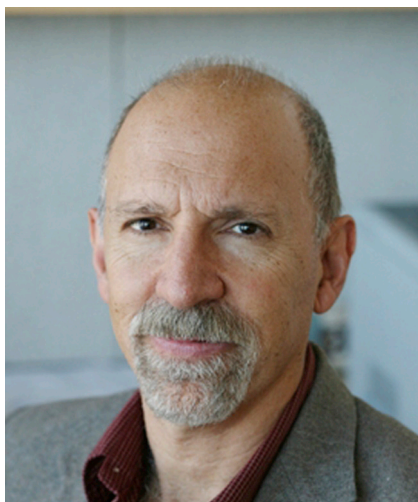


Presidential Address: All in the Family, or “Gee, Our Old LaSalle Ran Great”¹

Neil Risch^{2,*}



For those of you who aren't familiar, here is a picture of a LaSalle (Figure 1). Is that not a gorgeous car? I definitely covet one of those!

I am going to start off by thanking a bunch of people—particularly the staff, whose pictures are up here. There are many more on the staff; these are just some that I picked out. Of course, everyone knows Pauline, who is really in charge of this meeting. And as I told her, people tell me, “This is your meeting!” Well, not exactly. And it's been an incredible honor to work with Joe and the rest of the staff. Their pictures are here—so if you see them during the meeting, please go up and thank them. It is an enormous amount of work to put forward this meeting. Another person who has done an enormous amount of work is our fearless and tireless program chair, Chris Gunter. We owe her, as well as the entire program committee, a big debt of gratitude; as you can imagine, reviewing 3,000+ abstracts is a big chore, and programming it all and having it all make sense are really difficult. So, as you go through the meeting this week, if you see Chris or people on the program committee, please thank them; I think they have done, as you will see during the week, a fantastic job with the meeting.

I want to thank everyone who voted for me. Some of you have complained before that we only have one candidate for president listed on the ballot. But it turns out that my

presidential race was more competitive than you might think. That is because we allow write-in candidates. Technically, we don't usually show election voting results, but in this case we are going to make an exception. Here are the actual results from my election:

Neil Risch: 546
Donald Duck: 221
Ben Tennyson: 195
Coraline: 112

And, as you can see, it was very close. But fortunately I was able to defeat Donald, Ben, and Carlie. So, it appears that at least for the ASHG presidential election, prior experience is not disqualifying.

In seriousness, I really do want to thank the society for this tremendous honor and privilege. It has been an exciting year for me. I still have a few more months to go, but it's just been wonderful, and I recommend it to any of you who ever thought about doing a job like this—it's an exciting and wonderful thing to do.

I want to welcome everyone to Baltimore also. This is the fifth time we've met in Baltimore, which actually ties for the most visited venue. It ties with my home town, San Francisco, and San Diego. But, sadly, at least for the near future, this is going to be the last time, and that's because we have just outgrown it. The venue is not big enough; the society has grown so much over the last several decades that we now have fewer venues available.

You've probably seen this before, but here is a plot showing the growth of our meeting over the past 35 years. There's been a 7-fold increase (Figure 2). And what I am displaying here (Figure 3), if you look at the blue bars, is the diversity of meeting venues for the first three decades of the society; the red represents the last three decades. You can see dramatically greater diversity in the venues in the first three decades—there are many places we visited one time—in the early history of the society. But that is not happening any more—we are much more restricted in the locations we can go. There are pluses and minuses to being large, and one of the minuses is that we don't have as much diversity in the locations that we visit anymore.

¹This article is based on the address given by the author at the meeting of The American Society of Human Genetics (ASHG) on October 6, 2015, in Baltimore, MD, USA. The audio of the original address can be found at the ASHG website.

²Institute for Human Genetics, University of California, San Francisco, San Francisco, CA 94143 USA

*Correspondence: neil.risch@ucsf.edu

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Figure 1. A La Salle Automobile
 “La Salle Series 39-5067 Convertible Coupé 1939” (https://commons.wikimedia.org/wiki/File:La_Salle_Series_39-5067_Convertible_Coupe_1939.jpg); photo taken by Lars-Göran Lindgren Sweden and licensed under the CC-BY-SA 3.0 license (<https://creativecommons.org/licenses/by-sa/3.0/deed.en>).

I think as many past presidents have done, I looked at the past presidential addresses to try to get some guidance about what to talk about. So, I thought, let’s hear what others have said. Here is a list of some things that others have noted:

- That the speech is a daunting task that keeps you up at night
- Requests that members be engaged
- Trends in membership size
- Prior content of presidential addresses
- That we are living in rapidly changing times (this has been said many times)
- That everything has already been said
- That this talk will be long forgotten ...

