Meritocracy in Science – A Necessary Myth

Sebastian Kozuch

Ben-Gurion University of the Negev

Abstract: The methodology of meritocracy in STEM has been severely criticized as of lately in terms of the diversity, equity, and inclusion debate. However, there are more aspects where meritocracy fails, namely the effect of luck events and the exponential Matthew effect. Herein we discussed this matter and how it affects science and scientists. Nevertheless, we also explain that even with its faults, meritocracy is the best available doctrine, and neglecting it in research and education is self-defeating. We describe some possible measures to limit these flaws, but still keeping its edge for science.

1. Introduction

Recently an article[1] raised a heated controversy[2–4] in the notoriously active diversity war in science. Its title was "In Defense of Merit in Science", and included a long list of distinguished authors led by Krylov. As such, it can be considered as the frontline in the fight in favor of meritocracy in STEM, a concept that was traditionally undisputed[*] until the recent evolution of the postmodernist movements commonly grouped under the "Diversity, Equity and Inclusion" (DEI), umbrella term. The topic is old, but the latest publication of many treatises dealing with meritocracy is a sign of the times (most of these books present an unambiguously negative viewpoint,[5,7–13] but some are supportive of meritocracy[6]).

All these passionate opinions lead us to think that the debate about meritocracy is still incomplete, and maybe some new perspectives must be taken into account (preferably research-based perspectives). Contrary to most works on this field, in the present paper we will *not* deal with DEI and identity-based issues, on education disparities, on the global south/north division, on having English as a mother tongue,[14] or on the social impact of meritocracy (although the conclusions we will reach here might be extrapolated to these fields). Our focus will be on the more general points of how accurate and useful merit judgements are from the standpoint of both science and the individual. In particular, we will

[*] Meritocracy was mostly undisputed in its theoretical sense from the second half of the 20th century,[5,6] since it was a much better approach than alternative methods including corruption, nepotism and discrimination (such as legacy admissions). The discussion of how much these nefarious methods are still in practice today is not the objective of this article.

discuss whether the selection of researchers for a position, grant, or award based on their scientific CV and profile is just and justified, or if it is a defective proxy of the real qualities of the candidate.

To have a common ground, we should start by defining the term meritocracy. According to Wiktionary, it is:[15] "*1) Rule by merit and talent, 2) A type of society where wealth, income, and social status are assigned through competition*". For Wikipedia,[16] it is "*the notion of a political system in which economic goods or political power are vested in individual people based on ability and talent, rather than wealth or social class*". In other words, meritocracy involves career advancement and power keeping exclusively due to the real abilities and better aptitudes of individuals compared to others, and strictly excluding any privileges. The meritocracy subjective scale will therefore depend on the field, with the requirements of a meritorious chemist completely at odds with the ones of, say, a football player.[*] But in general terms concepts like hard-working, wisdom, knowledge, intelligence, fast learning, disruptiveness, grit, motivation, thick-skin, physical agility and strength, dexterity, rhetoric capacity, sociability, inventiveness, imaginativeness, discipline, etc., are commonly use as characteristics of the best candidates, again depending on the field. However, at the judgement time for a job position or an award, meritocracy fundamentally means who has the most impressive curriculum vitae (and maybe also recommendation letters), without any direct judging of those talents.

Not so far ago, the opposite to meritocracy was cronyism and all its acquaintances: nepotism, favoritism, discrimination, prejudice, bias, impartiality, clientelism, and corruption. As such, meritocracy was praised, being a democratic trait. In many cases this was just lip service, but even in corrupted places meritocracy was the acceptable lie. However, not long ago meritocracy began to have negative connotations,[5,7–13] as it forces further inequalities (especially against the underprivileged minorities that it supposedly tries to help). Curiously, the term as originally coined in the book "The Rise of the Meritocracy"[17,18] also had negative connotations since, according to the author,[13,19] it can create a divided and equality-devoid society dominated by a ruling, meritorious elite[5,7,8] (which, arguably and to a certain extent, happened[18]). Or as Sandel argues in the book "The tyranny of merit":[5]

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[*] Here and in the rest of the article, by "football" we mean the real association football, aka "soccer" in the US.

