Diversity of participant representation within the 66th Lindau Nobel Laureate Meeting

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The 66th Lindau Nobel Laureate Meeting (LiNo16) was dedicated to the field of physics. A total of 29 Nobel Laureates, 1 A.M. Turing Award recipient and 400 young scientists attended LiNo16 in Lindau, Germany. Young scientists from 80 countries attended the meeting. Out of the 400 young scientists at the meeting, only 30% were women scientists, and only one of the Nobel Laureate attendees was a woman.

Natural sciences have often been dominated by a single stereotype: white men from predominantly Western or developed countries. Although a lot is being done to increase human capacity in the sciences in the less developed and developing world, it has become apparent that there is a persistent lack of diversity in the sciences.[1,2] Extensive studies have also revealed that the rate of participation of women and minority groups in science, technology, engineering and mathematics (STEM) is significantly lower than the representation of women and minorities in society at large. As a strategy to improve women and minority representation, more countries are encouraging the involvement of these groups in science from a young age – a strategy which is the norm in many developed countries and which has been shown to have a positive correlation with high representativity of women and minority groups.

It is evident that global scientific collaborations encourage unity and inclusion regardless of power, race, beliefs and gender.[3,4] It has become imperative for society to be well capacitated in order to deal with global issues. The exclusion of certain groups based on gender and race, among other factors, means the game is played with less than half of the team. Diversity should be the basis for increased collaboration and not grounds for marginalisation. Nowotny et al.[5] describe diversity as a prominent theme in science and technology to determine technical processes, economic systems and social structures.

Since 1951, 350 Nobel Laureates have committed to the exchange among scientists with the aim of fostering education, inspiration and connection,[6] leveraging on diversity for increased scientific output as a result of collaboration and sharing of best practice experiences. This initiative, which is realised through annual meetings, has fostered and increased exchange amongst young scientists within their respective fields by exposure to a diversity of thinkers and new ideas. The meetings have encouraged global engagement on the unprecedented scale of the global problems we face today. Furthermore, the meetings enable the exploration and encouragement of the scientific diversity that lies in the world and the potential for addressing global issues.

We analysed diversity in terms of representation of gender and countries of origin at the 66th Lindau Nobel Laureate Meeting. Additionally, we ponder here on the lessons that came with the meeting. It is expected that our analysis will help to sensitise, motivate and improve the number of women and underrepresented regions with respect to participation in STEM meetings and forums. A diversity of attendees ensures a balanced benefit from the lessons that are acquired during such meetings. Through diversity, we believe that current scientific global challenges can be re-evaluated and innovations towards solutions developed more objectively, independent of gender, beliefs and race bias.

The Nobel Prize: A background

The Lindau Nobel Laureate Meetings were formed 66 years ago to contribute to reconciliation among the countries that were involved in World War II.[7] The initial aim of the meetings was to foster a peaceful and prosperous future for all, particularly in Europe. Current global challenges are not limited to interstate wars but include issues around transformation, women's empowerment, diversity and new issues around the unprecedented development taking place in science, technology and innovation. The Lindau Nobel Laureate Meetings have always been about science and bringing together Nobel Laureates and young scientists. During these meetings, young scientists are provided with a chance to interact, learn and be inspired to create a better future.

Taken from the archives of the Lindau Nobel Laureate Meetings,[8] 30% of Nobel recipients who attended the Lindau Nobel Laureate Meetings in the past 65 years have been from the discipline of physics (Table 1). This figure represents the largest number of attendees, followed by the discipline of chemistry with 26.6%.[8] Only three Nobel Laureates had connections with Africa, either by birth or relocation. Africans are therefore considered to be a minority when it comes to representation in these prestigious meetings. Given that Africa is expected to account for more than half of the world's population growth between 2015 and 2050,[9] the urgency and importance of incorporating young scientists from minority regions such as Africa is an imperative. One of the five women to have won a Nobel Prize in natural science, Marie Curie, has been honoured twice with a Nobel Prize. Her first Nobel Prize was in Physics in 1903. She shared the prize with Antoine Henri Becquerel and Pierre Curie. It was in recognition of the extraordinary services she rendered by her joint research with Pierre Curie on the radiation phenomenon discovered by Professor Henri Becquerel.[10]

The data presented in Table 1 indicate the total number of Nobel Laureates who participated in past Nobel Laureate meetings. These data include the majority of Nobel Laureates who have participated in the meetings since 1951. The few women and minorities among the Nobel Laureates who were part of the meetings heavily depended on the few women and minorities with Nobel Prizes in science. This raises a concern with regard to the number of female and minority participants in future science meetings. Would an increased number of female and minority participants in future science meetings boost or encourage these groups to be involved in breakthrough science

and hence obtain Nobel Prizes? This question remains to be answered through an experiment waiting to be conducted by the Lindau Nobel Laureate committee.

