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### Chemical Education

## ICE-10: Nobel Prizes in 2021

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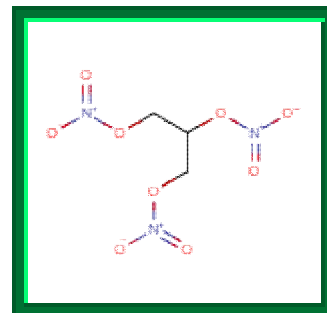


### INTRODUCTION

Dr Nobel, a Swedish chemist, introduced awards for scientists, linguists and peace promoters who developed methods, procedures, workflows, tools, products for 'the greatest benefit to humankind'. The award is called 'Nobel prize' and the recipient is known as 'Nobel Laureate' thereafter. It is the supreme honour ever bestowed in scientific world during last one century. Each awardee receives cash (Ten million SEK = approx. 1.1 million USD for full prize), gold medal and diploma in the annual meet (function in the year 2020 was not organised because of COVID-19 pandemic) celebrated by Swedish academy in the presence of Prince of the country. The oral presentation of

'Nobel lecture' by the Laureates of that year, banquet speeches by the awardees at banquet dinner are really a feast to brain, ears, eyes and taste-buds of participants/attendees of celebration.

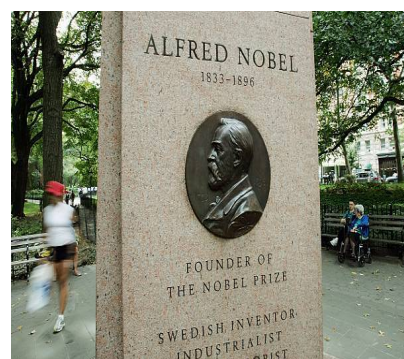
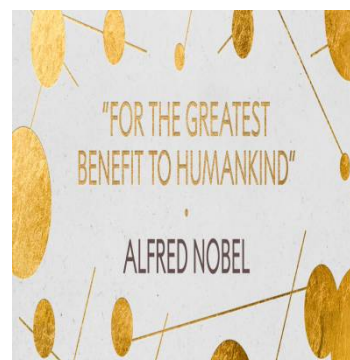
Alfred (Bernhard) Nobel was born to a Swedish couple (Immanuel Nobel and Carolina Andriette (Ahlsell) Nobel) on 21<sup>st</sup> October, 1833 in Stockholm. This family descended from Olof Rudbeck, best-known technical genius of the country. Mr Nobel learned five languages and was a fluent speaker by the age of seventeen years. Dr Alfred was an entrepreneur, technocrat, engineer, and unusually skilled experimentalist and synthetic chemist in designing and manufacture of explosives. He Yet faced catastrophic accidents and experiences. He never married and did not have biological-children. Dr Nobel invented dynamite, the blasting cap, gelignite, and ballistite. To his credit, he had around 350 patents including 58 English and 39 Swedish ones. The last will of Alfred Nobel was prepared on 27<sup>th</sup> November, 1895 and it was executed from year 1901. Dr Nobel breathed last in his home in San Remo, Italy on 10<sup>th</sup> December 1896 at the age of 63. He exclaims that he was advised 1mg of nitro-glycerine as a medicine in his last period of life. This was one of the chemicals in large quantities, he researched in most part of active span of the career. Also, it revolutionised mining technology, earned him name, fame and fortune. In the medical treatment, NG is still one of coveted vasodilator (relaxation of vascular smooth muscle; increasing blood flow in veins, arteries and cardiac tissue) drugs (in a variety of pharmaceutical formulations viz. extended-release/sublingual tablet, spray, intravenous injection, and transdermal form) saving patients from angina pectoris caused by CAD (Coronary Artery Disease or ischemic heart disease).



**Disciplines in Nobel Awards (DNA) for Human achievements (Ha!):** Three Nobel awards are in basic pure sciences viz. Physics, Chemistry and Physiology or Medicine. Fourth prize is for Literature belonging to linguistics group and fifth prize goes for peace to individuals or institutions striving promotion of relieving/diminishing fears and consequences from hunger, violence/sexual assault in war, restrictions in oral expression, etc. The [chart 1](#) lists number of Nobel prizes awarded, and number of Laureates during these 120 years.