> "Suppose we could fulfill the promise of giving every child an equal chance to compete for success in school, in the workplace, and in life. Would this make for a just society?... If we are free to rise based on our own choices and talents, it seems fair to say that those who succeed deserve their success… Despite its powerful appeal, however, there is reason to doubt that even a perfectly realized meritocracy would be a just society. To begin, it is important to notice that the meritocratic ideal is about mobility, not equality… What matters for a meritocracy is that everyone has an equal chance to climb the ladder of success; it has nothing to say about how far apart the rungs on the ladder should be. The meritocratic ideal is not a remedy for inequality; it is a justification of inequality."

While this is a compelling argument to which we broadly subscribe, beyond the many practical and theoretical difficulties it entails (many of which Sandel already elucidates in his book[5]), it does not look at the problem through the perspective of the advancement of science in particular, and society in general. Indeed, not many will accept hiring a non-meritorious science professor without exceptional credentials.

If meritocracy is the positive force we learned to love in science, and if we want the best people for our university, is there a problem with meritocracy in STEM? Our stance is that meritocracy is a myth, but it is a necessary myth.

2. Meritocracy is a Myth

When asked what are the key qualities of a successful scientist, the top ten choices of a small panel of scientists were:[20] passionate, resilient, detail-oriented but visionary, creative thinker, determined, knowledgeable, team player, self-motivated, effective communicator, and capable of thinking outside the box.

Most of us will agree with this list. However, this list appeared in an article called "Successful Scientist: What's the Winning Formula?" The reality is that, while all these qualities are tremendously important, they are not mandatory, and they lack a huge (and probably the main) factor in the equation.

Luck is the only necessary (but not sufficient) factor in academic success. It can be raw, brutal, bizarre, arbitrary, and chaotic, but it is omnipresent. It is pervasive in every domain, and science surely is not immune to it. Many other factors are important, but we all know a star professor that happens to be lazy, or maybe not as bright as they seem, or perhaps they lack creativeness.

If we enter into the social and psychological traits that are currently considered to be absolutely necessary requirements for success in science (such as networking capabilities, small talk skills in conferences, rhetoric, mentoring, etc.), we will see that they are desirable but absolutely not mandatory requirements. Indeed, we all know "that very successful professor in the department" who shows some traits of neuroticism, psychopathy, obsessive-compulsiveness, autism, bipolarity, narcissism, paranoia, schizoid, antisocial, histrionic, or any other personality disorder that can affect their social interactions. Fortunately, neurodiversity and other disabilities are currently more understood and accepted, or at least tolerated, in the scientific environment.[21–23] Moreover, slight divergence from the norm might actually be positive for creativity, productivity, and other scientifically desirable traits.[24–26]

This makes us think that those "key qualities of a successful scientist" are just good traits in general terms, but they can easily be compensated by other traits. In reality, some of these "essential" factors are at odds within each other, suck like perfectionism vs. efficiency, or disruptiveness vs. consistency. The only component that is absolutely and consistently essential is luck.

At least, science has a sense of metacognition.[27,28] As such, science can study how luck affects science. And it appears to be a profound effect.[29–31] From starters, and as widely known, we can ponder into how our fate is shaped by genetics, epigenetics, accidents, upbringing, place and time of birth, or any other form of privilege or disadvantage. But as said above, this article is not the place to talk about these effects. Still, even without these factors, there are many other flavors of luck.

For the sake of the argument, we would like to present a brief classification of luck categories by illustrating hypothetical (but realistic) examples of facts affecting scientists' lives. We recognize that they are familiar cases roughly known by every researcher, but by explicitly detailing them, they will aid in getting an overall perspective on luck influencing factors. And acknowledging them may help us avoid taking them for granted.