Table 1: The total number of Nobel Laureates per discipline who attended the Nobel Laureate Meetings in the past 65 years

Discipline	Number of Nobel Laureates	Percentage (%)
Chemistry	123	26.60
Interdisciplinary	1	0.22
Peace	9	1.95
Physiology/Medicine	132	28.57
Economic Sciences	56	12.12
Literature	2	0.43
Physics	139	30.00

Diversity of LiNo16

We analysed data on diversity within the meetings using the total number of participants in the 66th Lindau Nobel Laureate Meeting. The data used were obtained from the meeting handbooks.[7] The LiNo16 handbook contained all the relevant information on the participants. The handbook groups participants according to their country of origin and their affiliated countries. A world map is provided in Figure 1 which indicates the total number of participants (by nationality) at the meeting. The total number of participants was dominated by young men (70%). Africa, as a continent, was only represented by a total number of 25 participants, when compared to 41 and 89 participants from the USA and Germany, respectively. This indicates that women and African participants were under-represented during the 66th Lindau Nobel Laureate Meeting.

The lack of diversity was also observed from the total number of Nobel Laureates who attended the 66th Lindau Nobel Laureate Meeting. In total, 10 countries were represented and the USA had the majority of attendees. The USA is ranked top for all prizes except Literature, where France, Germany and the United Kingdom perform better.[11] Israel was the only country with a female Nobel Laureate who was present at the meeting. However, as she is the only woman alive to have won a Nobel

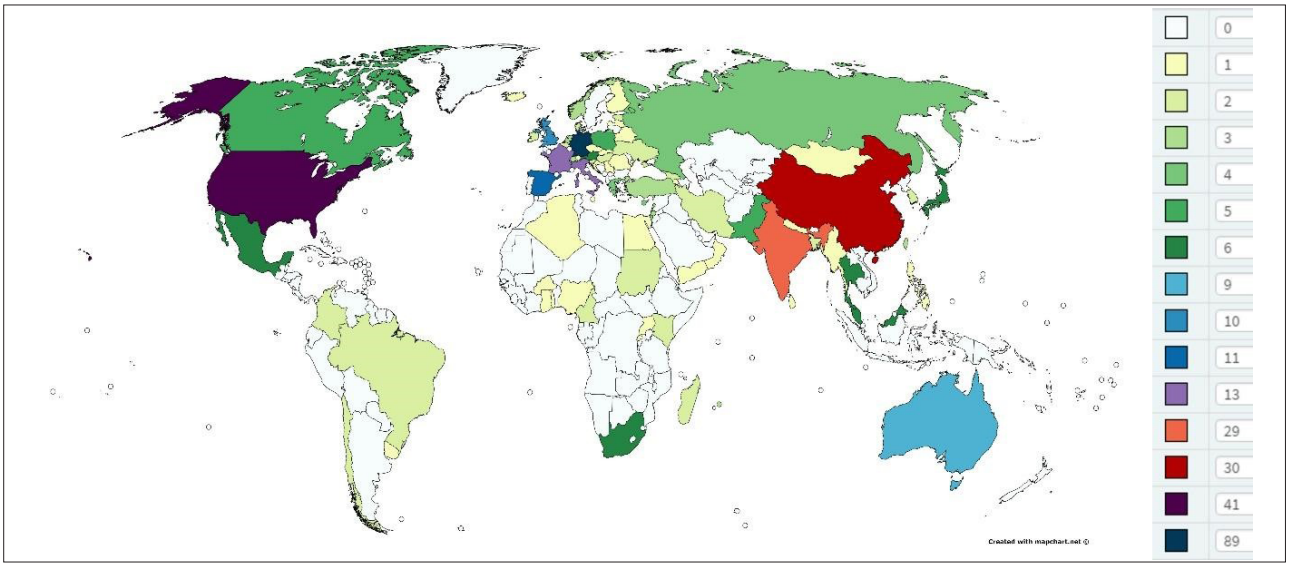

Figure 1: The 80 countries that were represented at the 66th Lindau Nobel Laureate Meeting. The total number of young participants is indicated by the colour and number on the chart to the right of the figure.

