Diversity, Equity & Inclusion – Resources for ChBE

September 2020

I. Diverse Teams are more Creative & Productive
II. Cognitive Habits and Implicit Association
III. What Actions can Promote Diversity?

Women & Others are Under-represented in STEM

- Data show that women, Black, Hispanic/Latinx, and Native American scientists are significantly underrepresented in STEM in academia at percentages well below their makeup in the American population at large.
- Data are from NSF (2018)

Doctorate recipients, by subfield of study, citizenship status, ethnicity, and race: 2018

(Number)

Subfield of study	All doctorate recipients[a]	Temporary visa holders	U.S. citizens and permanent residents								
			Total	Hispanic or Latino	Not Hispanic or Latino						Ethnicity not reported
					American Indian or Alaska Native	Asian	Black or African American	White	More than one race	Other race or race not reported	
All fields	55,195	17,604	35,404	2,582	115	3,305	2,456	24,951	1,102	371	522
Chemistry	2,810	1,022	1,711	106	4	176	77	1,268	42	12	26
Engineering	10,183	5,583	4,218	280	8	678	167	2,829	129	59	68
Chemical engineering	981	478	469	35	2	78	7	318	18	5	6

Doctorate recipients, by subfield of study and sex: 2018

(Number and percent)

Subfield of study	Total[a]	Male	Female	% female
All fields	55,195	29,798	25,368	46.0
Chemistry	2,810	1,743	1,067	38.0
Engineering	10,183	7,726	2,453	24.1
Chemical engineering	981	688	293	29.9

https://ncses.nsf.gov/pubs/nsf20301/data-tables/

Research Shows Diversity Yield Favorable Outcomes

- McKinsey regularly examines the financial performances of large numbers of companies across every sector and correlates their financial performance as a function of the diversity of their boardrooms.

- McKinsey has divided up companies into four groups (“quartiles”) based on the percentages of women in their leadership.

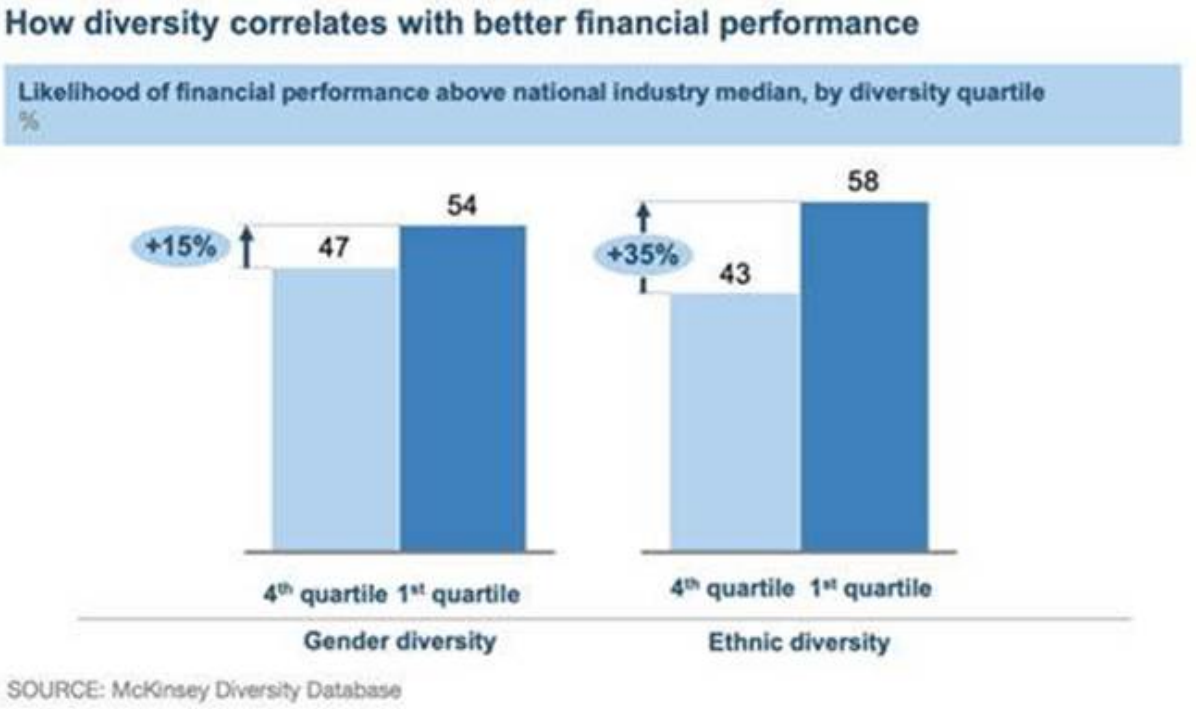
- Their research, as well as work of others, show that diverse teams produce many desirable outcomes.

