troscopic data. Fragmentation occurs in the excited or ionic state, that is, after the rotational wave packet is probed by the ionization pulse. Hence, the rotational spectra observed at the mass of a molecular or atomic fragment correspond to those of the unfragmented parent molecule and thereby allow the direct assignment of fragment to parent. A horizontal cut through the CRASY data at the frequency of a selected isotope yields a mass spectrum containing the signal of parent and all fragments, as shown for three frequencies on the left of Fig. 4. For CS_2, we observe the fragmentation of covalent bonds and the formation of S_2, CS, S, and C fragments. The direct characterization of multiple fragmentation pathways in a heterogeneous sample will be of particular importance for the investigation of noncovalently bound clusters, where the interpretation of pump-probe data is hindered by ease of fragmentation [see, e.g., the vast literature on phenol-ammonia clusters as summarized in (*31*)].

Analogously to the correlation of rotational structure and ion mass with mass-CRASY, electron-CRASY data correlates rotational structure with photoelectron spectra. This allows the measurement of electron spectra with structural selectivity. The combination of electron- and mass-CRASY experiments allows the indirect correlation of mass and electron spectra via rotational frequencies. In appropriate cases, mass- and electron-CRASY experiments could therefore deliver data comparable to that available from femtosecond electron-ion coincidence experiments, which have to be performed with very low signal collection rates and are highly time-consuming (*32*, *33*). In the present study, we observed identical electron spectra for different CS_2 isotopes because the isotopic composition has a negligible effect on the electronic structure of the molecule (fig. S7). The bimodal shape of the electron spectrum is due to the presence of a bright $^1\Sigma_u^+$ and a dark $^1\Pi_g$ excited state, which interact upon bending of the molecule (*34*).

The experimental results presented here raise the prospect of numerous spectroscopic experiments on larger and more complex molecules. The only fundamental issue limiting the applicability of CRASY is the requirement of an appreciable anisotropic polarizability (and corresponding rotational Raman cross sections) in the investigated molecules. The same limit applies to nonadabatic alignment experiments, which have been successfully demonstrated for a number of larger chromophores; for example, iodobenzene, dibromothiophene, and difluoroiodobenzene (*35*, *36*). To observe substantial nonadiabatic alignment, the phase relation between the states forming the rotational wave packet must be favorable. This condition does not apply to CRASY, where the mere existence of rotational coherence and the associated temporal signal modulations are sufficient to generate a detectable signal. With the high sensitivity demonstrated here for CRASY, we expect that a large majority of chromophores will be accessible to CRASY experiments.

The information content of rotational spectra is very large, and the interpretation of such spectra is commensurately complicated. The additional spectroscopic axes in CRASY experiments can assist the analysis of rotational spectra in impure samples; for example, by correlated determination of ion masses (in mass-CRASY), ionization potentials (in electron-CRASY), or fluorescence spectra (in fluorescence-CRASY). Together with the recent development of mathematical algorithms for the semiautomated assignment of rotational spectra (*37*), this technique may generally facilitate the structural characterization of constituents in inherently unstable samples or samples containing inseparable compounds.

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Supporting Online Material

www.sciencemag.org/cgi/content/full/science.1204352/DC1
Materials and Methods
Figs. S1 to S7
References

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Race, Ethnicity, and NIH Research Awards

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We investigated the association between a U.S. National Institutes of Health (NIH) R01 applicant's self-identified race or ethnicity and the probability of receiving an award by using data from the NIH IMPAC II grant database, the Thomson Reuters Web of Science, and other sources. Although proposals with strong priority scores were equally likely to be funded regardless of race, we find that Asians are 4 percentage points and black or African-American applicants are 13 percentage points less likely to receive NIH investigator-initiated research funding compared with whites. After controlling for the applicant's educational background, country of origin, training, previous research awards, publication record, and employer characteristics, we find that black applicants remain 10 percentage points less likely than whites to be awarded NIH research funding. Our results suggest some leverage points for policy intervention.

The U.S. National Institutes of Health (NIH) has a long history of working to increase the diversity of its intramural and extramural biomedical research workforce, especially through programs such as Minority Access to Research Careers, Minority Biomedical Research

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Support, Research Centers at Minority Institutions, and Diversity Supplements. However, the effects of these programs on the pool of funded NIH grants have not been reported.

In fact, there have been relatively few studies on the racial and ethnic composition of populations that apply for federal research funding. Studies of race and ethnicity in science generally focus on differences in representation (*1*–*3*). A recent National Academies study (*4*) emphasized the need to increase the participation of minorities in science and engineering. In this study, the terms employed for race and ethnicity denote commonly used sociocultural classifications.

We hypothesized that scientists of different races and ethnicities with similar research records and affiliations would have similar likelihoods of being awarded research grants. To test this, we used data from the NIH IMPAC II (Information for Management, Planning, Analysis, and Coordination) grants data system consisting of application and investigator data for Research Project Grants (RPGs) submitted between FY 2000 and FY 2006 (*5*, *6*). During the application process, investigators self-identified their race and ethnicity. Our analysis sample contains Type 1 R01 grant applications; the R01 is the oldest and most widely used investigator-initiated research project grant. Our sample is limited to Ph.D. investigators at U.S. institutions and includes 83,188 applications with data available for most of the explanatory variables. Because investigators can submit multiple grants for different projects, this represents 40,069 unique investigators.

To receive NIH funding, applications are evaluated by a peer-review process that considers the significance, innovation, and approach of the grant application, the investigator(s), and the research environment. Applications determined to be meritorious are discussed in detail and scored. About half of all applications are scored. Among those that are scored, relative merit score, budgets and NIH institute priorities, which vary by year and by institute, determine which applications are funded.

Award success frequently depends on an iterative process of commentary, revision, and review, and many applications are resubmitted as revised or amended applications. To capture this activity, we collapsed revised or related applications that were received within 2 years of the original submission into one application for the purposes of determining the award probability for the application. Information about an application and its review was derived from the last funded or unfunded application submitted. Because individuals could have submitted more than one grant application during our sample time frame, we estimated all standard errors used in test statistics by treating the data for each applicant as a cluster. We supplemented information from IMPAC II with institutional information from the Department of Education Integrated Postsecondary Education Data System (IPEDS); investigator information from the NIH Doctoral Record File (DRF), which is derived from the National Science Foundation Survey of Earned Doctorates (SED), a census of doctorates awarded in the U.S. since 1974; and faculty data from the Association of American Medical Colleges (AAMC) Faculty Roster. Of the investigators in the sample set, 57% were matched to the DRF. Race and ethnicity were identified by using a combination of self-reported responses in IMPAC II, the DRF (*7*), and the Faculty Roster. Although applicants self-identify race, ethnicity, and gender, this information does not appear in the application and is not available to the review committee, staff, or council. However, information contained in the application biosketch, such as the undergraduate or doctoral institution attended and applicant names, may in some cases be used as a proxy for race/ethnicity (*8*). For those investigators for whom we could not identify race or ethnicity, we included a dummy variable set to equal one in our analysis to account for missing data.

Applications from Asian, black, Hispanic, and Native American investigators together are 21% of the total for NIH research grant opportunities and are represented in similar proportion both to medical school faculty and biomedical Ph.D. matriculants (*9*). In our study sample, applications from Asian investigators were 16.2%, blacks were 1.4%, Hispanics were 3.2%, Native Americans were 0.05%, whites were 69.9%, and other/unknown were 9.2% of total applications. Due to the small number of applications from Native Americans in the sample ($N = 41$), the analysis focuses on Asian, black, Hispanic, and white investigators.

We examined the relationships among race, priority score, and award probability. Applications with good scores were more likely to be funded, regardless of race/ethnicity (table S1 and fig. S1). The relatively small number of applications for some of the racial and ethnic groups, coupled with the large number of NIH institutes, did not allow us to evaluate award probabilities by institute.

There were significant differences in award probability by race and ethnicity (Fig. 1) in our sample. Compared with NIH R01 applications from white investigators, applications from black investigators were 13.2 percentage points less likely to be awarded ($P < .001$), and those from Asian investigators were 3.9 percentage points less likely to be awarded ($P < .001$). Table S2 shows that the award probabilities in our analysis sample were very similar to those found in the entire RPG application pool. Thus, for the entire RPG pool, if blacks had the same award probabilities as whites (36.4% for RPGs and 29.3% for R01s) one would expect to see 1071 RPG awards instead of 585, and 337 R01 awards instead of 185 in our analysis sample.

Table S3 shows the distribution of applications submitted by year. We did not include new proposals submitted in 2007 and 2008 because we cannot observe them for the additional 2 years needed to account for resubmission. In addition, changes after 2008—including (i) the new NIH scoring system implemented in 2009 and (ii) the impact of funding from the American Recovery and Reinvestment Act (ARRA)—would introduce information that is not comparable to the rest of the sample. An analysis of success rates from FY 2000 to FY 2008 reveals only small year-to-year changes in award probabilities by race/ethnicity, suggesting that our study is representative of the entire period (fig. S2).

To measure productivity at the time of application, publication and citation information from Thomson Reuters Web of Science and *Journal Citation Reports* was matched to R01 application investigator information. We were able to match 84% of grant applications to publications with greater than 90% confidence. As described in more detail in the supporting online material, the matching process used conservative criteria and therefore may underreport publications for applicants with common

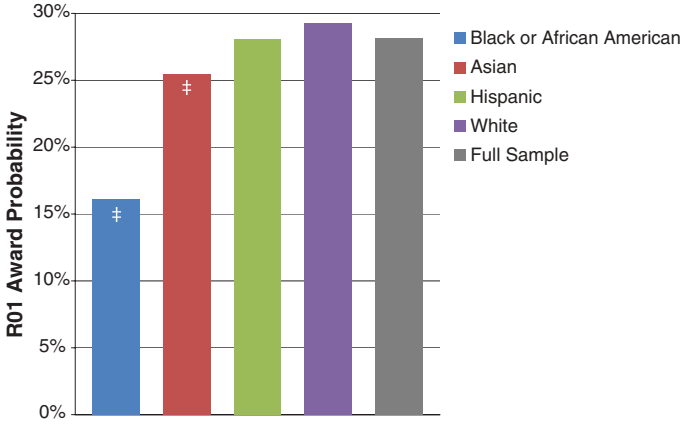

Fig. 1. Probability of NIH R01 award by race and ethnicity, FY 2000 to FY 2006 ($N = 83,188$). Based on data from NIH IMPAC II, DRF, and AAMC Faculty Roster. ‡, $P < .001$; **, $P < .01$; *, $P < .05$.

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names. This measurement error may have biased the coefficients in the model. The sign and size of the bias would depend on the relative magnitude of the average and variance of the underreporting, as well as the covariance between the underreported, and other variables in the model, and would be typically less than the omitted variable bias were these variables to be left out (*10*, *11*).