It started getting frustrating because everything I had thought of to say had already been said. In fact, if you look at the second-to-last comment on this list, *that* had already been said. So I couldn’t even say that everything had already been said. So where did that leave me? I think it was Jeff Murray who said (and I’m paraphrasing), “This talk will be long forgotten.” So I said to myself, is that really true? I decided to test this out and see. I did a lot of work here—you will think it was totally ridiculous, I’m sure. I

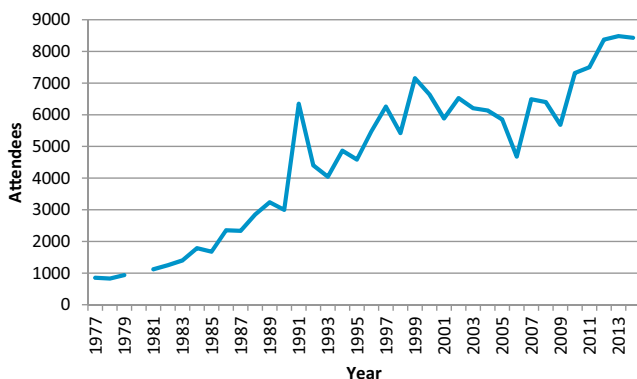


Figure 2. ASHG Meeting Attendance Has Increased 7.3-fold over the Past 35 Years

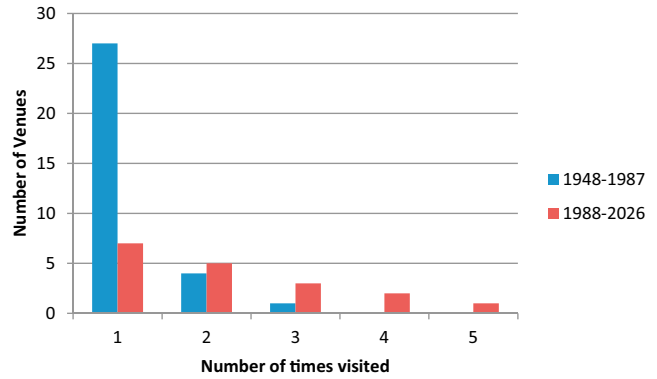


Figure 3. Diversity of ASHG Meeting Venues between the First 30 years and the Last 30 Years

looked at the number of citations of all the prior presidential addresses (Figure 4). The majority of presidential addresses have been cited fewer than 20 times. Only a few have been cited more than that—in fact, six have been cited more than 50 times. One of them has been cited 723 times. I know this is a big room here, but does anyone want to shout out if they know whose that was? The most cited one was the first one (Figure 5). This is a very famous paper, “Our Load of Mutations” by Herman Muller.¹

Ah, Aravinda got the right answer. He would be the one to know. He is a past president and probably did the same analysis; it wouldn’t surprise me in the least.

This famous paper is still current, and people are still citing it today. I then looked back at the distributions of citations without that one, and it turns out that there is a very negative regression line (Figure 6) toward few citations for the more recent ones. In fact, I noticed that for the past 10 years, the median number of citations for presidential addresses has been two, and then I discovered that those were actually self-citations!

This was great news for me because the pressure is off! So, I decided to “go for broke.” Here goes—fasten your seat belts!

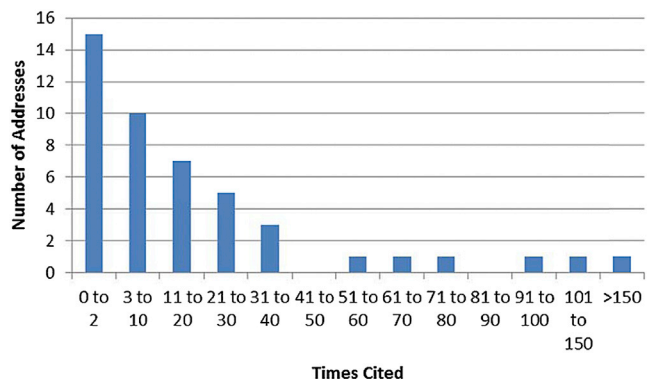


Figure 4. Number of Times ASHG Presidential Addresses Have Been Cited
 Data from Google Scholar as of October 2015.

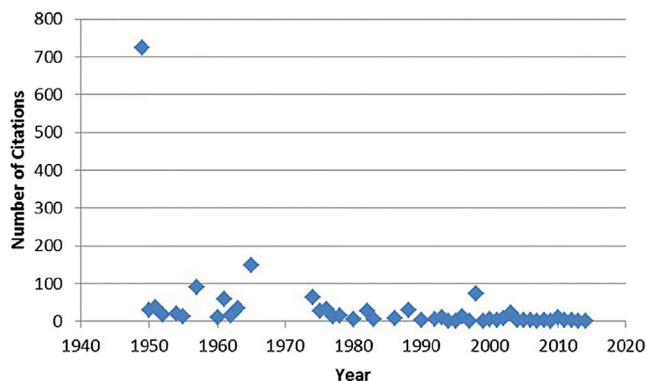


Figure 5. The Most Often Cited Presidential Address Is the First One

As president, I took the job seriously. At least I tried to. You can judge whether I did or not! I read the bylaws. Now, I don't know how many of you have actually read the bylaws. I did actually read the bylaws, more than once. And this one about the committees struck me:

ARTICLE VIII – COMMITTEES Committee members, except those serving by virtue of holding other office, shall be appointed by the President and may be removed by a majority vote of the Board of Directors. The President's appointments shall, to the extent possible, reflect the diversity of the Society's membership.

But it doesn't say how diversity is to be defined. So I didn't know what I was supposed to do here. Is it by professional orientation, by advanced degree, by gender, by race or ethnicity, or by other socio-demographic factors?

What I decided to do was an analysis of the diversity of the society throughout its history because I thought that could give me guidance in terms of these appointments. Here are the results.