- *"Oil and climate crisis prompts more research in energy sources and catalysis*."
  This is a completely **external**, **temporal**, and **macro** luck effect that strongly favors specific fields through grant allocations. Of course this also implies that other fields will be disfavored due to the restructuring of national and international priorities. Some researchers can tweak their expertise to fit to the new global requirements, but those who were already working on these topics will hit the jackpot in the next

grant season. In these cases, "macro effect" means a large-scale effect that is not directly connected to a person; "external" that it is beyond their influence; and "temporal" that it can occur only at specific, almost random timing.

- *"A young student receives one of the many new possible projects that their supervisor hoards in a drawer. The project is, surprisingly, easy, reproducible, and it results in an unexpected breakthrough."*
  This is an **external** luck effect for the student, but it might be **internal** for the PI. It is a purely **micro** effect, subscribed to the here and now of the laboratory. And it can have profound consequences for the student.[32,33] If the project indeed results revolutionary, they might have the fortune of publishing it in Nature/Science/Cell journal, which will let them win an award and a very lucrative fellowship to carry out a following postdoc in any laboratory in the world of their choosing. All this based on this particularly successful article, and basically nothing more. For this, the student only needed to be sufficiently talented (and avoid screwing up the demarcated path with bad decisions).[34]
- *"A proposal for a lucrative research grant was denied. While three reviewers were very positive, one reviewer wrote an astonishingly negative piece."*
  Every researcher can relate to this. It is baffling to understand how reviews can be diametrically contradictory, even in "exact" sciences. What are the chances that a proposal falls into the hands of one of these "reviewer two"[35,36] instead of more positive referees? Since a big grant might change the nature of any laboratory, and everyone buys tickets for this lottery, this is an accepted reality in STEM. We try to minimize these setbacks by writing more grants and trying to make as many friends as possible, but the bingo grant system is a patent issue. As such, even if winning or losing grants has a strong **internal** effect, we will classify it as an **external**, **micro** luck factor.
- *"An economic bubble exploded in some world region, generating a crisis in the industry, triggering an exodus of young workers to look for alternative jobs as postdocs, who later flood the market for new PIs at the time we are looking for a tenured-track position."*
  This is an example of a **locational**, **temporal**, **external**, **macro** ripple effect which can very negatively affect young researchers, and it is completely beyond their hands. Although there is sometimes a struggle to find good postdocs,[37] the general trend shows that their numbers grow year by year in the short[38,39] or long[40–45] term. This is

positive for established PIs, who suddenly (and cheaply) can obtain more qualified workers in their groups. One can even argue that it might be good for science, with a larger pool of candidates to choose from. But if we speak of the *scientific community*, the prospects for young researchers are bleak.[46]

- *"A young researcher was tangentially interested in a new, virtually unknown fringe field of dubious importance. After the researcher publishes a couple of articles in a decent journal, people realize that this fringe field might hold the key to solve some critical world problem."*

  In this scenario, the young researcher suddenly and unexpectedly is one of the selected "specialists" at the front of the forming wave of this potentially revolutionary discipline (such as recently was AI, or previously nano).[47] This is a **temporal** and **macro** effect. Some would argue that this might not be such a stroke of luck if the researcher was a visionary that understood the potential of the discipline. We beg to differ; there are many bright young scientists, and if they could predict what will be the next big thing, all of them would go for it. As we know, it is difficult to make predictions, especially about the future,[48,49] and therefore we include this effect as an **external** one. Noteworthy, timing can be everything:[50] if you enter into a new, undiscovered research field right before it is hot, it can result in fame and fortune; entering later, and you will be just another hard-working researcher; but move into the field too early, much before the revolution, and it can make you a martyr, hopefully remembered as a pioneer but never reaching success in life (a kind of Van Gogh effect).

From all these cases we can conclude that meritocracy is a myth. Luck is such a powerful force that it can make or unmake the career of the most talented researchers. And there are many more prototypical situations than depend on how fortunate we are.