We analyzed the probability of receiving an R01 award using probit models estimated through maximum likelihood. Our analysis progressed through five models that added explanatory variables most likely to explain the observed race/ethnicity differences (table S4). In place of reporting probit coefficients, we report the marginal effect of the variable on the award probability, which is the change in the award probability due to each predictor separately, with other variables evaluated at their mean values. The resulting regression estimates are correlations between the covariate and the probability of receiving an R01 award and should not be interpreted as having a causal impact.

The race/ethnicity estimates of marginal effects in table S5 can be interpreted as the percentage point difference in the probability of receiving an NIH R01 award between applications from white investigators (the omitted category in the regressions) and applications from investigators of a given race/ethnicity. Model 1, which controlled for demographic characteristics, showed that applications from black investigators were 13.1 percentage points ($P < .001$) less likely to be awarded an R01 than white investigators, and applications from Asian and Hispanic investigators were 5.4 ($P < .001$) and 2.7 ($P < .05$) percentage points less likely to be awarded, respectively. When we added controls for education and NIH training in Model 2, the marginal effects did not change in size or significance. Model 3 added controls for employer characteristics, which reduced the significance of the marginal effects for Hispanics, but not for Asians or blacks ($P < .001$), compared with Model 1. Model 4 included controls for previous NIH grants, NIH review experience, and NIH institute, and while it reduced the award differential for blacks and Asians by 1 percentage point, the differential was still significant ($P < .001$). With the full set of covariates in Model 5, the award probabilities for applications from blacks were 10.4 percentage points lower, and for Asians were 4.2 percentage points lower, than for whites ($P < .001$). Our models fit the data well, correctly classifying R01 award outcomes for between 71 and 72% of the observations in the sample. In summary, Hispanic award probability differentials were explained by variables added in Models 4 and 5, but none of the observable characteristics in Models 1 to 5 fully explained the differential for Asians or blacks.

Next, we examined the average number of grants per person, the proportion of investigators submitting single and multiple grants, and the likelihood of application resubmission. On average, investigators had three to four Type 1 R01 grant applications each. We found that blacks and Asians resubmitted more times before being awarded an R01 (2.01, $P < .06$ and 1.85, $P < 0.001$, respectively) compared with whites (1.58), and at the same time blacks (45%) and Hispanics (56%) were significantly less likely to resubmit an unfunded application compared with white investigators (64%, $P < 0.001$) (table S6). We estimated Model 5 after introducing controls for the number of resubmissions and then estimated the model separately by the number of times a grant was submitted (table S7). Applications from black and Asian investigators were significantly less likely to receive R01 funding compared with whites for grants submitted once or twice. For grants submitted three or more times, we found no significant difference in award probability between blacks and whites; however, Asians remained almost 4 percentage points less likely to receive an R01 award ($P < .05$).

Together, these data indicate that black and Asian investigators are less likely to be awarded an R01 on the first or second attempt, blacks and Hispanics are less likely to resubmit a revised application, and black investigators that do resubmit have to do so more often to receive an award. Assistance with the grants submission and resubmission process may provide a policy lever for diversifying the scientific workforce.

Next, we examined the nativity of R01 applicants, because only U.S. citizens and permanent residents are eligible for NIH pre- and postdoctoral training programs. We used information from the DRF that allows us to identify citizenship at the time of Ph.D. receipt. For Ph.D. applicants that were not matched (15 to 22%), we manually reviewed their biosketch information to obtain information on the location of the school awarding the undergraduate and graduate degrees. If all degrees were received outside the United States, these individuals were classified as foreign-born and foreign-educated. More than 70 percent of these individuals had degrees from non-U.S. institutions. Applicants that we were unable to classify were categorized as having missing citizenship information, and we included a dummy variable in the model for those cases.

Figure S3 shows that 87% of Asian, 45% of black, 56% of Hispanic, and 25% of white applications were from non-U.S.-citizen investigators. When the analysis sample was restricted to include only those applicants who were U.S. citizens at the time of Ph.D. receipt, the difference in R01 award probability for Asian applications was cut in half and was no longer statistically significant (table S8). However, the 10 percentage point difference in award probability for blacks did not change (–0.107, $P < 0.001$) after including all covariates.

NIH pre- and postdoctoral training fellowships and traineeships serve as an intermediate step on the biomedical career path between degree completion and becoming an independent researcher. We expect training variables to

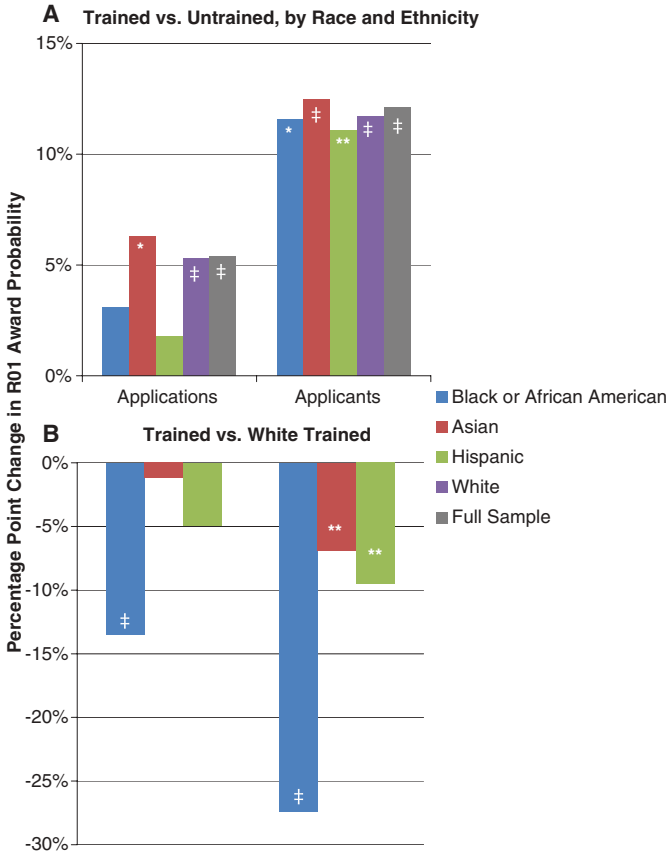

Fig. 2. Effects of race and ethnicity on the probability of R01 award for applications and applicants. **(A)** Within-race comparisons of applications and applicants with or without previous NIH F or T training program participation using the U.S. citizen and permanent resident sample. **(B)** The effect of race/ethnicity on R01 award probability for applications and applicants with previous NIH F or T training program participation compared with white participants. ‡, $P < .001$; **, $P < .01$; *, $P < .05$.

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be positively correlated with receiving an R01 award. Using the U.S. citizen and permanent resident sample, we explored the impact of NIH pre- and postdoctoral fellowships (F), NIH pre- or postdoctoral traineeships (T), and NIH career development awards (K), which are largely awarded to early career investigators as grant funding for research.

Participation in these programs varied by race, ethnicity, and program (table S9). For R01 applications from U.S. citizens, 69% from Asian investigators, 54% from blacks, 62% from Hispanics, and 62% from whites were associated with previous NIH F, T, or K support. More applications from Asians were associated with previous T support (58%) compared with blacks (44%), Hispanics (45%), and whites (43%), whereas fewer applications from black investigators were associated with previous F awards (16%) compared with whites (27%), Hispanics (22%), and Asians (22%). Previous K support was associated with 17% of applications from Asian investigators, 10% from blacks, 16% from Hispanics, and 11% from whites.

Early scientific training is first included as a covariate in Model 2, which omits post-training variables such as current institution. After controlling for demographic characteristics and educational background, fellowships were associated with a 2.5 percentage point increase in the probability of R01 award ($P < .001$), traineeships with an increased award probability of 2.2 percentage points ($P < .001$), and career development awards with an increased award probability of 4.8 percentage points ($P < .001$) relative to R01 applicants who had no previous participation in these NIH training programs. The estimated impact of training is reduced once the full set of covariates is included in Model 5 (table S8).

Participation in training programs significantly improved subsequent R01 award probability for both applications and applicants (Fig. 2A, table S10). However, when we examined the effect of race/ethnicity on R01 award probability for all applications and applicants that received F or T training, we found that training did not mitigate differences in award probability (Fig. 2B and table S10). Compared with R01 applications from white U.S. citizens or permanent resident investigators with previous NIH training experience, applications from black investigators were 13.5 percentage points less likely to be funded ($P < .001$). For all applicants who received F or T training, blacks were 27.4 percentage points ($P < .001$), Asians were 6.9 percentage points ($P < .01$), and Hispanics were 9.5 percentage points ($P < .01$) less likely to ever receive an R01 award compared with whites. A closer investigation of the impact of training by race/ethnicity may provide insight into differences in R01 award probability and perhaps provide a policy lever for diversifying the scientific workforce.

Research has established that the perception of scientific merit is affected by past performance—such as association with high-ranking departments or institutions and previous funding and publication records—and by access to organizational resources (*12*). If this is the case, and racial and ethnic groups do not have the same distribution of these characteristics, then including controls for these effects might reduce or eliminate differences in award probability.

There were fewer total applications from blacks (27%) at institutions receiving the most NIH funding (the top 1 to 30) compared with whites (33%, $P < .05$) but a similar number at institutions ranked 31 to 100 in amount of NIH funding awarded (table S11) (*13*). Applications from white investigators were more likely to be associated with a previous NIH RPG or K award (78%) compared with blacks (69%), Asians (73%), and Hispanics (70%) ($P < .001$). Average number of publications and citations at the time of application varied significantly by race and ethnicity. Black R01 applicants published a similar number of articles compared with white applicants (13.7 compared with 14.3, respectively), whereas Hispanic and Asian applicants on average published more articles than white applicants (17.8, $P < .01$, and 28.8, $P < .001$, respectively). In biomedical sciences, a last-author position indicates responsibility for managing the group carrying out the research described in the publication. Blacks had a lower percentage of papers that were last-authored (22.4%, $P < .001$) compared with whites (30.4%), Asians (34.2%), and Hispanics (30.3%) (tables S11 to S13). The largest observable difference was in the number of citations at the time of the R01 application. On average, white applicants had 78 citations to previous work, blacks had 40 ($P < .001$), and, as with publications, Asians (143, $P < .001$) and Hispanics (90, $P < .01$) had more citations than white applicants. However, even after controlling for these differences, there were significant differences in R01 award probability between applications from blacks and whites (table S5, Model 5).

We examined the marginal effects of these characteristics on R01 award probability for the full sample. Working at a nonacademic research organization increased the probability of receiving an R01 award by 4.2 percentage points ($P < .01$), whereas working at an institution with the most NIH funding (ranked 1 to 30 in total grant funding) increased the R01 award probability by 9.7 percentage points ($P < .001$), and those with substantial NIH funding (ranked 31 to 100) increased R01 award probability by 6.1 percentage points ($P < .001$) compared with all institutions ranked below 200 in NIH funding (Fig. 3 and table S5). Previous research awards were associated with increased subsequent award probability. Previous receipt of NIH RPG or K grants increased the probability of R01 funding by 8.2 ($P < .001$) percentage points. Serving on an NIH review committee (itself an indication of receiving NIH funding) increased R01 funding by 8.2 percentage points ($P < .001$). Publications and citations also were significant contributors to R01 funding. An application from an investigator with more last-authored publications relative to total publications had a 2.1 percentage point greater chance of receiving R01 funding ($P < .05$). In addition, investigators with citations above the median (more than 24 citations) at the time of application were 3.6 percentage points ($P < .001$) more likely to receive an R01 award (*14*). The number of first-authored papers by the applicant had no significant effect on the award probability, regardless of race or ethnicity. We tested whether these marginal effects varied by race and found no significant differences.