McKinsey & Company

https://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters#

Diverse Teams are More Creative & Productive

- Those in the top quartile for gender diversity were 15% more likely to outperform the median financial returns for their industry than the bottom quartile.
- The effect was even greater when categorizing companies based on ethnic diversity (35%).
- The conclusions are robust: study has been replicated by McKinsey, and studies by other groups using metrics like R&D productivity and number of patents have similar conclusions. The data are clear: **Diverse teams perform better**.



https://www.mckinsey.com/featured-insights/diversity-and-inclusion/diversity-wins-how-inclusion-matters
https://www.weforum.org/agenda/2019/04/business-case-for-diversity-in-the-workplace/

Why do Diverse Teams Perform Better?

- No definitive answers yet, but two interesting hypotheses.

1) People who have different experiences have different resources to draw upon.

- The broader the set of experiences of people working on a problem, the more resources they have with which to work.
- Your experiences, especially while young, alter the structure and activity of the brain.
- If a person spends their formative years making sense of auditory and tactile data that other people never interact with at all, it can radically alter the structure and activity of the brain – example, early music training

http://musicianbrain.gottfriedschlaug.org/papers/Schlaug_Music_Child_Brain_NYAS2005.pdf
https://www.jneurosci.org/content/23/27/9240
https://academic.oup.com/cercor/article/13/9/943/342632
https://science.sciencemag.org/content/267/5198/699

Why do Diverse Teams Perform Better?

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1) People who have different experiences have different resources to draw upon.

- Music is not unique; the same is likely true of every set of formative experiences that a person has.
- People who speak different languages have different brain structures and different psychological reactions to situations, and psychologists can controllably switch bilingual people from one reaction to another by making them simultaneously process in a particular language.

Thus, individuals with different backgrounds and different life experiences have different thought habits. Systematic, institutional biases that deplete the pipeline of people with shared, minoritized experiences are therefore depriving us of teammates with cognitive habits and intellectual resources that are different from the majority.

https://www.sciencedirect.com/science/article/abs/pii/S0093934X13001120
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0094842
https://www.sciencemag.org/news/2015/03/speaking-second-language-may-change-how-you-see-world

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No definitive answers yet, but two interesting hypotheses.

2) The nature of work in homogeneous vs heterogeneous groups differs.

- Members of visibly homogeneous groups generally tend to interact with one another under the assumption that they basically share the same perspectives, that they can quickly come to consensus, and that they do not need to explain basic, core facts to one another.
- Homogenous groups make assumptions, work quickly, and prioritize agreement over exploration.
- Introduction of visibly heterogeneous members causes groups to slow down, share more information, explore more options, and make fewer factual errors.

In other words, it's not just that diverse groups perform better, homogeneous groups perform worse.

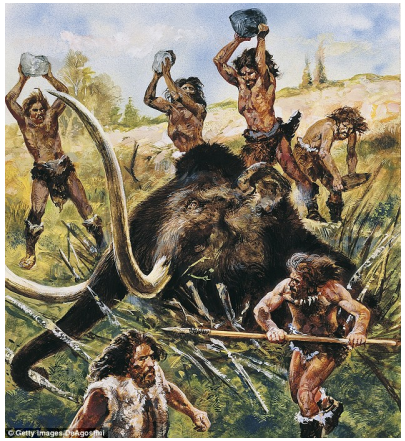
https://www.scientificamerican.com/article/how-diversity-makes-us-smarter/

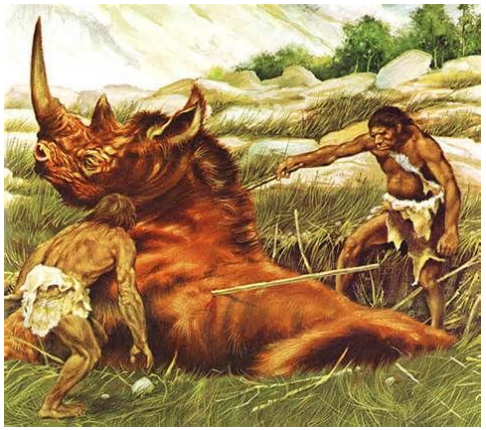
Observation from the above, in the context of STEM and R&D:

Diversity should be an objective of the scientific community because our homogeneity hampers innovation.

Cognitive Habits and Implicit Association

- Cognitive habits exist evolved over thousands of years to keep you alive, run you away from predators, feed you energy-rich foods and not poison.
- This evolutionary accident also brings automatic habits of which you may be unaware.





- Our brains evolved to collect a massive quantity of data – tactile, auditory, visual, olfactory – and to rapidly extract meaningful conclusions from it.
- To make fast fight-or-flight decisions that kept you alive when confronted with a predator in early human history, your brain evolved to take shortcuts.