There have been 200 members who have been elected to the board of directors. I found them all by looking at the back of *The Journal*, since they are all named there, and then I went to Wikipedia and Google and discovered

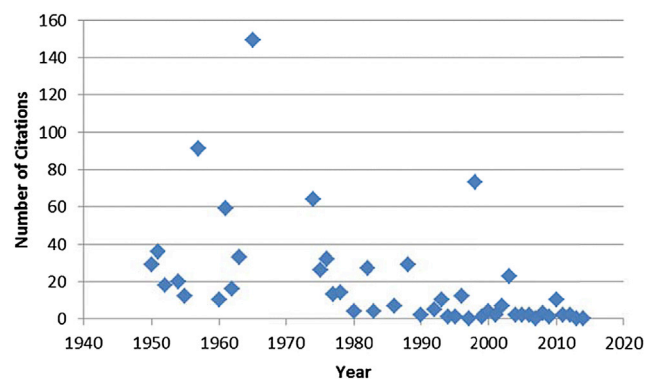


Figure 6. A Significant Declining Trend of Presidential Address Citations over Time—Even Excluding the First One

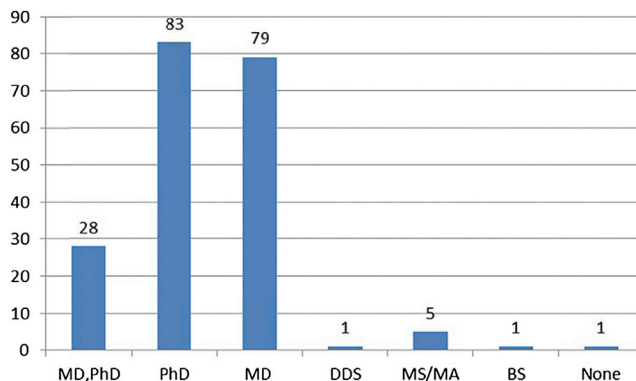


Figure 7. Elected ASHG Board of Directors Members by Degree

them and found out as much information about them as I could (Table S1). And one of the things I found out about every one of those 200 board members was their degree. Here are the numbers (Figure 7). It turns out that there is a pretty even split between the PhDs and the MDs and a decent number of MD-PhDs. Probably many of you don't realize we've had a dentist, five people with master's degrees, and one person with a bachelor's degree serve on the board of directors, and we actually had one person who didn't have a college degree. That was in the older days, which I found very interesting.

The other thing I wanted to do was to see whether there has been a trend toward a change in the structure of the board and the president in terms of their degrees. I did not anticipate the results—it was a big surprise. There has been a dramatic change (Figure 8). At the beginning, in the early years of the society, primarily PhDs were in the leadership, but come the 1970s and 1980s, there was a complete reversal: the MDs were of prominence in the society. However, since 1990 we have been seeing a reversal again, and we see now, true of the board and the president, an ascendance of PhDs. I did not do an analysis to try to figure out what was underlying this trend, but I am guessing that over the past few decades we have been driven by technology, because this is the era of the genome; the genome sequence has understandably brought a lot of people into the field. It is a very exciting time. We will see whether there is going to be a shift again because there is often a lag time between the discoveries related to the human genome and when they are translated into clinical practice.

You saw that another category I had on the list before is gender, so I wanted to see the female proportion of those who have served as various ASHG officers (Figure 9). The highest percent (about 28%) is for the board of directors, followed by the secretary (23%) and the president (about 16%). Treasurer, interestingly, has been about 12%, and the lowest, actually, has been for journal editor. There have been 14 editors in the history of the society, and we've had one woman. I think everyone knows who that is: Cynthia Morton, who has served the society in many roles, including that one.

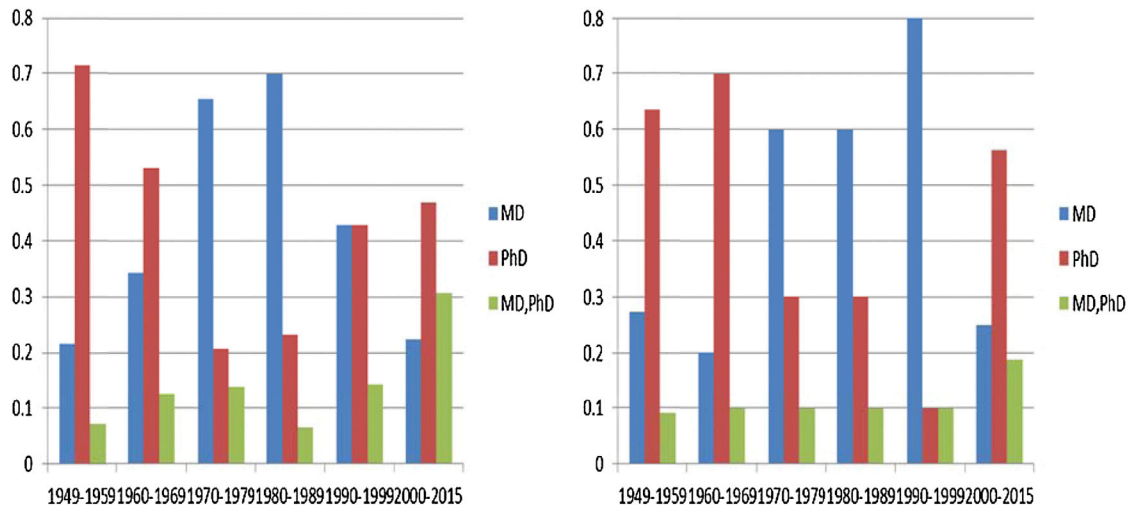


Figure 8. Degrees of Elected ASHG Board of Directors Members and Presidents by Decade
Board members are on the left, and presidents are on the right.