Next, we estimated the effect of our model variables on the probability of receiving a priority score during the review process (table S14). Negative marginal effects indicate that the application was more likely to be unscored, whereas positive marginal effects indicate the application was more likely to be scored. In the full sample, all of the variables associated with increased award probability were also signifi-

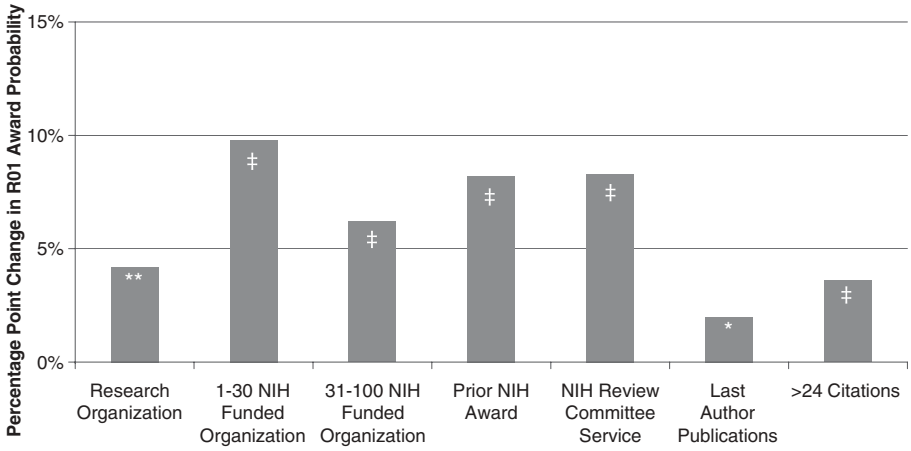

Fig. 3. Effects of affiliation and previous research on R01 award probability. 1 to 30 and 31 to 100 NIH-funded institutions were derived by ranking institutions by NIH funding received FY 2000 to FY 2006. ‡, $P < .001$; **, $P < .01$; *, $P < .05$.

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cantly associated with increased likelihood of an application being scored ($P < .001$). Marginal effects for whites, Asians, and Hispanics are not different from the full sample. However, marginal effects for applications from blacks were significantly different from the full sample ($P < .05$): For blacks only, NIH review committee experience ($P < .001$) and citation count ($P < .01$) were significantly correlated with receiving a priority score. Together, these results suggest that previous research and affiliation do not have the same impact across racial and ethnic applicant groups.

Throughout the education pipeline, blacks are less likely to graduate from high school, attend college and major in biomedical science, and obtain a Ph.D. in biomedical science. Nevertheless, upon entering the biomedical academic career track, black and white faculty members are equally likely to be tenured at institutions that grant doctorates and at Research I institutions. (*3*). Given our previous results, we expected to find that black scientists who made it to the stage of principal investigator would have similar chances of obtaining NIH funding, all other things being equal. We find it troubling that the typical measures of scientific achievement—NIH training, previous grants, publications, and citations—do not translate to the same level of application success across race and ethnic groups. Our models controlled for demographics, education and training, employer characteristics, NIH experience, and research productivity, yet they did not explain why blacks are 10 percentage points less likely to receive R01 funding compared with whites.

Although our models do not fully explain the funding gap, the greatest differences between blacks and whites that we observed were in the effect of previous training and the probability of receiving a priority score. Although more research is needed to discern the basis for the award differences, it is possible that cumulative advantage may be involved (*15*). Small differences in access to research resources and mentoring during training or at the beginning of a career may accumulate to become large between-group differences. This suggests that more analysis on the impact of NIH training may be warranted. In addition, further research into the review process could help to understand why variables that increased the likelihood of an application receiving a priority score for the full sample did not have the same impact for applications from black investigators.

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6. Data sources and methods are described more fully in the supporting material on *Science* Online.
7. Sometimes applicants report different race/ethnicity in IMPAC II and the DRF. In that case, the most frequently reported race/ethnicity was used.
8. We investigated whether attending an undergraduate Historically Black College or University had an impact on R01 award probability compared with the balance of the Ph.D. researcher sample and we found no statistically significant relationship.
9. American Association of Medical Colleges Faculty Report, U.S. Medical School Faculty (AAMC, Washington, DC, 2008); www.aamc.org/data/facultyroster/usmsf08/start.htm.
10. C. R. Bollinger, *Rev. Econ. Stat.* **85**, 578 (2003).
11. D. Lubotsky, M. Wittenberg, *Rev. Econ. Stat.* **88**, 549 (2006).
12. R. K. Merton, *Science* **159**, 56 (1968).
13. Funding data are available from RePORTER at http://report.nih.gov/award/trends/FindOrg.cfm.
14. We combined two categories of citations (the third and fourth quartiles) into a single category (>24 citations / citations above the median) for Fig. 3 for ease of presentation.
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Supporting Online Material

www.sciencemag.org/cgi/content/full/333/6045/1015/DC1
Materials and Methods
Figs. S1 to S4
Tables S1 to S15
References

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Three Periods of Regulatory Innovation During Vertebrate Evolution

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The gain, loss, and modification of gene regulatory elements may underlie a substantial proportion of phenotypic changes on animal lineages. To investigate the gain of regulatory elements throughout vertebrate evolution, we identified genome-wide sets of putative regulatory regions for five vertebrates, including humans. These putative regulatory regions are conserved nonexonic elements (CNEEs), which are evolutionarily conserved yet do not overlap any coding or noncoding mature transcript. We then inferred the branch on which each CNEE came under selective constraint. Our analysis identified three extended periods in the evolution of gene regulatory elements. Early vertebrate evolution was characterized by regulatory gains near transcription factors and developmental genes, but this trend was replaced by innovations near extracellular signaling genes, and then innovations near posttranslational protein modifiers.

The gain, loss, and modification of gene regulatory elements has led to many phenotypic changes during animal evolution, including pigmentation changes in dogs, fish, and flies (*1*–*3*); bristle patterns on flies (*4*); and skeletal differences in fish (*5*, *6*). A recent analysis of published genome-wide association studies also noted a strong enrichment for regulatory regions to be in linkage with trait/disease-associated single nucleotide polymorphisms (*7*). Mutations in regulatory modules can avoid the pleiotropic effects that often result from protein-coding mutations and, hence, can provide an exceptionally flexible source of evolutionary change (*8*).

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Supplemental Information for Ginther et al., 2011

Materials and Methods

Details of Data Linkage:
In this supplement we provide a description of how the data sets were developed, an explanation of methods used in the analysis, and additional estimation results.

We created the analysis samples by combining data elements from several different sources. The initial sample dataset was derived from IMPAC II and stored in a Microsoft SQL Server 2005 database. These data were then matched to US Department of Education IPEDS organizational information, US National Science Foundation Doctoral Record File (DRF) PhD degree information, DRF and AAMC Faculty Roster race/ethnicity information, MEDLINE publication data, and Web of Science citation information to create the analysis sample *(1)*.

We matched IPEDS data to IMPAC II data using an algorithm that compared standardized name fields, institutional identifiers such as DUNS, EIN numbers, and Federal Interagency Committee on Education (FICE) codes, and institution locations. We manually reviewed a random sample of these records to determine the quality of the match and did not find any mismatches. For the 100 institutions not linked to IPEDS by our algorithm, we matched these records using a manual process. In total, we matched 487 organizations within IMPAC II to records in the IPEDS database. These 487 organizations were the sponsoring organization on 67.2% of the applications in our full dataset.

Since 1993, NIH has matched DRF person records with IMPAC II profiles going back to 1958. To link these records, NIH employed a five step matching process that uses an individual's name, address and research expertise to determine a similarity score. When this similarity score went above a threshold, the records in the two databases were considered matched. Data from the DRF were used to confirm degree-related information in IMPAC II and to add information about the educational history of the applicant pool, such as BA-granting, and PhD-degree granting institutions. In the full data set, the above process provided a strong match for 55.1% of applicants in the dataset, comprising 56.8% of the applications.

We developed a set of algorithms to determine the publication history of applicants at the time of application. These algorithms combined a series of name-based matches with email and ZIP code matches. We tested these algorithms using an initial sample of 800 applicants from all racial/ethnic groups. Approximately 13,000 candidate papers were identified for this sample and partitioned into High Confidence matches (exact name matches combined with at least one additional attribute) and Low Confidence matches based on name matching standards and name frequency values derived using the IMPAC II database as a reference set. The Low Confidence group matches were sub-sampled at intervals based on author name frequency, and a name frequency threshold was identified, below which the publication matching precision was at least 81%. A review of approximately 1,500 publications from the High Confidence group whose author names were common determined the precision for this group to be 99% (false positive error approximately 1%). These same algorithms were then applied to the full dataset of 79,218 applicants, with 317,326 publications identified in the Low Confidence group for author names below the frequency threshold representing at least 81% precision, and 273,286 identified in the High Confidence group. Names that are shorter and more common (e.g. Asian names) are more likely to overstate publications since methodologies to match authors rely on shorter name strings. However, our conservative matching approach required more attributes than just name for inclusion (email and ZIP code) and we eliminated the most frequent names for which our matching precision was below 81%. We discuss the impact of measurement error on our estimates below.

Variable Derivation:
The following provides additional information about how selected variables were derived in the analysis sample.

1. Race/Ethnicity: An applicant's race/ethnicity was derived from IMPAC II with additional information provided from the DRF and/or the AAMC Faculty Roster if IMPAC II data were not complete.
2. Nativity and Citizenship: An applicant's citizenship was derived from the DRF, and the citizenship variables refer to citizenship status at the time of receipt of the doctorate. Nativity was derived from the DRF citizenship variable along with information from IMPAC II. If an NIH applicant was not matched to the DRF, but received all of their degrees from non-US institutions, they were classified as a non-citizen.
3. Degree Information: An applicant's degree type was derived from IMPAC II with additional information provided from the DRF if IMPAC II data were not complete.
4. Organization Type: Organization type was derived from IMPAC II and used to broadly classify the type of organization sponsoring the applicant's submission.
5. Carnegie Classification: The classification of the applicant's sponsoring institution was provided through IPEDS and linked through the sponsoring organization information from IMPAC II.
6. Prior Training Support: We used IMPAC II to determine if an applicant was the principal investigator on any fellowship (F) or career (K) awards, or if the applicant was appointed as a trainee on a training grant (T), prior to the first submission for a grant.
7. NIH Institutional Funding: To determine the NIH funding rank of an organization, we averaged the annual grant support received for each sponsoring institution from FY2000 to FY2006 and ranked them in descending order of the total grant dollars received. These institutions were then categorized into 4 categories, Top 30, 31 to 100, 100 to 200, and 200+.
8. Total Grant Applications and Awards: We counted the number of R01 applications and awards by individual investigators going back to fiscal year 1980 to get an accurate count of grants submitted over an investigator's career. Of course some individuals were still active researchers and may have submitted grants past FY2006.