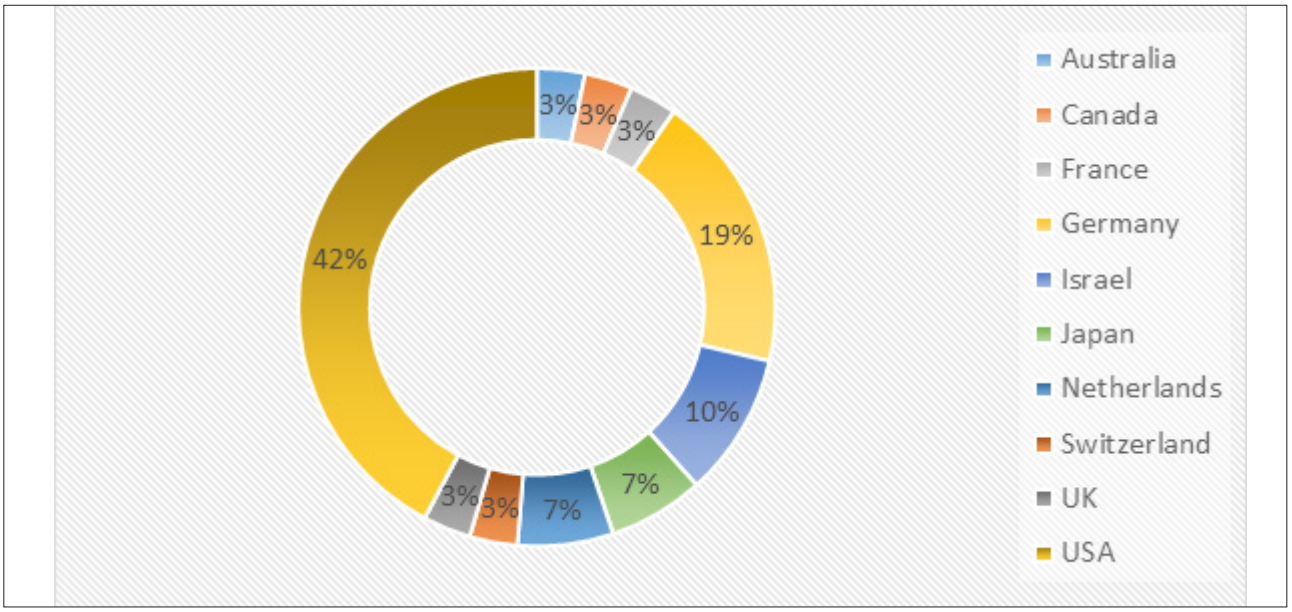

Figure 2: Graphical representation of the total number of Nobel Laureates (by country, %) who attended the 66th Lindau Nobel Laureate Meeting.

Prize in the Natural Sciences, this speaks more to the lack of diversity in the Nobel Prize awards themselves than the meeting. Countries such as the USA and Germany with their large numbers of Nobel Laureates (more than 15% each; Figure 2) were represented by only men.[4]

Analysis

It is evident from the data on the number of Nobel Laureates and young scientists who participated in the 66th Lindau Nobel Laureate Meeting (Table 2), that countries with Nobel Laureates who attended the meeting had a higher number of young scientist participants. This was also verified by the data on individual governments' expenditure on education. It was also observed that most countries with higher expenditure on education (primary to tertiary) were mostly represented at the meeting (Table 3). The young scientist attendees from Germany (and possibly from the other EU countries) could also be strongly linked to the fact that they had a greater awareness of the meeting, which is, after all hosted in Germany. Countries like China and India had a total number of young participants of 29 and 30, respectively. Both these countries have a population of more than 1 billion people; the number of their young scientists at the meeting could therefore be considered relatively inadequate.

A total of 10 countries which were represented by their Nobel Laureates had a total of 46% young scientists who participated in the meeting. This number of participants was almost half of the total number of young scientists at the meeting yet they comprise only 12% of countries that were represented in the meeting. Of the 10 countries that were represented at the 66th Lindau Nobel Laureate Meeting, only Sweden, Russia and Italy were absent. These three countries fall under the top 10 countries with the most number of Nobel Laureates in the fields of Peace, Literature, Economics, Chemistry, Physics and Physiology or Medicine. The increase in the number of US Nobel Laureates only began after World War II – before which the European nations were much more successful.[12] The dominance of Western countries is because of the huge socio-political power these nations have held over the last century as well as their bigger investment in STEM research when compared to their developing world counterparts.