I also wanted to look at the trend over time to see whether there have been changes; it has been very dramatic (Figure 10). The female proportion of those serving on the board of directors and as president has increased, particularly for the board of directors. For the past 15 years, the board of directors has been over 50% female. We're not quite there yet with the president, which is more in the range of 25%, so maybe we need to do a little more work there. In other surveys we have looked at, the female proportion of the general membership is actually more than 50%. So overall, this is a good trend.

Here is some other demography. I wanted to also look at the race and ethnicity of the board members and presidents (Table 1). It turns out that 97.5% of board members have been white, and it's almost the same for the presidents. On the board, we have had four Asians and one Latino and no African Americans; for presidents, it has been pretty much the same—we have had three Asians, and all the rest have been white.

One category we don't routinely ask about—and wasn't particularly easy to discover in Wikipedia either—is indi-

viduals from the LGBT community. So that one was a little harder for me to figure out. But, I can assure you that at least one individual from the LGBT community has served both on the board of directors and as president.

Do I hear those tweets going? I hear a lot of tweets. OK.

I also want to take this opportunity to congratulate our newly elected officers: Nancy Cox, Nico Katsanis, Charles Rotimi, and Sarah Tishkoff. I don't think I need to point out to you that this is the first time in 66 years of this society that an individual of African descent has served on our board of directors. And I think it is about time!

I was also curious about the fact that we see more women in the society and in leadership roles. I was wondering whether this trend mimics what has been going on in society more broadly. It turns out that yes, it does (Figure 11). There's actually been a dramatic increase over the past five or six decades in terms of the number of individuals who have achieved college educations—bachelor's degrees, master's degrees, and doctoral degrees. But it's been more dramatic for women. If we look at the sex ratio (Figure 12), the increase is also very dramatic—for bachelor's and master's degrees, back in 1950, it was three women for every ten men. Today, it is the opposite—the female-to-male ratio is 1.3 to 1.4. For the doctoral degrees, you can see the same thing. In the first three decades, it was flat, but the past four decades have seen a dramatic increase in doctoral degrees among women. In fact, the ratio is now above 1; there are more females than males with doctoral degrees.

I would just like to make a point about this, which is going to be relevant before long. Prior to the 20th century, it was commonly believed that men were intellectually superior to women. It was argued that this was because women were not capable of the same level of rational thinking that men were and hence were less suited to science than to household work. Furthermore, early brain studies concluded that women were intellectually inferior because they had smaller and lighter brains.

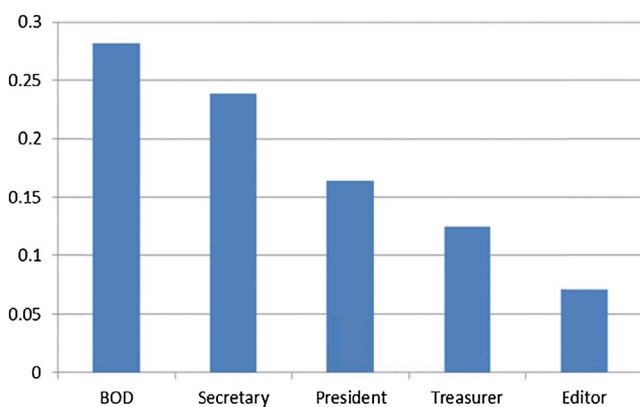


Figure 9. Female Proportion of ASHG Officers

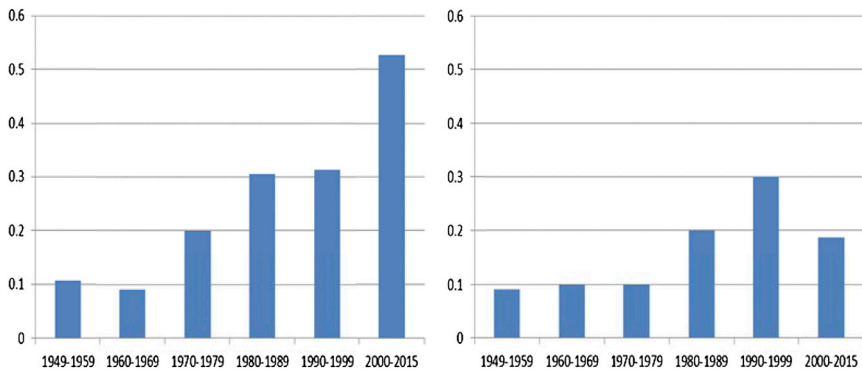


Figure 10. Female Proportion of Elected ASHG Board of Directors Members and Presidents by Decade
Board members are on the left, and presidents are on the right.

Fortunately, we are past all that—all that has changed. As I showed you, women now exceed men in educational achievement across the board. So that is definitely the good news.

Now here is the bad news: “Is an Educated Wife Hazardous to Your Health”? I don’t know how many of you guys out there have seen this article,³ but it turns out that a wife who is more educated than you are can be hazardous to your health. In fact, the risk of cardiovascular disease is significantly increased if your wife is smarter than you. So, good luck, guys!