Missing data and/or data conflicts:
We have used IMPAC II to create a person-record for the individual applicant that includes time-invariant demographic characteristics. However, individual applicants can and do change their gender, race/ethnicity, and birth date in IMPAC II. Where there were multiple observations in these fields, we used the most-frequently reported race and ethnicity, sex, and birth date. We dropped 5,853 individuals with missing age because they had missing information for multiple variables such as age, race, and sex.

When we had missing information for variables other than age, we included dummy variables that took on a value equal to one in the specification to control for that fact. Our models included dummy variables to account for missing information in the sample on race (9% missing), citizenship status (15%), PhD field (27%), rank of PhD institution (36%), human subjects (.03%), and publications (16%).

Sample selection:
Our sample included R01 grant applications associated with new projects (Type 1) submitted between FY2000 and FY2006. We did not evaluate continuing R01 grants (Type 2). Grant applications in our sample could have been resubmitted as revised applications multiple times. Information about the application and its review was derived from the last funded or unfunded application submitted. We restricted this sample to individuals with a PhD residing in the United States. This sample included

83,188 observations with non-missing data for the explanatory variables. This sample was further limited to US citizens for specific aspects of the analysis.

Table S1 provides information on the number, percentage, and award probability of all RPG applications for FY2000 – FY2006, as well as all R01 applications, and PhDs residing in the US, broken down by race and ethnicity. We examined whether award probabilities differed between Whites and other race/ethnicities and found that Asians, Blacks, Hispanics, and those with unknown race were significantly less likely to receive an R01 award than Whites.

Award Probabilities by Priority Score:
We examined the relationship between race, priority score, and award probability in our funding sample. **Table S2** shows the distribution of priority scores by race and ethnicity in the analysis sample. We divided the priority score into 25 point bins across the full 100 to 500 scoring range and graphed the award probability in each interval by race in **Figure S1**. These results indicated that NIH funding was largely determined by priority scores. The lower the priority score, the higher the likelihood of being funded for all race and ethnic groups. As priority scores exceed 200, award probabilities drop close to zero and equal zero past 400.

Success Rates by Race 2006 - 2010:
In 2009 the NIH review process substantially changed. Consequently, our sample was adjusted to include only Type 1 applications and their revisions that were submitted between FY 2000 and FY 2006 and observed through 2008. To evaluate whether funding rates were stable across race/ethnicity groups and time, we examined success rates by race. The NIH tracks success rates for each fiscal year. NIH success rates are defined as the percentage of reviewed grant applications that receive funding. They are computed on a fiscal year basis and include applications that are peer reviewed and either scored or unscored by an Initial Review Group. The NIH success rate differs from the funding rate used in this analysis because a grant could be unfunded in one fiscal year and then be resubmitted and funded in a subsequent fiscal year. The success rate would include the grant application in the denominator in the first year and in both the numerator and denominator in the second fiscal year. Applications submitted multiple times in a single year include the grant in the success rate denominator only once. In our funding rate analysis, this grant application would be counted in the numerator and denominator only in the last year it was submitted.

Table S3 shows the distribution of grants submitted by race/ethnic group each year. We examined race/ethnicity differences in relative success rates from FY 2000 to FY 2008 to determine whether success rates fluctuated across race and ethnicity categories over the sample time frame. The relative success rate is the success rate for a particular race divided by the success rate for all applicants in a given year. **Figure S2** shows that relative R01 success rates by race and ethnicity were fairly stable over time.

Citizenship by Race/Ethnicity:
We examined the percentage of citizens by race/ethnicity at the time of PhD receipt. **Figure S3** shows that 87% of Asian applications were from non-US citizen investigators. 45% of Black and 56% of Hispanic applications were from non-citizen investigators, as were 25% of White applications. For that portion of each group (15 – 22%) unable to be classified, we assumed they were not citizens if they did not appear in the DRF (a census of PhDs in the US).

Multivariate Regressions:
We used probit models to test the effect of various investigator and organization characteristics on award probability. We used heteroskedasticity-robust standard errors that were clustered on the individual applicant in order to adjust for the fact that applicants could submit more than one proposal in our sample *(2)*. P-values for the race variables were corrected for multiple comparisons using the Bonferroni method.

The Bonferroni method adjusts the p-values to reduce the likelihood of rejecting the null hypothesis when it is true. Coefficients were transformed to be marginal effects and can be interpreted as the change in probability resulting from an infinitesimal change in the independent variable. When the independent variable is a dummy variable (as was the case with many of our covariates), the coefficient reports the percentage point change in the probability given that the dummy variable changes from zero to one where all other covariates were evaluated at the mean of the predictors.

The probit models were specified as follows. Model 1 included gender, race/ethnicity, age, naturalized citizen, non-citizen, and foreign PhD degree variables. This baseline model provided information on the association between race and ethnicity and funding without any other explanatory variables. Model 2 included the covariates from Model 1 plus degree type, previous NIH training support, PhD field, and the NIH funding rank of the PhD institution. Model 2 variables controlled for the effect of NIH training on funding probability. To the extent that NIH training provides good preparation for a research career, we expected these variables to have a positive association with receiving an award. Model 3 included variables from Model 2 and employer characteristics such as organization type (university, hospital, research institute), the Carnegie ranking of higher education institutions, the NIH funding rank, and the geographical region of the employer. We expected that the more research-intensive the institution, the higher the likelihood of receiving funding. Model 4 included Model 3 variables and indicator variables for NIH funding experience and environment including the applicants' prior receipt of NIH grants and NIH review committee experience, the NIH institute receiving the application, the fiscal year of grant award, and whether the grant involved human subjects. We included these controls to adjust for differences in funding rates across NIH institutes, annual differences in success rates, and differences in experience with the NIH funding process. Model 5 included all variables from Model 4 and controlled for investigator productivity at the time of application, such as publication and citation counts, median and maximum journal impact factor, and percentage of publications where the grant applicant was a single author, first author and last author. **Table S4** shows the covariates included in each probit model. **Table S5** shows our main results.

Goodness of Fit:
Probit models do not have a single measure of goodness of fit like the R^2 in the linear regression model. We evaluated the goodness of fit of the probit models by comparing predicted outcomes with actual outcomes in the data. Assuming a symmetric loss function, the fitted outcome, $\hat{y} = 1$, if the predicted probability was greater than .5, and $\hat{y} = 0$ if the predicted probability was less than or equal to .5. We compared the fitted outcomes of award probability from the model, $\hat{y}$, to the observed outcomes in the data. Our models fit the data well, correctly predicting R01 award outcomes for 71-72% of the observations in the sample.

Measurement Error in Probit Models:
Our data matching process may have underreported publication and related information for a given applicant. This measurement error may have biased the coefficients in the model. While there were fewer results for the implications of measurement error in probit and related models, this research suggested that, at least qualitatively, the results were similar in sign and magnitude to those found in linear models *(3, 4)*. The sign and size of the bias on the mismeasured variables depended on the relative magnitude of the average underreporting and the variance of the underreporting. Hence it was not clear if the coefficients on publications and related information would be under- or overestimated. The sign and magnitude of the bias on other correctly measured variables depended on the covariance between publications, citations and other variables included in the specification. In practice, previous researchers have found that measurement error bias is often not particularly large. Moreover, the bias is typically smaller than the omitted variable bias had these variables been left out *(5,6)*. Given the relevance of prior

research for R01 awards it is important to include these variables in the analysis despite the presence of measurement error.

Robustness Tests:
We conducted a series of robustness tests to examine whether our basic results were sensitive to variables included in the models.

(1) We examined whether there were race/ethnicity differences in award probabilities for grant applications submitted the first time and upon resubmission (**Tables S6 and S7**). **Table S6** shows the number of grants submitted and awarded and the percentage of grants awarded by the number of times submitted. Award probabilities increase for all race/ethnic groups with the number of times a grant is submitted. **Table S7** shows the effect of controlling for resubmissions on race/ethnicity coefficients in the probit model. The first column presents the results of Model 5 from **Table S5.** In the second column we added dummy variables for the number of times a grant was submitted (once, twice, or three times or more). Controlling for resubmissions in Model 5 did not change the estimated results for Blacks and Asians. In the third column, we estimated Model 5 for those grants submitted only once. We still found significant differences for Asians and Blacks in R01 award probability compared to Whites, but the estimated effects were about one percentage point smaller. The fourth column shows the race/ethnicity differences for grants submitted twice. The estimated effects for Asians were very similar to those found in Model 5 (first column). However, Blacks who submitted grants twice were 13.5 percentage points less likely to receive an R01 award compared to Whites who submitted twice. A much smaller proportion of proposals were submitted three or more times (Table S6). In this case the difference between Black and White award probabilities dropped by 10 percentage points and was no longer statistically significant. However, Asians were still almost 4 percentage points less likely to receive R01 awards upon the third submission than Whites. This suggested that race/ethnicity differences for Blacks and Asians relative to Whites in award probabilities were partially explained by the probability of submitting a revised grant and lower award probabilities upon resubmission for these two groups.

(2) Only US Citizens and Permanent Residents qualify for NIH training, so award probabilities may have been affected by citizenship status. To explore this possibility we limited the sample to US citizens only. **Figure S3** shows the percent of applications by citizenship status at time of PhD. **Table S8** shows the distribution of training by race/ethnicity. **Table S9** shows the effect of race and selected coefficients on the award probability for a sample limited to US citizens. In contrast to the results in **Table S5**, **Table S9** shows that the Asian coefficient was no longer statistically significant. This indicated that the difference in award probability for Asians may be driven by non-citizen Asians who did not have access to formal NIH training programs.

Figure 2 and **Table S10** examined the effect of training on R01 award probabilities. In **Figure 2A** we limited the sample to US Citizens and Permanent residents and regressed R01 award on a dummy variable that equaled one if the application received F or T training; for applicants, we regressed whether the person has ever received an R01 award on training. We performed separate regressions for the full sample and each race. Each bar in **Figure 2A** shows the effect of receiving training relative to not receiving training by race/ethnicity. F or T training significantly increased the probability of an NIH applicant ever receiving an R01 award. In **Figure 2B** we limited the sample to those who received F or T training only and regressed R01 awards (for applications) and ever received an R01 award (for applicants) on dummy variables for race/ethnicity with White as the omitted race category. Each bar in **Figure 2B** shows the effect of race on R01 award probability relative to Whites with training. We also estimated the effect of

race on R01 awards using Model 5 for those that received training only and found that applications from Blacks were -0.115, ($p<.001$) less likely to receive funding and Black applicants were -0.163, ($p<.001$) less likely to ever receive an R01 award compared to Whites after controlling for the full set of covariates. Despite the positive association between training and R01 awards within race groups (**Figure 2A**), **Figure 2B** shows that training did not narrow differences in R01 awards across race/ethnic groups.