| <a href="https://www.nobelprize.org/prizes/lists/all-nobel-prizes/">https://www.nobelprize.org/prizes/lists/all-nobel-prizes/</a> |                           |               |                  |                 |                 |
|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------------|------------------|-----------------|-----------------|
| Chart. 1a Nobel prizes during 1901 to 2021                                                                                        |                           |               |                  |                 |                 |
| Categories                                                                                                                        | Discipline of Nobel Prize | # Prizes..... | # laureates .... | # organisations | Time line       |
| Pure Science                                                                                                                      | Physics                   | 115           | 219              | Not eligible    | Years 1901-2021 |
|                                                                                                                                   | Chemistry                 | 113           | 186              |                 |                 |
|                                                                                                                                   | Medicine                  | 112           | 224              |                 |                 |
| Linguistics                                                                                                                       | Literature                | 114           | 118              |                 |                 |
| Humanity                                                                                                                          | Peace                     | 103           | 109              | Unique org.     | 25              |
|                                                                                                                                   |                           |               |                  | ICRC            | 3 times         |
|                                                                                                                                   |                           |               |                  | UNHCR           | 2 times         |
|                                                                                                                                   |                           |               |                  |                 | 30              |
| Applied science                                                                                                                   | Economic sciences         | 53            | 89               | Not eligible    | 1969-2021       |
|                                                                                                                                   | Total                     | 609           | 975              |                 |                 |

| Discipline of Nobel Prize | # Prizes   | Awarded to One person | Shared by   |               |
|---------------------------|------------|-----------------------|-------------|---------------|
|                           |            |                       | Two persons | Three persons |
| Physics                   | 115        | 47                    | 32          | 36            |
| Chemistry                 | 113        | 63                    | 24          | 25            |
| Medicine                  | 112        | 39                    | 34          | 39            |
| Literature                | 114        | 110                   | 4           | —             |
| Peace                     | 103        | 69                    | 31          | 2             |
| Economic sciences         | 53         | 25                    | 20          | 8             |
|                           | ----       | -----                 | -----       | -----         |
| Total no of prizes        | <b>609</b> | <b>353</b>            | <b>146</b>  | <b>110</b>    |
|                           |            |                       |             |               |
|                           |            | 1*353=                | 2* 146=     | 3* 110=       |
|                           |            | 353 +                 | =292 +      | 330=          |
| Total no of Laureates     |            | <b>975</b>            |             |               |



**Nobel Prize in Economics:** In the year 1968, Sweden's central bank (The Sveriges Riksbank) on the commemoration of its 300th anniversary funded to institute Nobel prize in Economics Sciences. This prize was in Memory (death day) of Alfred Nobel, founder and the sole financier of the five-Nobel Prizes, which were awarded since 1901 under the umbrella of Swedish academy. Dr. Ragnar Frisch and Dr. Jan Tinbergen were recipients of first prize announced in 1969 for developing applied dynamic models in the analysis of economic processes. The Nobel Foundation undertakes all administrative chores including refereeing/selection process and the Laureates had been receiving the awards since 1969 at the same ceremony. So far (1969-2021), Nobel-Prize-in-Economic-Science had been awarded 53 times, the number-of-Nobel-Laureates-in-ES being 89.

**Nobel Prizes in 2021:** This year (2021), seven Pure science experts, three applied Science practitioners, two peace promoters (including one woman) and one linguist are bestowed with Nobel Prizes under the six categories ([chart. 2](#)). The awards are for their ground breaking contributions that resulted in greatest benefit to humankind in health, wealth, information and good--bad-discrimination perspectives. The focal themes of their long, intricate, fundamental perseverance with state-of-intelligence-perception-knowledge extraction tools are of wide range. Typical corner stones are physical modelling of Earth's climate, quantifying variability and reliably predicting global warming, interplay of disorder and fluctuations in physical systems from atomic to planetary scale, asymmetric organocatalysis, receptors for temperature and touch, effects of colonialism and the fate of the refugee in the gulf, safeguarding freedom of expression to sustain democracy/peace, empirical contributions to labour economics, and methodological contributions to the analysis of causal relationships using natural experiments.

| Chart. 2 Nobel Laureates of 2021 |                        |                     |                                                               |
|----------------------------------|------------------------|---------------------|---------------------------------------------------------------|
| Categories                       | Nobel Prize in         | # Laureates in 2021 | Organization responsible for selection                        |
| Pure Science                     | Physics                | 1+2                 | The Royal Swedish Academy of Sciences for the Nobel Prize     |
|                                  | Chemistry              | 2                   |                                                               |
|                                  | Physiology or Medicine | 2                   | Karolinska Institute                                          |
| Linguistics                      | Literature             | 1                   | Swedish Academy                                               |
| Humanity                         | Peace                  | 2                   | Committee of five persons elected by the Norwegian Parliament |
| Applied (Economic) science       | Economics              | 1+2                 | Royal Swedish Academy of Sciences                             |
| Total                            |                        | 13                  |                                                               |

Tables 1 to 6 incorporate the focal theme of awardees' research, country/year of birth of Nobel laureates, institute-of-employment at the time of announcement of award and share of award. The first responses of recipients of Noble prize winners (telephone-interview with Adam Smith, Chief Scientific Officer of Nobel Media, Sweden) just after the news reached the awardees are in Supplementary information (SI.1). SI-2 incorporates Noble words of Nobel Laureates and SI.3 describes gratitude expressed by Nobel Laureates to their mentors /institutes/funding agencies, life-partner etc. How Noble prize award message reached the recipient and why/how their brain didn't assimilate immediately (prank, beyond expectation, humility, although not auditory illusion) is described in SI.4.

