more powerful analyses of these important issues than was previously possible.

Analysis of NDIS can also yield valuable insights into the frequency and circumstances under which certain typing errors may occur. A review of a government database from Victoria, Australia, containing 15,021 9-locus STR profiles shows how important such a review can be for "quality control purposes" (*10*, *11*). The study found an error rate of about 1 in 300 for the typing of reference samples, which raises concerns about missed opportunities to develop investigative leads.

Disclosure of NDIS profiles would not violate any meaningful privacy interests (*12*). (There are easier ways to determine whether an individual has a criminal record than searching such a database, and the profiles would not be useful for medical diagnoses.) The profiles in the Victoria, Australia, database have been widely circulated for years with no known harm occurring. The U.S. government regularly argues to courts that broad mandatory DNA collection statutes are not unconstitutional precisely because the 13 genetic loci are noncoding and thus have no power to reveal any sensitive information. Moreover, as most research scientists know well, the government frequently releases sensitive information under controlled conditions to verified researchers. Even within the criminal justice context, law enforcement officials have made available data about the age, race, gender, geographic residence, and a wide range of other information about criminal offenders so that researchers can conduct studies aimed at improving and enhancing effective law enforcement.

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Some have suggested that the release of NDIS profiles would be unduly burdensome (*13*), but the relevant fields in the SQL database could be copied in a matter of minutes.

Open access to data is a fundamental tenet of science. The need for openness was reinforced by the recent National Research Council report, which decried the insularity of forensic science and called for greater involvement of the academic community in assessment, validation, and improvement of forensic science methods (*1*). Law enforcement should honor the norms of science and open the NDIS and other government DNA databases to independent scientific scrutiny. Doing so poses no meaningful risk and can only strengthen the quality of forensic DNA analysis.

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Weighing Reward and Punishment

IN THEIR REPORT "POSITIVE INTERACTIONS promote public cooperation" (4 September, p. 1272), D. G. Rand *et al.* find that targeted reward is at least as effective as targeted punishment in maintaining cooperation. In their experiment, infrequent reward may be sufficient because the group is small and interacts repeatedly. However, in real-world situations, punishment may be the more effective and cost-efficient option.

In many real-world cases, unlike Rand *et al.*'s example, the cost to Player A of giving Player B a material reward is roughly the same as the benefit Player B receives from the reward. (The benefit of nonpecuniary rewards, such as praise, may exceed their cost considerably. Rand *et al.* suggest this, but their experiment is not set up to provide evidence.) Thus, the cost of cooperation is simply shifted to those who provide the reward. However, the threat of punishment provides a less costly lever to force cooperation, even when the threat must be carried out. The cost of a match and a gallon of gasoline is much less than cost to repair the damage they could cause. Likewise, nasty words can hurt much more than the effort it takes to say them.

In real-world situations, when people are not interacting in a small group and when they are motivated by money, the threat of punishment is effective. Laws are based largely on this insight.

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Response

BARON ARGUES THAT INFREQUENT PUNISHments are more cost efficient than infrequent rewards. But our experiment does not represent a situation of intermittent rewarding. Instead, we have shown that contributions to the public good can be maintained by linking the public goods game to cooperative, wealth-producing pairwise interactions. Low contributors are denied cooperation in pairwise interactions, while high contributors are rewarded. Due to the ubiquity of such opportunities for targeted interaction, there is no need for costly peer punishment to enforce cooperation. Full cooperation in both the public and pairwise interactions leads to the best possible payoff. Thus, adding punishment cannot result in better outcomes.

Baron challenges the real-world applicability of the non–zero-sum rewards in our study. However, the availability of wealth-generating, non–zero-sum interactions is the essence of all social dilemmas—including the Prisoners' Dilemma (*1*–*5*), of which our reward interaction is an example, as well as the Public Goods Game (*6*–*9*) itself. These games represent the multitude of different

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 3 months or issues of general interest. They can be submitted through the Web (www.submit2science.org) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

cooperative interactions in which two or more people working together can achieve more than each person could alone. For example, consider mutually beneficial trade: Both parties pay the cost of abandoning something worth less to them than to the other, in order to gain something they find relatively more valuable. To enforce public cooperation, one can refuse to trade with those who do not contribute to the public good. Baron's claim that life offers few opportunities to create material benefits for others through cooperation questions the relevance of all work on social dilemmas, including his own (*10*).

Baron concludes by mentioning the role of punishment in law. However, our paper and most others on costly punishment (*4*, *5*, *7*–*9*) investigate peer punishment, not institutionalized punishment. The latter deserves further empirical and theoretical exploration.

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CORRECTIONS AND CLARIFICATIONS

Editors' Choice: "Microbial influences" (4 December, p. 1321). The image accompanying the text should have been credited to Ivanov *et al*., not Gaboriau-Routhiau *et al*.

Books *et al*.: "Science goes Hollywood" by C. Bohannon *et al*. (4 December, p. 1348). The first sentence of the reviewers' affiliations was inadvertently dropped. The reviewers are members of NeuWrite, a nonfiction writing group at Columbia University (www.neuwrite.org).

Policy Forum: "Bridging the Montreal-Kyoto gap" by J. Cohen *et al*. (13 November, p. 940). The author's e-mail should be jcohen@eosclimate.com. The HTML online version has been corrected.

Reports: "Engineering entropy-driven reactions and networks catalyzed by DNA" by D. Y. Zhang *et al*. (16 November 2007, p. 1121). In Fig. 4B, domain $\overline{4a}$ should have been domain $\overline{4t}$, with a length of 7 nucleotides. The corrected figure appears below. The following text should also be added to the Fig. 4B caption: "Domain $\overline{4t}$ has identity 5′-TTGAATG-3′ and is a subsequence of domain $\overline{4a}$."