(3) We examined how grant applications by race/ethnicity differed with respect to the observable characteristics of NIH training, prior research experience, and affiliation variables for the full sample and the unscored sample. **Table S11** and **Table S12** showed that there are significant differences between Blacks, Asians, Hispanics, and Whites in NIH training, prior NIH grants, and researcher productivity in both samples. **Table S13** shows the number of applications by race/ethnicity that had prior NIH training, prior NIH grants, NIH review committee experience, employment at research organizations and organizations ranked 1-30 and 31-100 in NIH funding, and had citations above the median.

(4) We tested whether the estimated effects in **Figure 3** differed significantly by race by interacting all of the variables in Model 5 with race and testing the joint significance of selected interaction terms. For example, to test whether estimated effects of research organization, 1-30 NIH funded organization, 31-100 NIH funded organization, prior NIH award, NIH review committee service, last authored publications, and >24 citations for Blacks differed from the full sample, we interacted the Black variable with all of the covariates in Model 5, and then tested whether these interaction terms for the subset of variables in **Figure 3** were jointly significantly different from zero. The heteroskedasticity-robust standard errors in this regression were clustered on the individual applicant. We failed to reject the null hypothesis that the interaction terms were equal to zero, indicating no significant differences in these coefficients by race.

By fully interacting model variables with race to perform the hypothesis test, we assumed that the residual variation for all race and ethnic groups was the same. This assumption was necessary because probit coefficients are scaled by unobserved residual variation *(7, 8)*. Coefficients from linear probability estimates are not scaled by residual variation. As a robustness check, we performed the hypothesis test using a linear probability model and found that coefficients for research organization, 1-30 NIH funded organization, 31-100 NIH funded organization, prior NIH award, NIH review committee service, last authored publications, and >24 citations for Whites ($p<.01$) and Asians ($p<.05$) differed significantly from the full sample.

(5) We estimated Model 5 for the full sample and by race for the probability of receiving a priority score. We tested whether the coefficients for Blacks, Asians, Hispanics, and Whites were jointly significantly different from those for the full sample by fully interacting them with the race variables and testing the joint hypothesis that the race interaction terms were significantly different from zero (as described above). We found that the coefficients for Blacks were significantly different from the full sample for the priority score model (**Table S14**) using both the probit and linear probability models. **Figure S4** shows how the marginal effects of selected variables on the probability of receiving a priority score differed between the full sample and Blacks.

(6) Prior to the enhanced review criteria announced in 2009 *(9)*, a large proportion of grant applications were streamlined during the review process and did not receive priority scores. We found significant race and ethnicity differences in the likelihood of having an unscored application. 40% of applications from Whites were unscored, while grant applications from Hispanics (42%, $p<.01$), Asians (46%, $p<.001$), and Blacks (59%, $p<.001$) were more likely to be

unscored. If the analysis is restricted to US citizens, likelihood of an unscored application shows little change for Blacks (60% p<.001) and Hispanics (44% p<.01), whereas the proportion of unscored applications for Asians is no longer different from Whites. Thus, a significant number of the unscored Asian applications were submitted by investigators who did not receive a PhD from a US institution.

(7) To test whether unscored applications explained the observed race/ethnicity differences in R01 award probability, we estimated the probit models after eliminating all unscored applications from the sample, leaving us with 48,226 scored proposals (**Table S15**). While the marginal effect for Black applications in Model 5 was reduced significantly from -10.4 to -6.5 percentage points (p<.05), unscored applications did not fully explain differences in award probability. We still found significant differences for Asians and Blacks in R01 award probability, however the sizes of these effects were smaller than what we observed in the full sample (**Table S5**). After controlling for all covariates, the coefficients for Blacks and Asian fell by about half.

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Figure S1. Award Probability by Priority Score

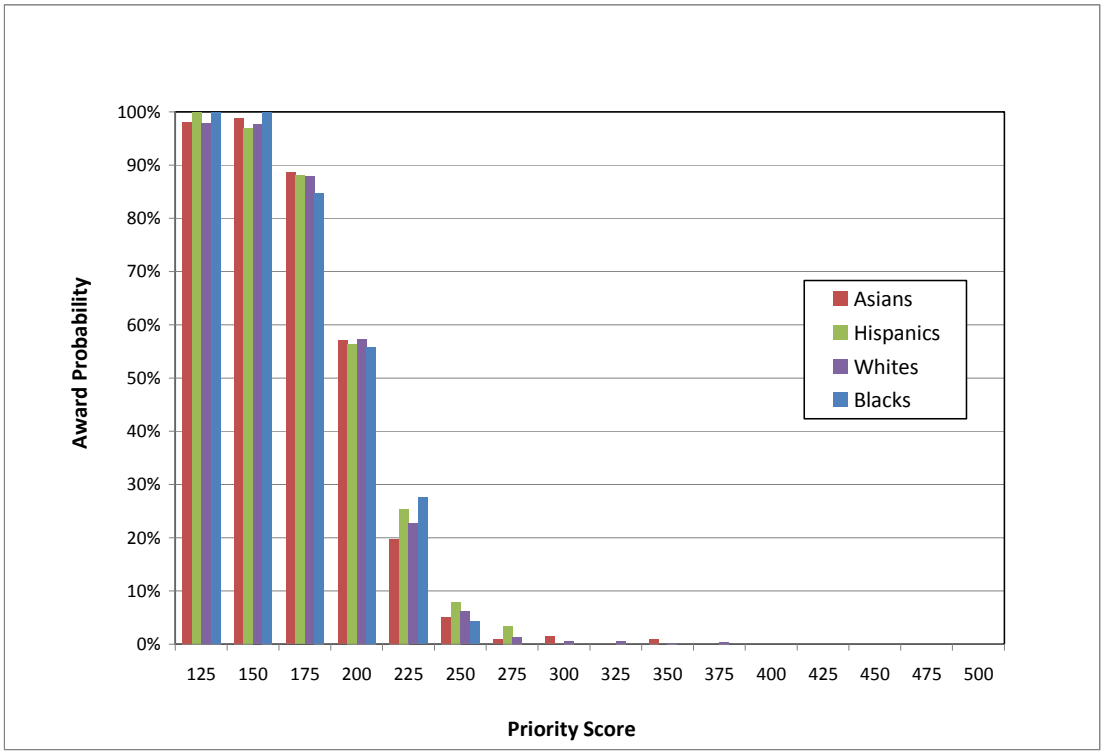

Figure S2. Relative R01 Success Rates by Race, FY 2000 – FY 2008.

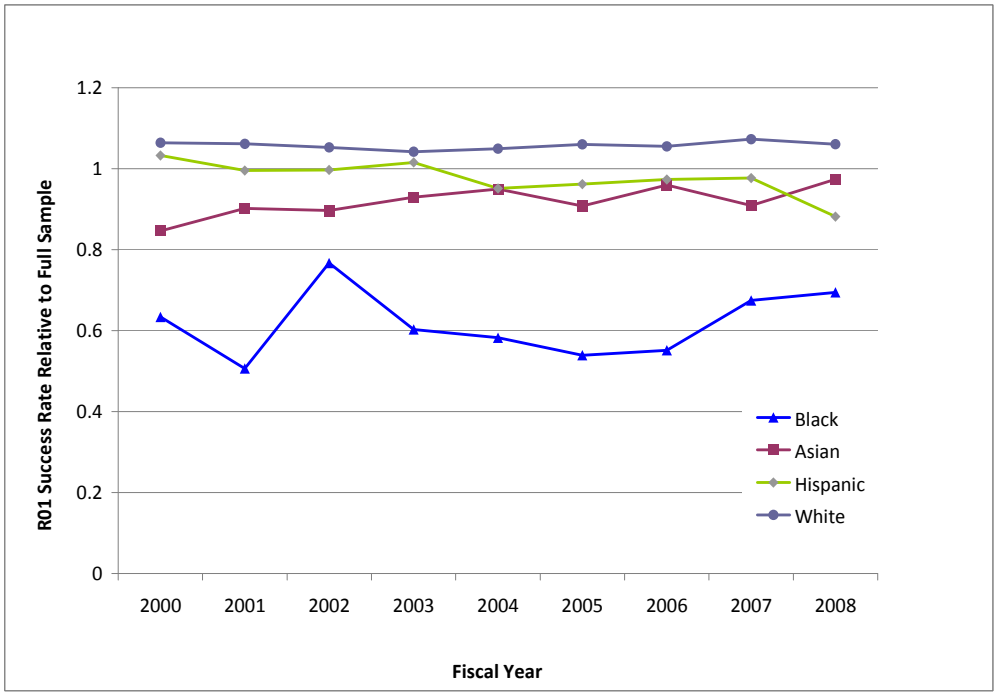

Figure S3. Percentage of applications from US native and foreign-born investigators, by race/ethnicity. Numbers within the boxes are numbers of applications.

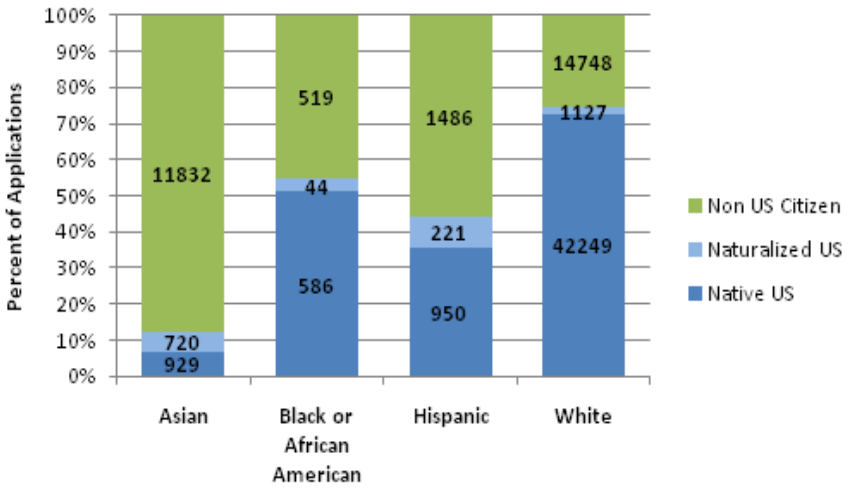

Figure S4. Marginal Effects of Factors Associated with Scored R01 Applications for the Full Sample and for Blacks. p<.001‡, p<.01**, and p<.05*.