<https://www.nobelprize.org/prizes/physics/2021/summary/>

## 2021 Nobel Prize in Physics

The Nobel prize in Physics of 2021 (NP.Phys.2021) goes for ground-breaking research in Climate models in the back-drop of Complex systems and their solutions for understanding/prediction in time and space of widely different (nano-, micro-, macro-) scales. One half of the prize is shared between Syukuro Manabe and Klaus Hasselmann for generating concrete valid knowledge of climate of earth and influences of human life style and man-made activities. The other half of the award is bestowed on Giorgio Parisi for monumental results with theory of dis-ordered, chaotic and random processes comprised in World climate and local weather phenomena. This intricate study of Physical-Mathematical-models and solution of the Complex systems has good impact in diverse disciplines like biology, neuroscience, mathematics and machine learning. In to-to the perception of inter-mix of interactions of matter and radiation through deterministic, analytical, numerical, hybrid and hierarchical networks/ workflows in a mental/brain/conscious consciousness space is a new dimensional tool for uplift and good for mankind in the evolutionary life processes.

**Weather and Climate on mother earth:** Atmosphere is the veil of gases, dust particles and water vapour surrounding the earth surface up to several miles up in the sky. It is the protective boundary between the Sun (outer space) and the biosphere making life-we-know possible on the mother planet.

The other planets and moons in our solar system also have an atmosphere, but of widely different composition, for example Mars with very thin layer of carbon dioxide.

**Atmospheric Science:** This is an intricate combination of three applied Sciences viz. meteorology (the study and forecasting of weather), climatology (the study of long-term atmospheric patterns and their influences), and aeronomy (the study of the physics and chemistry of the upper atmosphere). They are application of Pure (radiation, molecular, quantum) Physics and (macro-, nano-) chemistry to static/dynamic (compartmental as well as continuous) phenomena in atmosphere. The empirical, (made-easy by reducing complex-to-simple) physical, near-realistic-real-time dynamic (in space and/or time) paper-and-pencil fabricated to automatic-adaptive-machine generated models and knowledge-based-workflow of solutions complement to information for pareto-optimal short-/ long-term prediction.

Weather change is comprehended by meteorological physics-based-parameters (temperature, precipitation, wind or clouds) and also by processes occurring in the oceans and on land. It is hard to monitor temperature, pressure, humidity or wind conditions for every point in the large grids of atmosphere for shorter intervals of time over long periods with high accuracy. Further, the model equations are non-linear stiff differential type, which are sensitive for even small perturbations with a consequence of evolution of weather profiles in an altogether different way.

The Climate changes were understood with average values, standard deviations, highest and lowest measured values of weather-parameters. The general experience is it is pragmatic to get an idea of how much rainfall we can expect on average in Stockholm in December.

**Physics-based Models: Greenhouse effect:** In a house with glass panes, the rays of sun pass through and heats up the room inside. But the heat is trapped inside and does not dissipate mediately. In 1901, Nils Ekholm, meteorologist, friend and colleague of Nobel Laureate Svante Arrhenius used the word ‘greenhouse’ in describing the atmosphere’s storage and re-radiation of heat.

**Greenhouse gases:** The major portion of earth’s dry atmosphere comprises of nitrogen and oxygen to an extent of 99% (by volume), while greenhouse gases (carbon dioxide, methane, water vapour) are only in small proportion. The carbon dioxide (present just to 0.04 per cent by volume) is main culprit in global warming. It is the center of attraction in all major eco-system studies, as human intervention in control this process is possible. But water vapour is most powerful greenhouse gas, but not possible to control its concentration. If the atmosphere did not absorb this radiation, the surface temperature would barely exceed  $-18^{\circ}\text{C}$ . Arrhenius opined that if the level of carbon dioxide in the atmosphere halved, it would push Earth to enter a new ice age.