A hugely influential situation can be summarized by Sturgeon's law:[51] "ninety percent of everything is crap".[*] We know that most of the published research basically is inconsequential. We can argue that the useful projects are rooted in all that "useless" science, but still, most papers can be deleted from the record and nobody will realize they are missing. Which begs the question of why would we publish them in the first place. The answer is that we just do

[*] This eponymous law was a defense of science fiction literature attributed to Theodore Sturgeon, a celebrated author of this genre. Against the constant attack saying that 90% of sci-fi is crap, he argued that 90% of *everything* is crap, and therefore those attacks were unwarranted.

not know which paper will make the 10% cut of relevant articles. Wise scientists will try to direct their research in that direction, and hard-working scientists can linearly improve the probabilities of success by publishing more (or, as Pauling said, "If you want to have good ideas you must have many ideas. Most of them will be wrong, and what you have to learn is which ones to throw away"). Nevertheless, reality indicates that encountering a valuable project is still a matter of luck (or we would not be publishing so much crap).

If we add here the self-service bias ("you are personally responsible for your successes, but your failures are due to external factors"), confirmation bias ("you favor things that confirm your existing beliefs"), framing effect ("you allow yourself to be unduly influenced by context"),[52] and of course serendipity, the whole concept of talent is eroded.

In summary, as Kahneman's philosophical razor[53] says: "Success = talent + luck. Great success = a little more talent + a lot of luck".[54] In such perspective, science looks more like a game of snake and ladders than to chess.

And we still did not tackle the elephant in the room. While talent can be thought of being linear, luck is exponential (for those prepared to grab the opportunities). The scientist that published one thousand papers is not an order of magnitude better than the one that published a hundred, but for the former circumstances created an acceleration of their productivity. This was already depicted above with the case of the hypothetical student that published a Nature paper, where this first luck event opened opportunities that consecutively opened more and more opportunities. Due in part to psychological reasons, but mostly due to the way that the meritocracy scale works, one luck event such as a paper published in a high impact factor journal may lead to a snowball effect of prizes, fellowships, lucrative positions, better students, more papers… The earlier and more auspicious the events, the higher we can climb in the exponential success scale. This is something that consciously or unconsciously we all know, and we knew it for a very long time. Again, a minimum of talent is necessary to make this happen, but as we will see below, success and talent are not really correlated.

The effect is commonly called the Matthew effect (**ME**),[55] based on the biblical verse: "For whoever has will be given more, and they will have an abundance. Whoever does not have, even what they have will be taken from them." (Matthew 25:29, NIV).

ME in science can come in many flavors: scientific progress,[55,56] career,[55,57,58] funding,[59–61] citations,[56,62–64] rankings,[65] networking,[56] awards, etc. Some people produced some psychological elucidation for the effect.[13,66] But beyond these explanations, observational studies and mathematical modelling[31,57] have led to the unequivocal conclusion that ME in STEM exists, and it is vast.

ME is ubiquitous. In all cases it is virtually impossible to know who will obtain fame and fortune just by testing how talented they are. But once famous, their appeal, popular demand and overall success tends to grow like an autocatalytic process.[64] And this exponential behavior usually has non-linear chaotic origins, with small unexpected events having the potential to change the fate of a person, similar to the butterfly effect. For example, having a stomachache or a flat tire when going to present a candidate talk for a professorship position has severe consequences due to the "winner take it all" nature of the situation.

The ME concept was born to describe scientific careers,[55] but it exists everywhere, and recognizing it can help us understand ourselves. Think of the music industry and visual arts,[67] sports,[50,68] fashion modelling,[*] and of course business and wealth inequality, where most famous people were originally talented, but clearly not more talented than many others.

Note that sometimes success can even be exploited by roaming from field to field, such as the cases of famous athletes or businesspersons that turn to writers of bestsellers (usually non-fiction self-improvement books, with a terrible disregard to the survivorship bias). Expanding the portfolio is much easier when you already have a popular brand name. And then we have the "famous for being famous"[69] celebrities.[†] In STEM this includes Nobel laureates that wrote memoires,[70] advices,[71] or philosophical books.[72] The biggest reward of getting a Nobel is that you get the chance to speak about whatever you want.[73] Fame is fame.