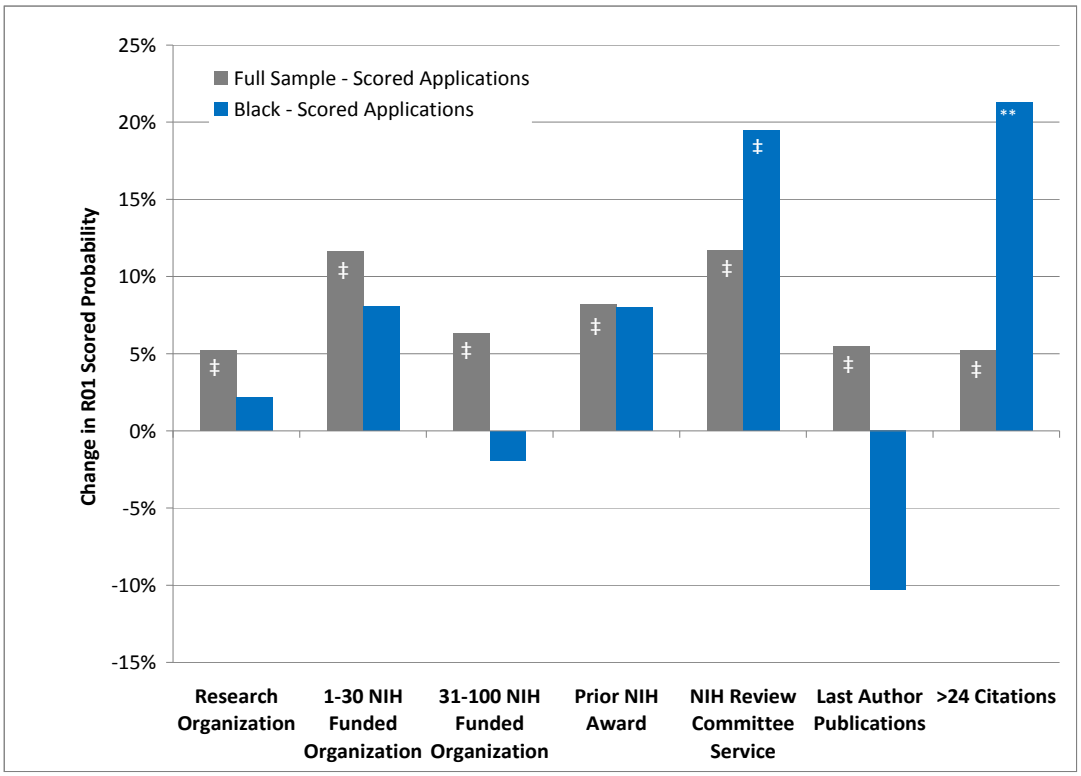

Table S1: Distribution of Priority Scores on R01 Applications by Race/Ethnicity 2000-2006

Race	Priority Scores					Number Scored 500 or Unscored	Total
	Number Scored 100-150	**Number Scored 151-200**	**Number Scored 201-250**	**Number Scored 251-300**	**Number Scored 301-459**		
Native American	s	s	s	s	s	s	41
Asian	993	2,940	1,949	1,047	340	6,212	13,481
Black	65	140	128	82	43	691	1,149
Hispanic	231	601	415	214	70	1,126	2,657
White	5,462	13,690	9,019	4,827	1,689	23,437	58,124
Other	s	s	s	s	s	47	99
Unknown Race	654	1,585	1,049	532	176	3,641	7,637
Total	**7,418**	**18,987**	**12,582**	**6,708**	**2,327**	**35,166**	**83,188**

Notes: s = suppressed for confidentiality (n<50).

Table S2. NIH Research Grant Applications and Awards FY2000-FY2006, by Race and Ethnicity. SOURCE: NIH IMPAC II, DRF.

All Competing RPG Applications (2000-06)				
Race	**Number of Applications**	**Percent of Applications**	**Number of Awards**	**Award Probability**
Native American	152	0.1%	48	31.6%
Asian	28,274	13.8%	8,040	28.4%***
Black	2,942	1.4%	585	19.9%***
Hispanic	6,954	3.4%	2,223	32.0%***
White	135,594	66.1%	49,303	36.4%
Other	227	0.1%	68	30.0%
Unknown	30,963	15.1%	8,404	27.1%***
Total	**205,106**	**100%**	**68,671**	**33.5%**
Competing New (Type 1) R01s (2000-06)				
Race	**Number of Applications**	**Percent of Applications**	**Number of Awards**	**Award Probability**
Native American	67	0.1%	18	26.9%
Asian	15,739	14.8%	4,006	25.5%***
Black	1,466	1.4%	250	17.1%***
Hispanic	3,705	3.5%	1,006	27.2%
White	70,773	66.5%	20,710	29.3%
Other	99	0.1%	27	27.3%
Unknown	14,519	13.7%	3,347	23.1%***
Total	**106,368**	**100%**	**29,364**	**27.6%**
Competing New (Type 1) R01s (2000-06) PhD Analysis Sample				
Race	**Number of Applications**	**Percent of Applications**	**Number of Awards**	**Award Probability**
Native American	41	0.0%	12	29.3%
Asian	13,481	16.2%	3,430	25.4%***
Black	1149	1.4%	185	16.1%***
Hispanic	2,657	3.2%	746	28.1%
White	58,124	69.9%	17,017	29.3%
Other	99	0.1%	27	27.3%
Unknown	7,637	9.2%	1,964	25.7%***
Total	**83,188**	**100%**	**23,381**	**28.1%**

Notes: Standard errors are clustered on the individual applicant. P-values are adjusted for multiple testing using the Bonferroni method. We test whether award probabilities by race are significantly different from Whites, p<.001***, p<.01**, and p<.05*.

Table S3: Number of Competing Type 1 R01s Submitted by Race/Ethnicity and Year

	Year							Total
Race	**Number 2000**	**Number 2001**	**Number 2002**	**Number 2003**	**Number 2004**	**Number 2005**	**Number 2006**	**Number 2000 -2006**
Native American	s	s	s	s	s	s	s	41
Asian	1,404	1,525	1,555	1,833	2,064	2,050	3,050	13,481
Black	138	141	138	158	188	159	227	1,149
Hispanic	310	297	314	340	390	426	580	2,657
White	7,712	7,464	7,031	7,736	8,105	8,333	11,743	58,124
Other	s	s	s	s	s	s	s	99
Race Unknown	487	540	620	952	1,244	1,436	2,358	7,637
Total	**10,073**	**9,988**	**9,674**	**11,039**	**12,008**	**12,419**	**17,987**	**83,188**

Notes: s = suppressed for confidentiality (n<50).

Table S4: Covariates Included in Probit Models

Variables	Model 1	Model 2	Model 3	Model 4	Model5
Demographics					
Race/Ethnicity	X	X	X	X	X
Gender	X	X	X	X	X
Age, Age-Squared[a]	X	X	X	X	X
Naturalized Citizen	X	X	X	X	X
Non-Citizen	X	X	X	X	X
Race Unknown	X	X	X	X	X
Foreign PhD	X	X	X	X	X
Nativity/Citizenship Missing	X	X	X	X	X
Education and Training					
Degree Type (PhD, MD/PhD)		X	X	X	X
NIH Training: (F, T, K)		X	X	X	X
PhD Major Field: (Biomedicine, Chemistry, Physics, Engineering, Psychology, Field Missing)		X	X	X	X
NIH Funding Rank of PhD Institution: (Top 30, 31-100, 100-200)[b]		X	X	X	X
Employer Characteristics					
Employer NIH Funding Rank: (Top 30, 31-100, 100-200)[b]			X	X	X
Employer Organization Type: (Research Institute, Hospital, Higher Education, Other)			X	X	X
Higher Education Carnegie Class: (Research Very High, Research High Research, Medicine, BA or MA Inst., Other, Carnegie Rank missing)			X	X	X
Region: (Midwest, South, West)			X	X	X
NIH Experience					
NIH Institute Code: (21 Indicators for IC receiving proposal)				X	X
Prior NIH Grant				X	X
NIH Review Committee Member				X	X
Grant uses Human Subjects				X	X
Human Subject Code Missing				X	X
Fiscal Year (2001 - 2006)				X	X
Research Productivity					
Publication Quartiles (4-7, 8-18, >18)[b]					X
Citation Quartiles (6-24, 25-84, >84)[b]					X
Maximum Impact Factor of Publications[a]					X
Median Impact Factor of Publications[a]					X
Ratio of First author/ Total Publications[a]					X
Ratio of Last author/ Total Publications[a]					X
Ratio of Single author/ Total Publications[a]					X
Publication information missing					X

Notes: Variables are indicator variables (0,1) unless otherwise indicated. [a]Continuous variables. [b]Categorical variable definition.

Table S5: Probit Estimates of the Effect of Race/Ethnicity on R01 Funding Award
Marginal Effects, Standard Errors in Brackets, FY 2000 - FY 2006

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Native American	0.036	0.034	0.027	0.054	0.063
	[0.076]	[0.077]	[0.077]	[0.081]	[0.084]
Asian	-0.054***	-0.054***	-0.051***	-0.040***	-0.042***
	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Black	-0.131***	-0.131***	-0.119***	-0.110***	-0.104***
	[0.011]	[0.011]	[0.012]	[0.012]	[0.012]
Hispanic	-0.027*	-0.027*	-0.023	-0.014	-0.012
	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]
Other	-0.020	-0.020	-0.010	0.013	0.021
	[0.049]	[0.047]	[0.047]	[0.048]	[0.049]
Unknown Race	-0.049***	-0.044***	-0.040***	0.012	0.016
	[0.006]	[0.006]	[0.006]	[0.007]	[0.007]
Non-citizen	0.004	0.021**	0.016*	0.024***	0.018**
	[0.006]	[0.007]	[0.007]	[0.006]	[0.006]
Naturalized Citizen	-0.020	-0.022*	-0.028*	-0.015	-0.018
	[0.011]	[0.011]	[0.011]	[0.011]	[0.011]
Foreign-PhD	0.071***	0.071***	0.081***	0.093***	0.093***
	[0.008]	[0.013]	[0.014]	[0.014]	[0.014]
Foreign-Born Missing	-0.055***	-0.049***	-0.046***	-0.019	-0.019
	[0.005]	[0.012]	[0.012]	[0.013]	[0.013]
F Recipient		0.029***	0.029***	0.011*	0.008
		[0.005]	[0.005]	[0.005]	[0.005]
T Recipient		0.018***	0.011**	0.012**	0.009*
		[0.004]	[0.004]	[0.004]	[0.004]
K Grant Recipient		0.049***	0.038***	0.018**	0.017**
		[0.006]	[0.006]	[0.006]	[0.006]
Employer Ranked			0.133***	0.112***	0.097***
1-30 NIH Funding			[0.008]	[0.008]	[0.008]
Employer Ranked			0.088***	0.072***	0.061***
31-100 NIH Funding			[0.007]	[0.007]	[0.007]
Employer Ranked			0.069***	0.055***	0.049***
101-200 NIH Funding			[0.007]	[0.007]	[0.007]
Employer Hospital			0.042**	0.036*	0.032*
			[0.014]	[0.014]	[0.014]
Employer Research			0.074***	0.048***	0.042**
Institute			[0.014]	[0.014]	[0.013]
Prior NIH Grants				0.088***	0.081***
				[0.004]	[0.004]
Served on NIH Review				0.091***	0.082***
Committee				[0.004]	[0.004]
Citations 3rd Quartile					0.032***
(24 - 84 citations)					[0.007]
Citations 4th Quartile					0.068***
(>84 citations)					[0.009]
Ratio of First Author					-0.009
to Total Publications					[0.008]
Ratio of Last Author					0.021*
to Total Publications					[0.008]
Ratio of Single Author					0.027*
to Total Publications					[0.011]

Notes: Numbers in table are marginal effects which report change in probability of receiving an R01 award given an infinitesimal change in continuous independent variables. Marginal effects on dummy variables report change in probability of receiving an R01 award given a change in the dummy from 0 to 1. Multiply marginal effects by 100 to obtain percentage points. Robust standard errors clustered on individual applicant in brackets. P-values on race adjusted for multiple comparisons using Bonferroni method. p<.001***, p<.01**, p<.05*. Number of observations = 83,188.