While we are on the topic of education—remember I said I was going for broke here—let’s talk about the genetics of educational attainment. In the “old days” (this is part of my theme), education, income, and socio-economic status were considered social covariates in genetic studies. Now it appears that they have become the direct object of genetic analysis. Recent studies have argued that educational attainment is just a surrogate for cognitive ability or IQ. In genome-wide association studies (GWASs), SNPs have been associated with educational attainment. Triggered by this, an editorial in *Nature*⁴ referred to this type of study as “Dangerous Work” and said that behavioral genetics must tread carefully here to prevent misinterpretation. Furthermore, the editorial made the following comment later on:

Be accurate. Researchers should design studies on the basis of sound scientific reasoning. For instance, in light of increasing evidence that race is biologically meaningless, research into genetic traits that underlie differences in intelligence between races ... will produce little.

Table 1. Demography of Elected ASHG Board of Director Members and Presidents

Group	Number (%)	
	Board of Director Members	Presidents
Asian	4 (2.0%)	3 (4.5%)
Black	0 (0.0%)	0 (0.0%)
Latino	1 (0.5%)	0 (0.0%)
White	194 (97.5%)	64 (95.5%)
LGBT	1 + ? (0.5% + ?)	1 + ? (1.5 + ?)

Really? If that is the case, why are we doing genetic-ancestry adjustments in all of our GWASs? Why are we doing admixture-mapping analyses? If I were to do a GWAS of race and ethnicity, what do you think that would produce?

To me, there is a disconnect here. Here is the problem. The following paper was pretty much inevitable: “A Review of Intelligence GWAS Hits: Their Relationship to Country IQ and the Issue of Spatial Autocorrelation.”⁵ I don’t know whether you have seen this (it came out a few weeks ago), but the author did an analysis looking at the relationship between country IQ and SNP scores based on those GWASs.

The paper included a scatter plot of national IQs and a Polygenic IQ SNP Score (“PISS”). And sure enough, what the author showed is that there is a strong correlation: African populations have the lowest SNP scores and the lowest country IQs, the folks in the middle are Latinos, up to the right are Europeans, and in the upper right corner are East Asians. The author then concluded,

It is thus likely that the vast majority of mutations affecting intelligence were already present in the ancestral African population and as humans settled in different parts of the world, these polymorphisms were subject to directional selection pressure, which produced an overall increase in human intelligence at different rates in different geographical areas.

As I said, you could almost see this coming. So, I thought, let’s look more carefully at these data. I examined SNP data in dbSNP for the major HapMap populations and calculated a mean PISS for the same SNPs. Just as the previous author had found, the mean PISS was 3.7 for Europeans, 4.4 for Chinese, 4.0 for Japanese, and 2.3 for Yorubans.

However, are you aware that there are two more individuals with genotype data in dbSNP? Yes, James Watson and Craig Venter. Their scores are provided together with the HapMap populations in [Figure 13](#). As you can see, James Watson has a PISS that is slightly lower than that for the average European, and Craig Venter has a PISS equal to the average for Yorubans. Apparently, a below-average PISS is still adequate to obtain a Nobel Prize and National Medal of Science. Or perhaps the PISS just has limited predictive value.

So what is this all about? Once again, 2 weeks ago, *Science* magazine published an editorial⁶ discussing the ecological

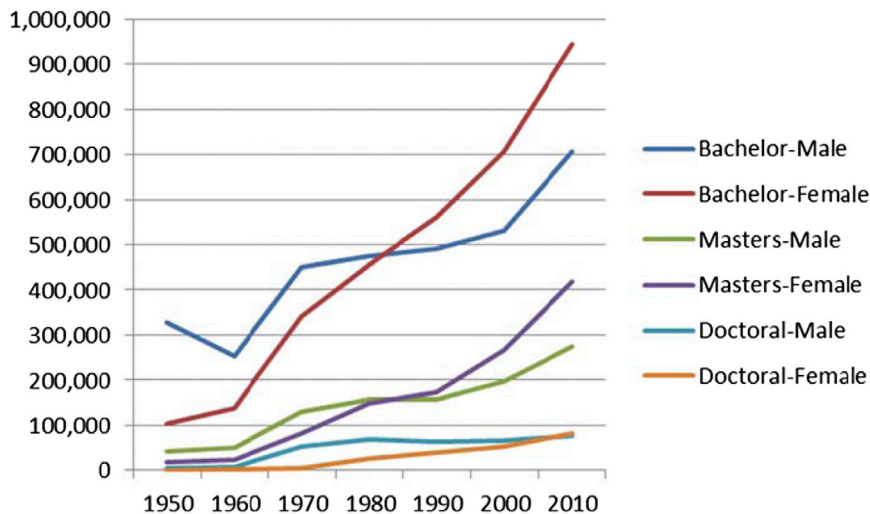


Figure 11. Advanced Degrees by Gender over Time

Data are derived from Table 310 of the National Center for Education Statistics 2012 *Digest of Education Statistics*.² The table's original title was "Degrees conferred by degree-granting institutions, by level of degree and sex of student: Selected years 1869–70 through 2021–22."

data are for the years 2003–2005 from the US Census. The line represents the probability that a child will receive a bachelor's degree by age 24 for each interval of household income in relation to the highest income category (>\$150,000). You see

correlation between asthma prevalence and ozone levels because ozone levels have dropped but asthma prevalence has gone up, so therefore one might conclude that we don't have to regulate ozone (Figure 14). The author needed to point out once again that correlation does not equal causation.