Maybe the question is not why there is ME in science, but why would there not be ME in science. As scientists, we are expected to be more logical and rational, but like Mr. Spock, we have an internal conflict between our Vulcan and Human nature.

One of our favorite papers ("Talent versus luck: The role of randomness in success and failure"),[31] which received the well-deserved IgNobel prize in 2022,[74] took an interesting approach on this matter. In this article, the authors prepared a statistical computational analysis of career evolution, which was strongly in agreement with Kahneman's razor and the ME. In their own words:

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[*] We briefly investigated what are the qualities that make a fashion model to be a supermodel, and what distinguishes them from standard models. We could not find any information of the difference in terms of talent or physical appearance, just that they somehow achieved prominence, and exponentially brought more profits for them and the corporations behind.

[†] There are probably several of these "famous for being famous" characters in science as well who enhance their image with, for instance, social media engineering. We will not give names here.

*"The success of the averagely talented people strongly challenges the "meritocratic" paradigm and all those strategies and mechanisms, which give more rewards, opportunities, honors, fame and resources to people considered the best in their field. The point is that, in the vast majority of cases, all evaluations of someone's talent are carried out a posteriori, just by looking at his/her performances -or at reached results- in some specific area of our society like sport, business, finance, art, science, etc. This kind of misleading evaluation ends up switching cause and effect, rating as the most talented people those who are, simply, the luckiest ones… Since rewards and resources are usually given to those that have already reached a high level of success, mistakenly considered as a measure of competence/talent, this result is even a more harmful disincentive, causing a lack of opportunities for the most talented ones. Our results highlight the risks of the paradigm that we call "**naive meritocracy**", which fails to give honors and rewards to the most competent people…"*

In other words: meritocracy is a myth.

Nevertheless, all this does not mean that we should neglect meritocracy.

3. Meritocracy is Necessary

Paraphrasing Churchill, we can say that meritocracy is the worst option, except for all those other options that have been tried. Moreover, science is completely dependent on it. The main reason is that you cannot select the most promising candidate without hard proof of their potential, which is obtained by checking their past achievements. This is such an obvious motive that this section will be much shorter than the previous one. However, there is a second reason: even if the meritocracy system is broken, universities have limited resources to fix it.

When hiring a researcher, a department cannot judge someone for what the candidate would have been if the circumstances had been more favorable. There is no crystal ball that tells us if a candidate would be outstanding despite having an unexceptional CV. If the candidate was unlucky with their projects, or if they had the misfortune of being born in an underprivileged world region, the "chalk talk" in front of a search committee is too late to fix it. Universities can only judge by proven merit, since misfortune is unmeasurable and silent. Every person that received a tenure-track position were at least minimally talented, but they were lucky as well, that is a fact. In that sense, meritocracy is a myth and it has a hard to correct seed of unfairness; but it is also a necessity, and science cannot work without it.[1]

As an analogy to this paradox, let us consider a hypothetical football team from the STEM league, the "Chemistry United". They are in dire need of a new player to win the STEM world cup. There is one candidate, let us call him "John Unlucky", who would have been a fantastic player, given the opportunity; but he was born in the US, a country that frowns at men's football. Shall Chemistry United take the risk of hiring John, someone who did not score many goals in his short career, with the hope that he suddenly expresses all his hidden possibilities? Maybe under better circumstances he would have obtained the Ballon d'Or. But, sadly for John, Chemistry United decided to hire "Juan de la Suerte", a player from Argentina, a country where people breathe football (and won the last World Cup), a place where Juan had the chance to play every day of his life and show his talent as a scorer. Chemistry United is not going to risk the cup to give John Unlucky the chance he deserves. Moreover, if they had hired John instead of Juan, people would automatically think that John is the nephew of the manager.[*]

The moral in the story of John and Juan appear in every field. Meritocracy is omnipresent when hiring anyone, from a judge to a chef, in a company or a foundation, in a private or state institution. We rationally try to select the best option from all the available possibilities, and for that we rely in reviews and established track record. This idea is perfect only in theory; but also in practice, with all its complications and faults, the naïve meritocracy was a complete success of the modern world.[6] It would be unwise and completely detached from society to behave differently in academic institutions, and certainly very dangerous for the advancement of science[1] or for high education purposes.