Of the 400 young scientists, 30 were selected by the Lindau Nobel Laureate Council to present their work as posters during the meeting. Only 26.7% of these presenters were women; the majority originated from or were studying in developed countries (Table 4). The highest number of poster presenters originated from and/or were studying in Germany, followed by the USA. China, Norway, Thailand and Slovenia were also each represented by one young scientist. No data were available on the total number of young scientists who submitted abstracts for poster presentations but were unsuccessful.

Table 2: The relationship between the countries of origin of the Nobel Laureates and young scientists who participated in the 66th Lindau Nobel Laureate Meeting

Country	Nobel Laureates	Young scientists
Australia	1	9
Canada	1	5
France	1	13
Germany	6	89
Israel	3	4
Japan	2	6
Netherlands	2	3
Switzerland	1	3
UK	1	10
USA	13	41
Total	31	183

Table 3: Government expenditure on education (GEE; in % of GDP, 1980–2009) of countries represented at the LiNo16 meeting

Country	GEE (GDP %)	Year	Country	GEE (GDP %)	Year
Denmark	7.8	2007	Germany	4.5	2007
Iceland	7.4	2007	Hong Kong	4.5	2009
Kenya	7.0	2006	Uruguay	4.5	2011
Norway	6.8	2007	Algeria	4.3	2008
Malta	6.4	2007	China	4.2	2014
South Africa	6.0	2013	Italy	4.3	2007
Belgium	6.0	2007	Romania	4.3	2007
Finland	5.9	2007	Spain	4.3	2007
Israel	5.9	2007	Czech Republic	4.2	2007
Slovenia	5.7	2006	Cyprus	4.1	2007
France	5.6	2007	Malaysia	4.1	2008
Mongolia	5.6	2009	Rwanda	4.1	2008
United Kingdom	5.5	2007	Thailand	4.1	2009
USA	5.5	2007	Chile	4.0	2008
Austria	5.4	2007	Greece	4.0	2005
Ghana	5.4	2005	Oman	3.9	2006
Netherlands	5.3	2007	Russian Federation	3.9	2006
Ukraine	5.3	2007	Egypt	3.8	2008
Hungary	5.2	2007	Cameroon	3.7	2009
Switzerland	5.2	2007	Slovakia	3.6	2007
Yemen	5.2	2008	Japan	3.5	2007
Brazil	5.1	2007	Georgia	3.2	2009
Latvia	5.0	2007	Mauritius	3.2	2009
Canada	4.9	2007	Uganda	3.2	2009
Ireland	4.9	2007	India	4.9	2014
Poland	4.9	2007	Armenia	3.0	2007
Colombia	4.8	2009	Madagascar	3.0	2009
Estonia	4.8	2007	Sudan	28	1985
Mexico	4.8	2007	Philippines	2.8	2008
Iran	4.7	2009	Pakistan	2.7	2009
Serbia	4.7	2008	Sri Lanka	2.6	1985
Burkina Faso	4.6	2007	Turkey	2.9	2005
Croatia	4.6	2009	Bangladesh	2.4	2008
Nepal	4.6	2009	Liechtenstein	2.0	2007
Togo	4.6	2009	Nigeria	0.8	1995
Australia	4.5	2007	Myanmar	0.6	2000
Belarus	4.5	2009	Palestinian Territory	N/A	N/A

Table 4: The data (by gender) on the total number of young scientists who presented posters of their work during the meeting

Discipline	Women	Men
Atomic, Molecular, Optical and Fundamental Measurements	1	2
Quantum Optics, Quantum Information and Photonics	1	4
Astronomy, Astrophysics and Cosmology	1	5
Bio-Physics	1	2
Solid-State, Materials Science and Condensed Matter Physics	2	6
High Energy Physics	2	3
Total	8	22

Conclusion

We believe that the benefits of attending the 66th Lindau Nobel Laureate Meeting are significant, and that scientific development can be improved by increased diversity of participation. Young female scientists were under-represented but slightly better represented than the female Nobel Laureates. It was also observed that there are regions that were very under-represented, both in terms of the number of attendees and the number of young scientists who were given an opportunity to present their work. It was also observed that there was a correlation between the number of Nobel Laureates and young scientists who attended the 66th Lindau Nobel Laureate Meeting. Representatives from developed countries dominated in the meeting because of the socio-political power these nations have held over the last century. Underdeveloped countries, which were mostly under-represented at the meeting, are spending far less on education as a proportion of their GDPs[13] when compared to the government expenditure on education by developed countries.

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