Here is another, more relevant example. Suppose I did a genetic study 50 years ago of educational attainment. What would I have found? I would have found a very strong genetic component—the presence of a Y chromosome. Doing the same genetic study today, I would find exactly the same thing, except that the effect would be in exactly the opposite direction.

So what is the problem here? The flaw in this conclusion is to think that what matters is the biology of the individual rather than the social context in which he or she lives.

Is educational attainment really a proxy for IQ or, more likely, for household income? Here, I am showing (Figure 15) the probability that a child will get a college education as a function of the income level of the family. The

difference is dramatic—there is an 8-fold lower probability for the bottom quintile. This difference has actually been increasing over the last four decades.⁷ In response to this, Sabrina Tavernise of *The New York Times* wrote an editorial entitled "Education Gap Grows between Rich and Poor, Studies Say"⁸:

Researchers are finding that while the achievement gap between white and black students has narrowed significantly over the past few decades, the gap between rich and poor students has grown substantially during the same period.

Now I am going to talk about some other trends I see going on. The field has really been moving away from family-based studies to case-control and cohort studies for gene discovery and characterization—and maybe I am partly responsible for that. But it makes sense, because in the era of genomics, you can assay the genome and you can assay the genome in everyone, so it's understandable why that has happened. As we are moving toward whole-exome and whole-genome sequencing, we are moving

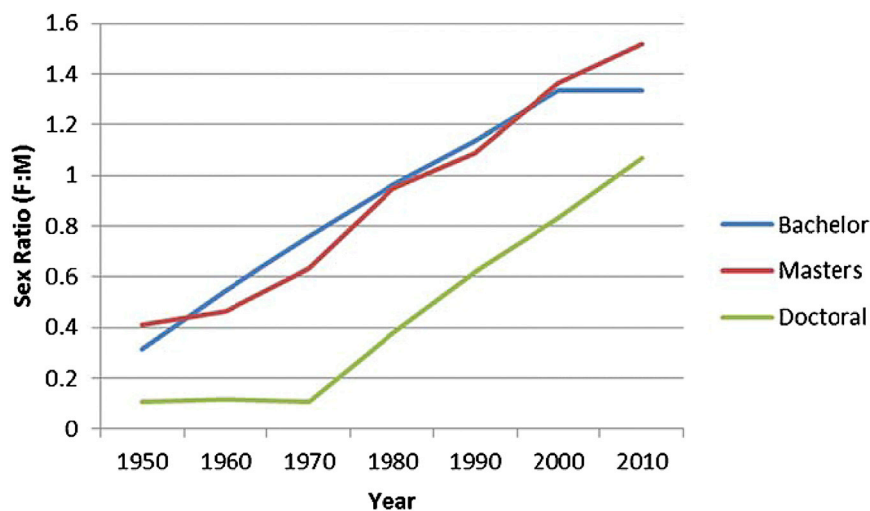


Figure 12. Female-to-Male Sex Ratio of Advanced Degrees over Time

Derived from data in Figure 11.

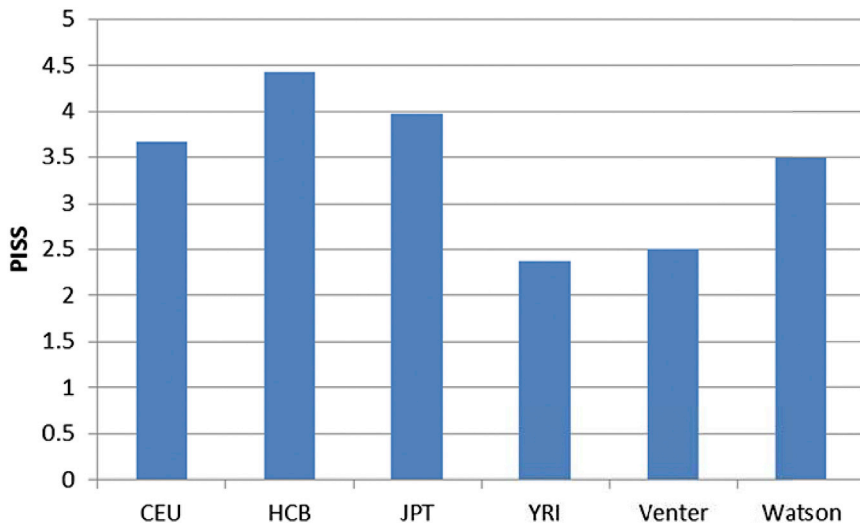


Figure 13. Polygenic IQ SNP Scores for dbGaP Populations and Individuals

6% of the cohort overall endorsed more than one category, that number is likely to grow as mating patterns continue to evolve. Thus, although myriad genetic markers can provide accurate estimates of individuals' genetic ancestry, characterizing the social aspects of race and ethnicity might be more challenging.

This leads me to one of my final topics, which is genetics and social identities. When it comes to our social identities, the concept of "choice"

from genetics to genomics; no longer does positional cloning have the same degree of prominence in our work. But it has also led to a shift in causal inference, because historically causal inference was based on segregation of variants in families and based on statistics. Now, it's based not on statistics at all but on subjective judgments of variants. So, ironically, to me, in the old days you would look at families to assess inheritance and transmission, but now families are being used for proving that a variant is not inherited because de novo mutation is one of the criteria required for something to be considered a functional variant.