**Historic (centuries old) atmospheric models:** The gases in the atmosphere (carbon dioxide, water vapour etc.) produce greenhouse effect increasing the earth’s surface temperature. But, the processes are very complicated. The protective role from harsh radiation harmful for human kind is a bliss for sustenance of life on earth.

Newton’s laws of motion (three-century old) are entirely deterministic. If climate is modelled in this frame, it cannot incorporate probability, fuzziness, possibility, stochasticity, chaos in data/processes/ or noise. There is no scope of interpreting in terms of Wave; [Ridge ; Curve; Surf; Brush] lets, or rough-sets profiles.

Pierre-Simon de Laplace, a French scientist, proposed (two-centuries back) that it is possible to calculate what has happened as well as what will happen in our world from a knowledge of the position and speed of all the particles in the universe.

Joseph Fourier, a French physicist, concentrated, two hundred years ago itself, on the energy balance between the (high frequency, UV for example) sun’s radiation towards the



ground and the radiation emanated from the surface (dark heat, longwave or lower frequency), now popular as IR.

In 1896, Arrhenius published first climate model enunciating that as the quantity of atmospheric CO<sub>2</sub> increases or decreases in geometric progression, earth's surface temperature will increase or decrease nearly in arithmetic series ([Arrhenius A. 1896. On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground, Phil. Mag. 41, 237-275](#)). For instance. If amount of carbon dioxide is doubled, then the temperature increases by 5–6°C. Astoundingly, the current estimates are close with all state-of-knowledge-science-tools; Though, sounds somewhat fortuitous, it is nearer to truth.

Richard Feynman (Nobel Laureate of Physics in 1965), believed in the primacy of doubt, not as a blemish on our ability to know, but as the essence of knowing. [[Palmer, T. \(2017\), The primacy of doubt: Evolution of numerical weather prediction from determinism to probability, J. Adv. Model. Earth Syst., 9,730–734, doi:10.1002/2017MS000999](#)].

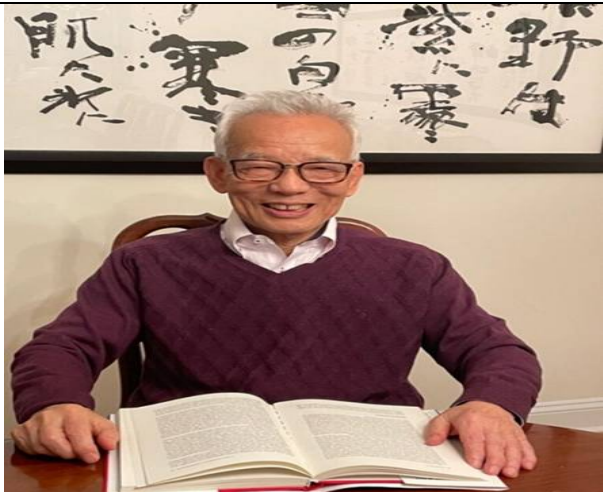
North American theoretical meteorologist, Edward Norton brought out butterfly effect. Lorenz showed scale changes (to the starting point of his) of computer weather models resulted in anything from sunny skies to violent storms. These cases are with no way to predict in advance what the outcome might be. The metaphoric example whether a butterfly flapping its wings in Brazil could cause a tornado in Texas is mind blowing. However, this was not very well received. Lorenz is responsible for chaos theory, now a vital module of not only climate modeling but also in many disciplines

**Classical models:** They cannot forecast say, what the weather will be in Stockholm on 10 December next year. In essence, it is impossible to develop long-term weather forecasts and one of the reasons being that weather (spatio-temporal domain) is chaotic.

**Table 1.1 Focal theme (b) of Nobel Prize for Physics in 2021**

|                            |                                                                         |                                                                                                                                                                                           |
|----------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Discovery</b>           | <b>!</b> Syukuro Manabe                                                 |  Physical modelling of Earth's climate, quantifying variability and reliably predicting global warming |
| <b>Object_achieved</b>     | <b>!</b> Klaus Hasselmann                                               |                                                                                                                                                                                           |
| <b>Knowledge generated</b> | <b>!</b> solid physical foundation for our knowledge of Earth's climate | <b>Benefit to mankind</b> Scientific knowledge with firm base                                                                                                                             |

| <b>Affiliation</b>                          | <b>Nobel Laureate (Phys)</b><br><b>Photo</b><br><b>Date &amp; place of birth</b> | <b>Share</b> |
|---------------------------------------------|----------------------------------------------------------------------------------|--------------|
| Princeton University,<br>Princeton, NJ, USA | <b>Syukuro Manabe</b>                                                            | 1/4          |

|  |                                                                                    |  |
|--|------------------------------------------------------------------------------------|--|
|  |  |  |
|  | <p>21 September 1931,<br/>Shingu, Ehime Prefecture, Japan</p>                      |  |