Cognitive Habits and Implicit Association

- Your brain still uses shortcuts all the time in daily life
- A quick glance at the woman on right and you immediately know she is angry. No deductive reasoning needed.
- Understanding of her state is immediate – your brain makes such quick judgements thousands of times per day
- An evolutionary trait, a necessary shortcut that has led to our survival and development.
- These shortcuts are probably unavoidable.

Cognitive Habits and Implicit Association

- These cognitive traits also lead to mistakes interpreting data about other human beings
- As social organisms, we evolved to interact with other humans, recognize each other, use relatively subtle visual cues to intuit the mental and emotional states of our peers, and so on.
- Your brain is especially well-adapted to make shortcut assumptions about other human beings.

- The heavier the cognitive load on your brain, the more your stressed brain relies on shortcuts to compensate.
- Example: in the time you've used in reading this paragraph, looking at the picture to the left, you've put in enough cognitive effort to recognize it as an image of President Obama upside down, and still not realize that the picture is wildly inaccurate until you turn it over.

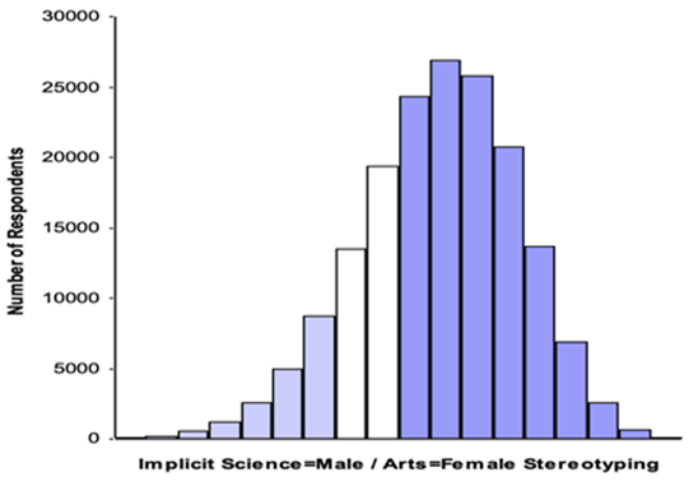
Cognitive Habits and Implicit Association

- This is an optical illusion known as the “Thatcher effect”, so called because the most high-profile historical example of this effect used an image of Prime Minister Margaret Thatcher.
- This is the essence of what psychologists mean by “implicit bias” or “implicit association.”
- In most situations, and especially when you put cognitive stress on your brain, you tend to rely upon cognitive shortcuts that make assumptions about people based on a limited set of superficial data. People with specific characteristics trigger implicit assumptions as a consequence of how human cognition works.

Cognitive Habits and Implicit Association

- A tool to measure the strength of these implicit assumptions is the Implicit Association Test (IAT).
- An IAT is an empirical measure of how strongly two categories are associated with one another in your head.
- Data associating binary gender (female or male) with science (science or liberal arts), (high quality data N=30000) shown here.

https://pi-liz.shinyapps.io/explore-iat/



- The IAT concludes that 70% of respondents have a statistically significant, measurable bias associating men with science and women with the liberal arts.
- This happens even though most people who know that they are taking the IAT are taking a test designed to measure their bias.
- If you separate the respondents into female-identified and male-identified groups, there is no difference in the statistical distribution.

Cognitive Habits and Implicit Association

- Unconscious biases are ubiquitous, and they are common even among populations who are disadvantaged by those biases.
- This is because our cognitive processes have been trained over decades to respond to data from a culture that is itself biased.
- When Americans grow up, most images of scientists one sees are of the scientist stereotype -- white lab coat askew, crazy mop of white hair, and not insignificantly, white and male.
- Most Americans associate “scientist” with “male” because that association has been reinforced again and again by a society that has deeply entrenched cultural biases, and even though women are disadvantaged by the existence of those biases, they still tend to rely on them because they were raised in the same male-oriented society as men.
- As evidence to support this point, the IAT data above can be divided into cohorts by nationality, and although there is always a persistent skew correlating male with science, the magnitude of skew is different among nationalities, because the cultural cues are a bit different.

https://www.pnas.org/content/106/26/10593

Cognitive Habits and Implicit Association

- Moreover, the same analyses have been run for race and science, sexual orientation and science, race and crime, and so on, and the conclusions are alarmingly similar:

  (1) Significant implicit biases are common, and probably unavoidable;

  (2) Victims of those biases are just as likely to hold those biases as those who are not;

  (3) These biases are consistent with the underrepresentation of certain subpopulations in the scientific professions.

- In other words:

  (1) You're probably a bit racist

  (2) Even if you're not white

  (3) We are ALL part of the problem.

What Actions can Promote Diversity?