Also, there have been major shifts in the demography of families because mating patterns have changed—there's more inter-racial mating, and this obviously has an impact on association studies, but other things too. This is a paper from my post doc Yambazi Banda, who did an analysis of our Kaiser GERA cohort⁹ (this is work that we do at Kaiser; Cathy Schaefer here is my colleague in that resource). In the 100,000 subjects who we genotyped, he looked at the population structure and its relationship with race and ethnicity. This is basically what we found: approximately 12%–17% of the cohort had ancestry from more than one continent. But more interesting, maybe, is the fact that among various combinations of racial and ethnic categories, we observed 50 different combinations. Whereas

appears to loom large. I'm so glad I actually got to include a line from an episode from *All in the Family*. This comes from a classic episode, probably the most widely seen episode. Sammy Davis, Jr. comes to visit Archie Bunker, and they're sitting there chatting. At one point, Archie turns to Sammy and says, "Sammy, [there's] something I always wanted to ask you ... You being colored, well, I know you had no choice in that. But whatever made you turn Jew?"

So what does this come down to? It comes down to the public's perception of what is a choice. But then I ask, why does it matter? Why and when would it matter whether something is a choice or not? This struck me also—the public's perception of the degree to which gender or sex is biological and genetic versus its perception about whether race and ethnicity are genetic or not. The way I am looking at this is their response to individuals who are transgender or transracial. Can you change your gender socially? Can you change your race socially?

I was struck by the great difference in the public reactions to Caitlyn Jenner (transgender) and Rachel Dolezal (transracial)—there was a much more positive reaction to Caitlyn Jenner than to Rachel Dolezal (Figure 16). So, is this saying something about people's feelings about being transgender versus being transracial?

Correlation doesn't mean causation

A rise in asthma prevalence (right) as ozone levels are dropping (left) doesn't invalidate the argument that tougher ozone standards would improve health.

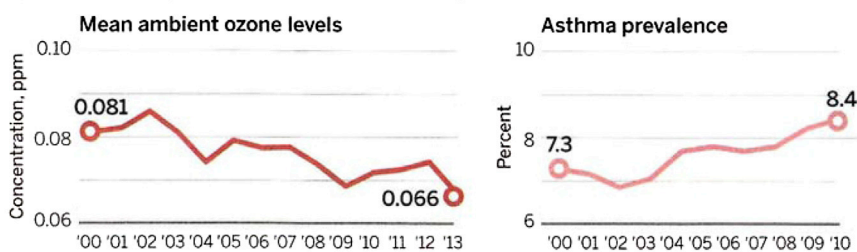


Figure 14. Ozone versus Asthma: Correlation Does Not Mean Causality

Reprinted from Mervis⁶ with permission from the American Association for the Advancement of Science.

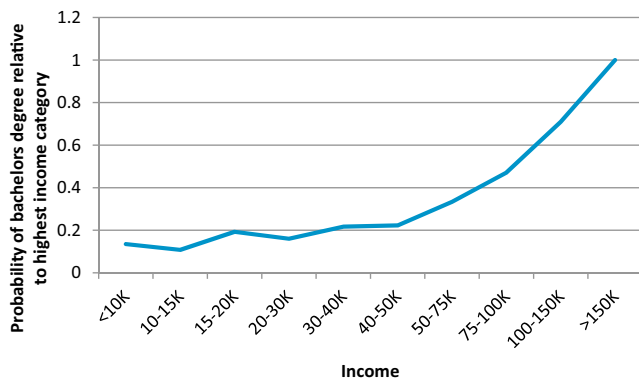


Figure 15. Probability of a Bachelor's Degree by Age 24 by Family Income in Relation to Highest Income Category

Data are of years 2003–2005 and are derived from Table 14 of the US Census Bureau Current Population Survey Data on School Enrollment.⁷

What about being “trans-religion”? You might think that is easily malleable because people can convert and change religions. But maybe not. I don't know whether you saw this—this is the result of a CNN poll¹⁰ that asked people about President Obama's religion: 39% said he was Protestant, 4% said Catholic, 29% said Muslim, 2% said Mormon, 1% said Jewish, 11% said “not religious,” and 14% said “don't know.” Among republicans, the percentage saying Muslim exceeded that saying Protestant. But this raised a question in my mind—does a high percentage of the public believe that Obama is Muslim because his biological father was Muslim or because his adoptive father was Muslim? Even though he has identified for decades as a Christian, can you not have a religious identity that is different from that of a parent?

Now another big question: why is it that homosexuality is genetic but race is not? Have the genetic studies of sexual orientation really been so conclusive? Then I'm going to ask another question: where are the genetic studies that reveal the brain structures involved in homophobia, which is also presumably familial and heritable?

Now I am going to quote from Samantha Allen, who wrote the following in *The Daily Beast* in an article titled “The Problematic Hunt for a ‘Gay Gene’”¹¹:

The popular media, once so easily convinced by LeVay that homosexuality resulted from brain size and by Hamer that homosexuality was genetic, promptly changed its tune that homosexuality is now epigenetic. Hooray? If it's hard to get excited about these studies, it's because, at this point, biological explanations for homosexuality are like iPhones—a new one comes out every year ...

In terms of promoting LGBT equality, it doesn't seem to matter as much whether people believe that gay people were “born that way” as it does that they simply know someone who is currently gay, no matter how they were born. Friendship is the trump card in the movement for equality, not etiology.