Table S6: Number and Percentage of R01 Application Submissions, Resubmissions and Awards by Race/Ethnicity 2000-2006

Race	Total Submissions 2000-2006			Grants Submitted Once			Grants Submitted Twice			Grants Submitted 3 or More Times		
	Number Submitted	Number Awarded	Percentage Awarded	Number Submitted	Number Awarded	Percentage Awarded	Number Submitted	Number Awarded	Percentage Awarded	Number Submitted	Number Awarded	Percentage Awarded
Native American	41	12	29.3%	s	s	16.0%	s	s	54.5%	s	s	40.0%
Asian	13,481	3,430	25.4%	8,452	1,563	18.5%	3,523	1,244	35.3%	1,506	623	41.4%
Black	1,149	185	16.1%	782	74	9.5%	257	65	25.3%	110	46	41.8%
Hispanic	2,657	746	28.1%	1,667	334	20.0%	704	281	39.9%	286	131	45.8%
White	58,124	17,017	29.3%	36,216	7,991	22.1%	15,539	6,010	38.7%	6,369	3,016	47.4%
Other	99	27	27.3%	s	s	5.1%	s	s	34.1%	s	s	53.3%
Race Unknown	7,637	1,964	25.7%	5,008	880	17.6%	1,894	721	38.1%	735	363	49.4%
Total	**83,188**	**23,381**	**28.1%**	**52,208**	**10,851**	**20.8%**	**21,954**	**8,341**	**38.0%**	**9,026**	**4,189**	**46.4%**

	Ratios of Resubmissions	
Per Applicant Comparisons	**Resubmitted/ Awarded**	**Resubmitted/ Unfunded**
Native American	2.24	73.2%
Asian	1.85***	62.4%
Black	2.01	45.3%***
Hispanic	1.37*	55.7%***
White	1.58	64.3%
Other	1.58	63.4%
Race Unknown	1.17***	38.8%***

Notes: s = suppressed for confidentiality (n<50). P-values on race adjusted for multiple comparisons using Bonferroni method. p<.001***, p<.01**, p<.05*.

Table S7: Probit Estimates of the Effect of Race/Ethnicity on R01 Funding Award, Controlling for Resubmitted Applications FY 2000 - FY 2006

Race	Model 5	Model 5 with Controls for Number of Resubmssions	Model 5 Grants Submitted Once	Model 5 Grants Submitted Twice	Model 5 Grants Submitted Three or More Times
Native American	0.063	0.048	0.018	0.228	-0.129
	[0.084]	[0.087]	[0.084]	[0.158]	[0.272]
Asian	-0.042***	-0.041***	-0.038***	-0.041**	-0.037*
	[0.006]	[0.006]	[0.006]	[0.012]	[0.018]
Black	-0.104***	-0.101***	-0.089***	-0.135***	-0.036
	[0.012]	[0.012]	[0.011]	[0.027]	[0.048]
Hispanic	-0.012	-0.011	-0.017	0.011	-0.010
	[0.010]	[0.010]	[0.010]	[0.020]	[0.032]
Other	0.021	0.001	-0.091*	0.193	0.086
	[0.049]	[0.045]	[0.038]	[0.101]	[0.116]
Unknown Race	0.016	0.023**	0.012	0.043*	0.059*
	[0.007]	[0.007]	[0.008]	[0.015]	[0.022]
Observations	**83188**	**83188**	**52199**[a]	**21947**[a]	**9026**

Notes: Coefficients report change in probability of receiving an R01 award given an infinitesimal change in continuous independent variables. Coefficients on dummy variables report change in probability of receiving an R01 award given a change in the dummy from 0 to 1. Robust standard errors clustered on individual applicant in brackets. P-values on race adjusted for multiple comparisons using Bonferroni method. p<.001***, p<.01**, p<.05*. [a] 16 observations were dropped from these regressions because missing human subjects data predicted the probability of award perfectly.

Table S8: Probit Estimates of the effect of Race/Ethnicity on R01 Funding Award, US Citizen Sample FY 2000 - FY 2006

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Native American	-0.022	-0.026	-0.031	-0.015	-0.008
	[0.114]	[0.115]	[0.115]	[0.128]	[0.133]
Asian	-0.014	-0.023	-0.027*	-0.021	-0.023
	[0.013]	[0.013]	[0.012]	[0.012]	[0.012]
Black	-0.130***	-0.132***	-0.123***	-0.115***	-0.107***
	[0.016]	[0.015]	[0.016]	[0.017]	[0.017]
Hispanic	-0.040	-0.040	-0.037	-0.030	-0.025
	[0.015]	[0.015]	[0.015]	[0.015]	[0.015]
Other	-0.045	-0.047	-0.039	-0.013	-0.007
	[0.051]	[0.048]	[0.048]	[0.050]	[0.051]
Unknown Race	-0.014	-0.010	-0.006	0.007	0.010
	[0.016]	[0.016]	[0.016]	[0.016]	[0.016]
Naturalized Citizen	-0.032**	-0.030*	-0.034**	-0.020	-0.026*
	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]
F Recipient		0.025***	0.025***	0.008	0.004
		[0.005]	[0.005]	[0.005]	[0.005]
T Recipient		0.022***	0.014**	0.017**	0.012*
		[0.005]	[0.005]	[0.005]	[0.005]
K Grant Recipient		0.048***	0.037***	0.020**	0.017*
		[0.008]	[0.008]	[0.008]	[0.007]
Employer Ranked			0.141***	0.118***	0.101***
1-30 NIH Funding			[0.010]	[0.010]	[0.010]
Employer Ranked			0.092***	0.078***	0.066***
31-100 NIH Funding			[0.009]	[0.009]	[0.009]
Employer Ranked			0.072***	0.058***	0.050***
101-200 NIH Funding			[0.010]	[0.010]	[0.010]
Employer Hospital			0.028	0.026	0.018
			[0.019]	[0.019]	[0.019]
Employer Research			0.072***	0.051**	0.041*
Institute			[0.018]	[0.018]	[0.018]
Prior NIH Grants				0.083***	0.073***
				[0.006]	[0.006]
Served on NIH Review				0.100***	0.086***
Committee				[0.005]	[0.005]
Citations 3rd Quartile					0.049***
(24 - 84 citations)					[0.009]
Citations 4th Quartile					0.092***
(>84 citations)					[0.013]
Ratio of First Author					-0.005
to Total Publications					[0.010]
Ratio of Last Author					0.023*
to Total Publications					[0.011]
Ratio of Single Author					0.018
to Total Publications					[0.013]
Observations	**47890**	**47890**	**47890**	**47890**	**47890**

Notes: Coefficients report change in probability of receiving an R01 award given an infinitesimal change in continuous independent variables. Coefficients on dummy variables report change in probability of receiving an R01 award given a change in the dummy from 0 to 1. Robust standard errors clustered on individual applicant in brackets. P-values on race adjusted for multiple comparisons using the Bonferroni method. p<.001***, p<.01**, p<.05*.

Table S9: Number and Percentage of Applications with NIH Training by Race/Ethnicity, US Citizen Sample, 2000-2006

Race	T, K or F		T		F		K		Total
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Native American	s		s		s		s		s
Asian	1,138	69.0%	958	58.1%	370	22.4%	280	17.0%	1,649
Black	340	54.0%	277	44.0%	98	15.6%	63	10.0%	630
Hispanic	726	62.0%	524	44.7%	259	22.1%	183	15.6%	1,171
White	26,700	61.6%	18,718	43.2%	11,583	26.7%	4,967	11.5%	43,376
Other	45	50.6%	26	29.2%	23	25.8%	13	14.6%	89
Race Unknown	366	38.3%	185	19.4%	153	16.0%	113	11.8%	956
Total	**29,318**	**61.2%**	**20,688**	**43.2%**	**12,489**	**26.1%**	**5,621**	**11.7%**	**47,890**

Notes: s = suppressed for confidentiality (n<50).

Table S10: Number of Applications and Applicants by Race/Ethnicity, F or T Training and R01 Awards 2000-2006

	Applications						Applicants					
	No Training			Trained			No Training			Trained		
Race	Number Submitted	Number Awarded	Percentage Awarded	Number Submitted	Number Awarded	Percentage Awarded	Number Submitted	Number Awarded	Percentage Awarded	Number Submitted	Number Awarded	Percentage Awarded
Native American	s	s	18.8%	s	s	33.3%	s	s	71.4%	s	s	100.0%
Asian	552	131	23.7%	1,097	331	30.2%	283	133	47.0%	513	306	59.6%
Black	311	46	14.8%	319	57	17.9%	185	51	27.6%	171	67	39.2%
Hispanic	501	124	24.8%	670	178	26.6%	270	124	45.9%	304	173	56.9%
White	18,520	4,849	26.2%	24,856	7,821	31.5%	9,753	5,349	54.8%	12,086	8,041	66.5%
Other	s	s	11.5%	s	s	43.2%	s	s	36.7%	s	s	62.5%
Race Unknown	649	145	22.3%	307	88	28.7%	406	171	42.1%	154	89	57.8%
Total	**20,601**	**5,304**	**25.7%**	**27,289**	**8,492**	**31.1%**	**10,934**	**5,844**	**53.4%**	**13,254**	**8,693**	**65.6%**

Notes: s = suppressed for confidentiality (n<50).