Until we have a robust AI that can predict successful scientists from the pool of available candidates,[27,28,75–79] meritocracy based on raw data from published papers and other achievements is the best way we have to advance science.

4. Converging Thoughts

In statistical mechanics there is the concept of Boltzmann distribution, which describes the occupation of states according to their energy and the temperature. In simple terms, if a system (like a molecule) can occupy different states, each one with a different energy (such as

[*] By the way, Chemistry United won the final match against the Mechanical Engineers Panthers, obtaining the STEM cup. Go Chem!

the molecular vibrational levels), what is the probability that a molecule will be in a specific state? Boltzmann's solution was:

$$P_i \propto e^{-E_i/kT}$$

where P_i is the probability of finding the molecule on level i, E_i is the energy of that level, T is the temperature, and k is a constant (called Boltzmann constant). In Fig. 1A we show different Boltzmann profiles at specific temperatures, where it can be seen the exponential decay of the functions (fast decay at low temperature, slow decay at high temperature, and a theoretically flat potential at infinite temperatures).

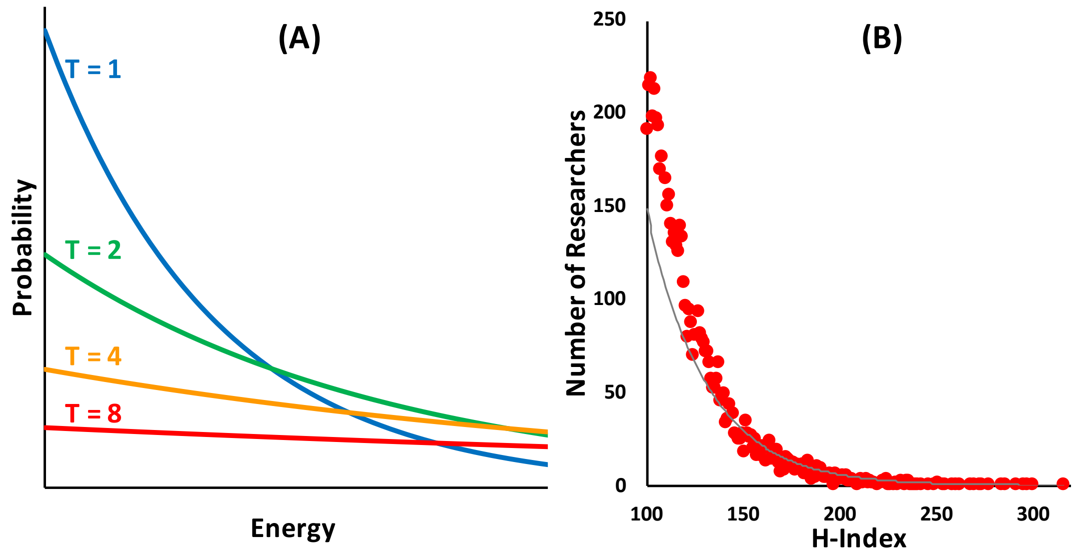

Figure 1. A) Example of Boltzmann distribution with arbitrary units. Each line corresponds to a different temperature, with lower temperatures making a sharper, more "unequal" profile, and at high temperatures having all the states populated with equal probability. B) Distribution of researchers with H-Index > 100.[80] The grey line is the fitted exponential function (R^2 = 0.98).