Now, do all gay men and women want to get married? Maybe not. I don't know how many of you have seen this cartoon from *The New Yorker* (Figure 17)—in case you can't read it, it says “Gays and lesbians getting married—haven't they suffered enough?”

So, if many gay men and women do not choose to get married, what is this really about? From the recent Supreme Court ruling,¹² I quote,

The marriage laws at issue are in essence unequal: Same-sex couples are denied benefits afforded opposite-sex couples and are barred from exercising a fundamental right. Especially against a long history of disapproval of their relationships, this denial works a grave and continuing harm, serving to disrespect and subordinate gays and lesbians. Pp. 18–22.

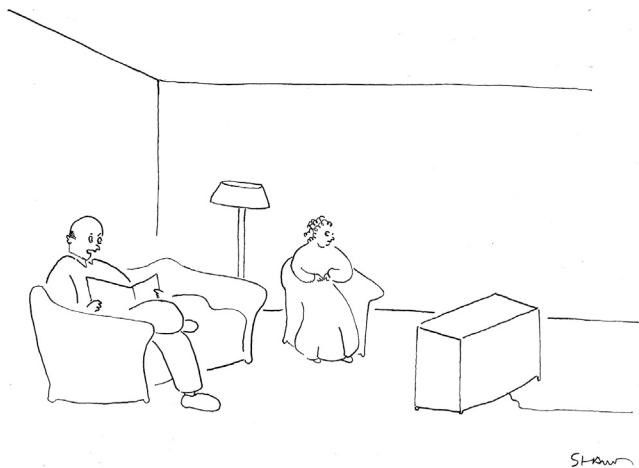
Now, I live in San Francisco, and I do watch TV occasionally, and right after the ruling they did interview folks on TV, and I was struck by some of the comments. In particular, one woman said, “I can be free; I can be me.” Then they interviewed another man, who said, “For the first



Figure 16. Different Public Reactions: Transgender Is Acceptable but Transracial Is Not?

(Left) Caitlyn Jenner. This image is the work of a US Department of State employee and was taken as part of that person's official duties. As the work of the US Federal Government, the image is in the public domain as per US Title 17 codes § 101 and § 105 and the Department Copyright Information.

(Right) Rachel Dolezal. This image is a cropped version of a photo (https://commons.wikimedia.org/wiki/File:Rachel_Dolezal_speaking_at_a_rally_in_Spokane.jpg) taken by Aaron Robert Kathman and licensed under the CC-BY-SA 4.0 license (<https://creativecommons.org/licenses/by-sa/4.0/deed.en>).



"Gays and lesbians getting married—haven't they suffered enough?"

Figure 17. Gay Marriage: Not for Everyone?

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time in my life, I feel like a human being." I repeat, "For the first time in my life, I feel like a human being." Now, I think those four dissenting Supreme Court Justices should hear that, over and over and over again, until it finally sinks in.

Isn't that what this is all really about—that no one should have to go through life feeling that he or she is something less than human? And for us as geneticists, what is most important is that genetics and geneticists should in no way contribute to those kinds of negative feelings on the part of anyone, no matter who they are or what their life choices are.

Now, back to families. What is it that is transmitted in families? There are many things, such as ethnicity or sexual orientation (whether due to genetics or otherwise), that parents might not be able to influence about their child. However, parents do have a direct influence on how their child feels about him- or herself, and that is what really matters.

I also wanted to say a few words about mentorship. I once had an African American student say to me that he had no role models. This is probably one of the most difficult things I have ever heard from a student. But it made me wonder, what makes for a good role model? Do role models need to be the same race, gender, and/or sexual orientation as those looking up to them? I don't know the answer to that, but I do know one thing that I have learned, in terms of good mentoring—that it's more important to teach your students how to deal with failures than how to deal with successes; good mentors will tell their students about their own failures and not their successes. I feel this is especially important and true for minority students, who come to the table often lacking the self-confidence that others have.

And by the way, one thing I want to announce is that this morning, at the board of directors meeting, I am delighted to tell you that we unanimously agreed to have a new ASHG award for mentorship. I feel this is long overdue.

In conclusion:

- (1) We have made advances when it comes to diversity, especially for women, but not really as much when it comes to racial diversity.
- (2) I do believe that mentoring is key to advancing diversity.
- (3) Advances in genomic technology are changing the way we study disease etiology as we transition from gene discovery to diagnosis and treatments, but families are still important both in research and in the clinic, and this is true for both genetic and non-genetic reasons.
- (4) Social justice and equality are normative values. Genetic arguments have no place in the fight for social justice and equality.

Now, you all heard the tune at the beginning, and I gave you a warning. So there is going to be a sing-along. I am going to show you the words (which are not the same as in the original version), and I want you to sing along with me because I'm losing my voice here.

(To the tune of "Those Were the Days," written by Gene Raskin):

The way we did the TDT
 Mapping genes by IBD
 Founder pops our cup of tea
 Those were the days
 Segregation and linkage too
 Family based the thing to do
 We could use a tool like GeneHunter-Plus again
 Didn't need no Biomek
 All pipetting done by tech
 Gee our old LaSalle ran great

(Sorry, I know that doesn't rhyme—I just wanted to see that car again!)

Those were the days!!!!

Finis.

Supplemental Data

Supplemental Data includes one table and can be found with this article online at <http://dx.doi.org/10.1016/j.ajhg.2016.02.009>.

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