Table S11: Distribution and Averages by Race/Ethnicity for Selected Covariates Full and Unscored Samples

Full Sample										
Race	**Prior Grant (Percent)**	**Prior K (Percent)**	**Prior F (Percent)**	**Prior T (Percent)**	**Prior F or T (Percent)**	**Research Org. (Percent)**	**Higher Education (Percent)**	**Review Committee (Percent)**	**1-30 Fund Rank (Percent)**	**31-100 Fund Rank (Percent)**
Native American	70.7%	9.8%	12.2%	29.3%	41.5%	0.0%	90.2%	39.0%	48.8%	29.3%
Asian	72.8%***	8.5%***	9.1%***	19.8%***	25.5%***	8.6%	83.0%	40.0%***	32.4%	38.7%**
Black	68.9%***	10.6%	12.9%***	34.0%	40.0%**	4.9%**	86.2%	47.8%	27.1%*	34.0%
Hispanic	69.9%***	12.4%	13.7%***	26.6%***	35.0%***	7.7%	81.7%	46.3%***	32.6%	35.2%
White	77.8%	11.2%	22.4%	36.5%	48.7%	8.6%	82.7%	53.2%	33.2%	35.4%
Other	70.7%	13.1%	23.2%	26.3%	37.4%*	3.0%*	84.8%	47.5%	31.3%	30.3%
Unknown Race	57.6%***	5.4%***	4.8%***	9.8%***	13.3%***	8.5%	78.4%***	31.5%***	32.0%*	34.3%
Total	**74.8%**	**10.3%**	**18.2%**	**31.0%**	**41.1%**	**8.5%**	**82.4%**	**48.8%**	**32.8%**	**35.8%**

Race	**Publications (Mean)[a]**	**Citations (Mean)[a]**	**Citations > Median (>24) (Percent)[a]**	**Maximum Impact Factor (Mean)[a]**	**Median Impact Factor (Mean)[a]**	**Single Author (Percent)[a]**	**First Author (Percent)[a]**	**Last Author (Percent)[a]**
Native American	11.0	67.3	43.5%	6.8	3.6	4.3%	38.5%	32.9%
Asian	28.8***	143.4***	64.5%***	13.6***	4.7***	5.4%***	32.8%***	34.2%***
Black	13.7	40.1***	39.7%	9.2*	3.2***	11.2%	40.8%	22.4%***
Hispanic	17.8**	90.3	49.3%	11.7***	4.2	7.6%***	37.1%	30.3%
White	14.3	77.7	45.9%	10.0	4.2	10.3%	38.2%	30.4%
Other	9.1**	44.51*	40.0%	8.2	3.6	8.4%	49.1%	27.3%
Unknown Race	17.6***	90.4	53.3%***	11.1***	4.5***	7.7%***	37.3%	27.7%***
Total	**17.2**	**90.1**	**49.8%**	**10.8**	**4.3**	**9.1%**	**37.2%**	**30.7%**

Notes: [a]Estimates limited to those with valid match to publications. Standard errors are clustered on the individual applicant. P-values are adjusted for multiple testing using the Bonferroni method. We test whether these variables are significantly different from Whites, p<.001***, p<.01**, and p<.05*.

Table S12: Distribution and Averages by Race/Ethnicity for Selected Covariates Full and Unscored Samples

Unscored Sample										
Race	**Prior Grant (Percent)**	**Prior K (Percent)**	**Prior F (Percent)**	**Prior T (Percent)**	**Prior F or T (Percent)**	**Research Org (Percent)**	**Higher Education (Percent)**	**Review Committee (Mean)**	**1-30 Fund Rank (Mean)**	**31-100 Fund Rank (Percent)**
Native American	63.6%	0.0%	0.0%	45.5%	45.5%	0.0%	81.8%	36.4%	36.4%	27.3%
Asian	67.2%***	7.0%***	8.3%***	18.7%***	24.0%***	9.2%	82.4%	33.6%***	27.5%	38.7%
Black	63.1%**	9.2%	13.9%**	31.5%	37.8%*	5.0%*	86.4%	39.5%	20.8%*	35.1%
Hispanic	63.7%***	11.7%	13.3%***	26.3%**	34.0%***	6.5%	81.4%	39.6%	27.2%	37.4%
White	71.9%	9.5%	21.6%	34.0%	46.2%	8.1%	83.3%	44.9%	27.6%	36.2%
Other	68.9%	15.6%	15.6%	13.3%**	22.2%**	4.4%	77.8%	44.4%	22.2%	28.9%
Unknown Race	49.4%***	4.2%***	3.9%***	9.1%***	11.7%***	8.0%	76.9%***	25.5%***	26.4%	33.7%
Total	**68.3%**	**8.6%**	**17.0%**	**28.4%**	**38.1%**	**8.1%**	**82.5%**	**40.6%**	**27.3%**	**36.4%**

Race	**Publications (Mean)[a]**	**Citations (Mean)[a]**	**Citations > Median (>24) (Percent)[a]**	**Maximum Impact Factor (Mean)[a]**	**Median Impact Factor (Mean)[a]**	**Single Author (Percent)[a]**	**First Author (Percent)[a]**	**Last Author (Percent)[a]**
Native American	7.1	28.6	14.3%*	7.1	2.2	14.3%	38.0%	34.0%
Asian	27.3***	119.0***	61.0%***	12.5***	4.3***	5.0%***	34.9%***	32.0%***
Black	14.3	35.3***	35.4%	9.3	3.1***	10.3%	41.9%	23.2%*
Hispanic	16.8	68.6	43.5%	10.4**	3.8	7.2%*	38.4%	28.0%
White	13.5	56.6	40.7%	8.8	3.7	9.7%	39.8%	28.7%
Other	9.3	49.0	38.9%	7.8	3.6	13.2%	52.8%	21.5%
Unknown Race	16.6*	75.3**	49.6%***	10.1***	4.1***	7.2%***	39.3%	25.0%***
Total	**16.6**	**70.5**	**45.5%**	**9.7**	**3.9**	**8.5%**	**38.8%**	**28.9%**

Notes: [a]Estimates limited to those with valid match to publications. Standard errors are clustered on the individual applicant. P-values are adjusted for multiple testing using the Bonferroni method. We test whether these variables are significantly different from Whites, p<.001***, p<.01**, and p<.05*.

Table S13: Number of Applications by Race/Ethnicity for Selected Covariates Full and Unscored Samples

Full Sample										
Race	**Prior Grant (Number)**	**Prior K (Number)**	**Prior F (Number)**	**Prior T (Number)**	**Prior F or T (Number)**	**Research Org (Number)**	**Review Committee (Number)**	**1-30 Fund Rank (Number)**	**31-100 Fund Rank (Number)**	**Citations > Median (>24) (Number)**
Native American	s	s	s	s	s	s	s	s	s	s
Asian	9,816	1,149	1,229	2,663	3,435	1,158	5,388	4,364	5,215	7,824
Black	792	122	148	391	460	56	549	311	391	347
Hispanic	1,856	330	365	708	931	204	1,231	865	936	1,081
White	45,232	6,507	13,018	21,203	28,298	4,998	30,927	19,290	20,600	22,290
Other	70	s	s	s	37	s	47	31	30	32
Unknown Race	4,398	416	369	748	1,013	648	2,408	2,445	2,616	3,418
Total	**62,164**	**8,524**	**15,129**	**25,713**	**34,174**	**7,064**	**40,550**	**27,306**	**29,788**	**34,992**
Unscored Sample										
Race	**Prior Grant (Number)**	**Prior K (Number)**	**Prior F (Number)**	**Prior T (Number)**	**Prior F or T (Number)**	**Research Org (Number)**	**Review Committee (Number)**	**1-30 Fund Rank (Number)**	**31-100 Fund Rank (Number)**	**Citations > Median (>24) (Number)**
Native American	s	s	s	s	s	s	s	s	s	s
Asian	4,157	436	513	1,160	1,487	567	2,079	1,705	2,395	3,353
Black	431	63	95	215	258	34	270	142	240	179
Hispanic	710	130	148	293	379	72	441	303	418	383
White	16,742	2,215	5,039	7,931	10,773	1,876	10,468	6,441	8,434	7,670
Other	s	s	s	s	s	s	s	s	s	s
Unknown Race	1,790	153	141	328	423	291	923	955	1,219	1,435
Total	**23,830**	**2,997**	**5,936**	**9,927**	**13,320**	**2,840**	**14,181**	**9,546**	**12,706**	**13,020**

Notes: s = suppressed for confidentiality, (n<50).

Table S14: Probit Estimates of the Effect of Selected Covariates on Receiving a Priority Score--FY 2000 - FY 2006

Variable	Model 5 Full Sample	Model 5 Blacks	Model 5 Asians	Model 5 Hispanics	Model 5 Whites
Employer Ranked	0.116***	0.081	0.131***	0.104**	0.107***
1-30 NIH Funding	[0.008]	[0.076]	[0.020]	[0.038]	[0.009]
Employer Ranked	0.063***	-0.019	0.082***	0.017	0.056***
31-100 NIH Funding	[0.007]	[0.067]	[0.019]	[0.037]	[0.009]
Employer Research	0.052***	0.022	-0.018	0.067	0.046**
Institute	[0.013]	[0.093]	[0.039]	[0.060]	[0.016]
Prior NIH Grants	0.082***	0.080	0.089***	0.071*	0.081***
	[0.005]	[0.045]	[0.012]	[0.029]	[0.006]
Served on NIH Review	0.117***	0.195***	0.114***	0.097***	0.118***
Committee	[0.005]	[0.040]	[0.012]	[0.026]	[0.005]
Citations above the median	0.052***	0.213***	0.047*	0.084*	0.057***
(>24 citations)	[0.007]	[0.065]	[0.019]	[0.043]	[0.009]
Ratio of Last Author	0.055***	-0.103	0.055*	0.044	0.053***
to Total Publications	[0.010]	[0.089]	[0.024]	[0.055]	[0.012]
Observations	**83188**	**1143**	**13481**	**2651**	**58124**
Chi-squared test that Coefficients are same as the full sample		14.03*	5.63	3.85	5.23

Notes: Coefficients report change in probability of receiving an R01 award given an infinitesimal change in continuous independent variables. Coefficients on dummy variables report change in probability of receiving an R01 award given a change in the dummy from 0 to 1. Robust standard errors clustered on individual applicant in brackets. p<.001***, p<.01**, p<.05*.

Table S15: Probit Estimates of the Effect of Race/Ethnicity on R01 Funding Award, Sample Omits Unscored Applications FY 2000 - FY 2006

Race	Model 1	Model 2	Model 3	Model 4	Model 5
Native American	-0.049	-0.052	-0.056	-0.066	-0.059
	[0.099]	[0.101]	[0.102]	[0.104]	[0.106]
Asian	-0.036***	-0.035***	-0.034***	-0.027**	-0.028**
	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]
Black	-0.093***	-0.094***	-0.084**	-0.069*	-0.065*
	[0.023]	[0.023]	[0.023]	[0.024]	[0.024]
Hispanic	-0.021	-0.021	-0.018	-0.011	-0.010
	[0.013]	[0.013]	[0.013]	[0.013]	[0.013]
Other	0.016	0.015	0.022	0.052	0.059
	[0.068]	[0.066]	[0.065]	[0.068]	[0.067]
Unknown Race	-0.023	-0.018	-0.017	0.038***	0.040***
	[0.009]	[0.009]	[0.009]	[0.010]	[0.010]
Observations	**48226**	**48226**	**48226**	**48226**	**48226**

Notes: Coefficients report change in probability of receiving an R01 award given an infinitesimal change in continuous independent variables. Coefficients on dummy variables report change in probability of receiving an R01 award given a change in the dummy from 0 to 1. Robust standard errors clustered on individual researcher in brackets. P-values on race adjusted for multiple comparisons using Bonferroni method. p<.001***, p<.01**, p<.05*.