In Fig. 1B we present the number of researchers with specific H-Index (a classic but highly debated measure of scientific achievements[81,82]); only researchers with h > 100 are shown[80] (that is, highly successful scientists), but we expect the trend to continue in a similar way for lower values. As typical for this kind of distributions (from wealth inequality to wine prices), it is close to an exponential function. This lead us to think that scientific success and/or inequality can be described as a Boltzmann distribution by a single parameter: temperature. In a "cryogenic" system, only a minority of researchers will accumulate most of the resources (large laboratories with all the excellent students, most lucrative grants, leading to the highest H-index), while the majority will have to do with the scraps; this is the “winner takes it all” structure. Alternatively, in a “scorching” system every researcher will have access to the same amount of grant money, and the laboratories will be evenly distributed in terms of personnel, lab space, and access to equipment. We can say that they are STEM forms of extreme capitalism and socialism.

In this perspective (similar to the Gini index in economy[83]), if we can fit this complex problem in only one dimension, and under a fixed amount of resources, the naïve meritocracy means a cold distribution, while the anti-meritocratic progressives would push for an infinitely hot distribution. Proponents of a cold system are wrong, since, as shown above, meritocracy is a myth. Advocates of a hot system are also wrong, since as shown above meritocracy is a necessity. A warm system, with a moderated, restrained meritocracy regime is the most constructive solution.

For instance, while every scientist agrees that the best thing for science is to get as much money as possible, there is an eternal discussion on how to cut the scientific budget cake. Shall we go for the “big science” (big grants for less people), or the “little science”? Granting a disproportionate amount of money to the most successful people in the most prestigious institutes is not an efficient approach, with a redistribution in smaller packages to more researchers producing a larger scientific output.[84–87] Little science appears to produce a bigger bang for the buck.

This is similar to the Ortega hypothesis,[88] which proposes that the greatest contribution to science comes from a multitude of “mediocre” scientists. This was highly debated,[89–93] and contrasted to the contending position, the Newton hypothesis (the greatest contribution to science comes from a small number of highly productive or revolutionary scientists). Without hard proof, it is our belief that science needs both types of scientists in a well-equilibrated system, but a bit of academic “socialism” can be very productive for the whole scientific endeavor.

If we add the absurd amount of wasted time and tears shed in the grant proposal funding system[94–98] with its almost random review evaluations[99] and the possible bias involved in the process,[84] then perhaps the whole science budget allocation should be rethought. If we already rely on a very cumbersome procedure of grant writing and reviewing that has a large random human component, we can also try a much less taxing random lottery system.[5,100–103]

It might or might not be better, but it will be more honest and much cheaper for the scientific body as a whole. But for sure the meritocracy scale is failing in this front.

Most of the world still thinks that if you work hard you will largely succeed. This is very region dependent, with 77% of the US believing in this, while in Japan it is only 40%.[104] Note that the question was not if hard work is a *necessary* factor, but if it is a *sufficient* factor. This is naïve meritocracy at its best, the belief that success is in your own hands. Of course the dark side of such mentality is that failure implies laziness. How much of this thinking pattern exists in STEM is debatable, but some countries and institutions work under the naïve meritocracy assumption more than others. For example, some institutes maintain a very cold atmosphere, providing little more than the institutional prestige to their researchers, who have to earn everything else, including their salaries through personal grants. Other places, while still dependent on external grants, provide a physical laboratory, an internal start-up budget, fellowships for students, technical and human resources, and a dignified salary to the PI. This provides a hotter distribution that aids talented but unlucky researchers.

An interesting approach is experimented at Ghent University, where a small research stipend is annually provided to any staff member that complies with very basic requirements.[105] This might award the necessary resources for researchers with an unfortunate streak of bad luck to stand again in their two feet and start generating science again. If indeed luck is such a double-edged sword, then statistically speaking some good researchers must unfairly fall into the abyss of failure. It is only fair to provide them with a safety net of resources. We can even suggest internal progressive consumption taxes:[13] larger grant overhead percentages when securing more grants, lower fellowships for the students in larger laboratories, etc. If the ME grows exponentially, we should divide it by an arbitrary exponential factor to keep it in check.