- If implicit biases are common and likely unavoidable, the proximal goal cannot be to eliminate bias but to acknowledge their pervasiveness, mitigate their effects, and cultivate just outcomes.
- The effectiveness of diversity-supporting programs to combat biased hiring and promotion practices is also a topic of significant study in modern economics and sociology.
- Data from a survey of 829 medium-to-large US companies monitored over 10 years.
- Economists able to statistically correlate the average effect of each individual intervention on the diversity of a company's middle and upper management over the 10 year period.

Poor Returns on the Usual Diversity Programs

The three most popular interventions make firms less diverse, not more, because managers resist strong-arming. For instance, testing job applicants hurts women and minorities—but not because they perform poorly. Hiring managers don't always test everyone (white men often get a pass) and don't interpret results consistently.

% CHANGE OVER FIVE YEARS IN REPRESENTATION AMONG MANAGERS

Type of program	White		Black		Hispanic		Asian	
	Men	Women	Men	Women	Men	Women	Men	Women
Mandatory diversity training				-9.2			-4.5	-5.4
Job tests		-3.8	-10.2	-9.1	-6.7	-8.8		-9.3
Grievance systems		-2.7	-7.3	-4.8		-4.7	-11.3	-4.1

NOTE GRAY INDICATES NO STATISTICAL CERTAINTY OF A PROGRAM'S EFFECT.
SOURCE AUTHORS' STUDY OF 829 MIDSIZE AND LARGE U.S. FIRMS. THE ANALYSIS ISOLATED THE EFFECTS OF DIVERSITY PROGRAMS FROM EVERYTHING ELSE GOING ON IN THE COMPANIES AND IN THE ECONOMY.
FROM "WHY DIVERSITY PROGRAMS FAIL," BY FRANK DOBBIN AND ALEXANDRA KALEV, JULY-AUGUST 2016

What Actions can Promote Diversity?

- Data show that mandatory diversity training just doesn't work.

- In fact, they are worse than ineffectual, they lead to a decrease in the diversity of management.
- This is a big problem, as mandatory diversity trainings are the most common intervention across the companies surveyed.
- Mandatory diversity training appears to make majority employees feel defensive and embittered towards their minority peers, which leads to increased harassment.
- Worst of all interventions studied are grievance systems, which end up being disproportionately used by majority employees to harass minority coworkers they don’t like.

https://hbr.org/2016/07/why-diversity-programs-fail

What Actions can Promote Diversity?

What works? Several strategies work well.

- If diversity training is voluntary instead of mandatory, the effect is strongly positive.
- Active recruiting works.
- The creation of centralized diversity task forces and hiring of diversity managers works extremely well.

Diversity Programs That Get Results

Companies do a better job of increasing diversity when they forgo the control tactics and frame their efforts more positively. The most effective programs spark engagement, increase contact among different groups, or draw on people's strong desire to look good to others.

% CHANGE OVER FIVE YEARS IN REPRESENTATION AMONG MANAGERS

Type of program	White		Black		Hispanic		Asian	
	Men	Women	Men	Women	Men	Women	Men	Women
Voluntary training			+13.3		+9.1		+9.3	+12.6
Self-managed teams	-2.8	+5.6	+3.4	+3.9				+3.6
Cross-training	-1.4	+3.0	+2.7	+3.0	-3.9		+6.5	+4.1
College recruitment: women*	-2.0	+10.2	+7.9	+8.7		+10.0	+18.3	+8.6
College recruitment: minorities**			+7.7	+8.9				
Mentoring				+18.0	+9.1	+23.7	+18.0	+24.0
Diversity task forces	-3.3	+11.6	+8.7	+22.7	+12.0	+16.2	+30.2	+24.2
Diversity managers		+7.5	+17.0	+11.1		+18.2	+10.9	+13.6

*College recruitment targeting women turns recruiting managers into diversity champions, so it also helps boost the numbers for black and Asian-American men.

**College recruitment targeting minorities often focuses on historically black schools, which lifts the numbers of African-American men and women.

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What Actions can Promote Diversity?

Common characteristics of effective diversity interventions:

(1) They are intentional. You can't force people to care about diversity, you have to let them come to the realization that it's important to them.

(2) They are institutional. Diversity interventions work only when they are designed to alter the way the entire organization functions, with tangible buy-in from all levels of the organization from leadership down.

(3) They are integrated. If diversity is a core value of an organization, it can't be considered as a topic that is segregated from the "real" work of the organization, it has to be an aspect of everything they do.

Resources collated by Prof. Tehshik Yoon, University of Wisconsin
https://yoon.chem.wisc.edu/tehshik/

Resources assembled as a presentation by Prof. Christopher W. Jones, Georgia Tech, https://www.chbe.gatech.edu/people/christopher-w-jones