In any case, the meritocratic rhetoric should be toned down. Failures and successes should be taken in proportion, not revered or demonized. We should never fall into ranking talent purely according to accomplishments, at least not as a linear univariable relationship. Judging exclusively by success is a completely naïve meritocracy policy (if not a malevolent meritocracy attitude[*]) that shows the "class cluelessness"[106] that plagues the research atmosphere.

Those researchers that succeeded must show humility and acknowledge their multidimensional luck. The idea of meritocracy is to select the most talented individuals, not

[*] Let us stick to Hanlon's razor before judging ("Never attribute to malice that which is adequately explained by stupidity").

to believe that the already selected individuals are the most talented. Older PIs who believe in hard work as a religion must face the fact that the number of postdocs is continuously growing while the number of tenured faculty positions is not, making it harder and harder to secure a new PI position. This means that for most current tenured PIs the hard work they invested in the past would probably not be enough in the present.[40–45] In other words, most older researchers would just fail in the world of today, and therefore they should be very careful with their advices to young researchers (and grateful for their temporal luck).

Moreover, if indeed the postdoc to PI ratio substantially grew with the years, it means that, on average, groups are getting larger and with more pyramidal structures, with cheap labor that mostly glorify the head of the pyramid at the cost of the lower workers. With more "supergroups" more big science can be achieved, which is good. But if that comes at the cost of fewer little science, it is bad. We cannot be content with such an outcome with all the skilled and dedicated scientific workforce that falls from the pipeline due to the always narrower tenure-track bottleneck. Such abuse of meritocracy is not good for science, and it is terrifying for talented, struggling young researchers.

In terms of hiring, checking the candidate's background is a two-edged sword. In principle we shouldn't care about the background and history of the person to avoid discrimination. However, if we compare candidates with similar records, one coming from a less tolerant, supporting, or scientifically literate background, and the second with a more fortunate history, then the first will most probably be the more meritorious. A person that achieves the same feats with many more hurdles will likely be more resilient and prolific in the future. This is good for diversity and for science as a whole.

Similarly, and contrary to what is commonly rationalized, it is worse to select the candidate that published two Nature papers while working on a top tier university under a Nobel laureate supervisor than to hire a candidate that did the same with a Jane Doe supervisor at the South-West Technical University of Absurdistan. University ranking[107] or advisor productivity[108] as a single predictor of candidates' future does work (not surprising, since they tend to be more selective from the start). But it seems that the best students from lower-ranked schools tend to be more productive in the long term than good students from top-ranked departments.[109] It is our belief that beyond these tested effects, and *ceteris paribus*, it is better to hire someone coming from less reputable institutions and less known advisors. While it sounds paradoxical, the fact that a student manages to publish more and higher without the resources of a prestigious institution and without the bias that big name researchers enjoy in the peer-review system[110–113] lead us to think that greater merit may come with lesser credentials. We leave it to the reader to extrapolate the weight of such rationale in terms of DEI.

5. Conclusions

A large part of the latest attacks against meritocracy were based on a DEI debate. Herein we discussed the matter from a different perspective, the fact that meritocracy is faulty since it does not take into consideration the colossal luck effect, and especially the exponential Matthew effect. However, we also explained why even if it is faulty, it is the best available way to advance science and scientists. In the end we propose some possible improvements to ameliorate the described flaws in the meritocratic ethos, but still keeping its edge for science. This is the middle way.[114]

Universities' objective is to improve the world through education and research, and in parallel it can behave in an equalitarian way. However, its objective is not to improve the world by making universities more equalitarian. As many people pointed out before, if we want to have a direct impact on society and give more chances to talented people (which at the same time can improve STEM), we need to improve education at all levels by being more involved with schools; and the sooner the better. This is the "teach them to fish" philosophy. The hiring season for PIs or postdocs is not the time. It is too late. Fighting against meritocracy because of world inequality is shooting ourselves in the foot. Still, we must fight against the naïve meritocracy and overcome all its myths. Academia should be a beacon of light in terms of rationality and progressiveness both outward and inward.

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