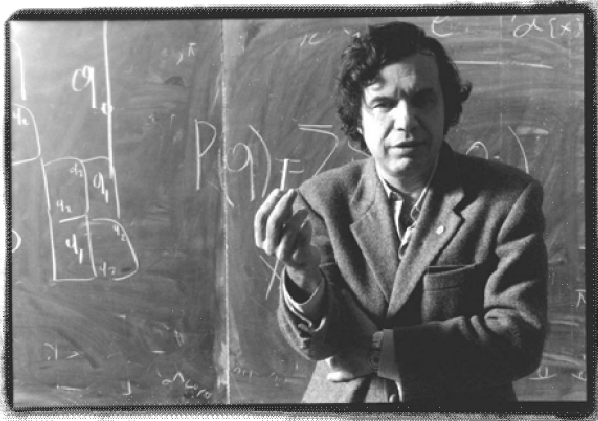
**Manabe era:** In the 1950s, Syukuro Manabe was a young and talented Japanese researcher in atmospheric physics. The ill effects of devastation of second world war, made him move to US. He continued the profession there for the rest of his academic career. Manabe made a start at understanding how increasing levels of CO<sub>2</sub> induce the rise in surface temperature of Earth. He arrived at a physical model with inputs of vertical transport of air masses arising due to convection and the latent heat of water vapour. It is different from Arrhenius concept (in 1890s) of radiation balance. Manabe's model was confined to one dimension (a vertical column, 40 kilometers up into the atmosphere), but numerical solution consumed hundreds of hours of computing time, which was precious in that period. The outcome that oxygen and nitrogen had negligible effects on surface temperature was an important information. On the other hand, doubling carbon dioxide amount increases global temperature by over 2°C is a milestone in the timeline of global warming research. An extension, 3D-climate model of Manabe proposed in 1975, is a beacon shedding light on the road in understanding the climate's hidden secrets of nano- to mega scale processes/interactions. Yet, he affirms that a human brain cannot compete with complexity of nature. In fact, there is so much physics involved in every raindrop that it would never be possible to compute absolutely everything A to Zee.

|                                                           |                                                                                      |     |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------|-----|
|                                                           | Klaus Hasselmann                                                                     |     |
| Max Planck Institute for Meteorology,<br>Hamburg, Germany |  | 1/4 |
|                                                           | <p>25 October 1931,<br/>Hamburg, Germany</p>                                         |     |

**Klaus Hasselmann era:** Nearly a decade after Manabe's contributions, Hasselmann proposed a new approach linking weather and climate models into a workflow. This line of thinking has a prospect of emerging into reliable climate models, although weather changes are chaotic and associated with rapid, abrupt variations. The chaotic profiles were transformed into rapid changing stochastic patterns.

**Table 1.2 Focal theme (a) of Nobel Prize for Physics in 2021**

|                   |                                                                                                                                              |                  |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Discovery</b>  | <ul style="list-style-type: none"> <li>Interplay of disorder and fluctuations in physical systems from atomic to planetary scales</li> </ul> | ▶ Giorgio Parisi |
| <b>Discipline</b> | Climatology                                                                                                                                  |                  |

| Affiliation                                                                                                                             | Nobel Laureate (Physics)<br>Photo, Date & place of birth                                                                                  | Share |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Sapienza University of Rome,<br>Rome, Italy                                                                                             | <p>Giorgio Parisi</p>  <p>August 1948, Rome, Italy</p> | 1/2   |
| <a href="https://www.nobelprize.org/prizes/physics/2021/parisi/facts/">https://www.nobelprize.org/prizes/physics/2021/parisi/facts/</a> |                                                                                                                                           |       |

**Giorgio Parisi era:** The spin-glass-system was the initial focus of Parisi's research agenda in early 1980s. He probed into dis-ordered, random and chaotic processes with hidden rules in real-life, natural-/nature phenomena. Typical subtle scenarios are found in spatio-temporal weather-climate changes and complex inanimate-chemical-/ living-bio-systems. In 1979, Parisi showed how the replica trick ingeniously solves a spin glass (complex) problem. And, the hidden structures in replicas were discovered and method was proposed to transform into mathematical frame. This has become a method of choice in probing into complex-disordered tasks. It took pretty long time for availability of proof that Parisi's solution is correct mathematically. His contributions are vital in understanding, theorizing and developing workflow for solution of complex nano- to mega processes in many pure-/application- sciences (of entirely random complex materials and phenomena ) with reliability to the possible extent. This frame could deal with long pending riddles like

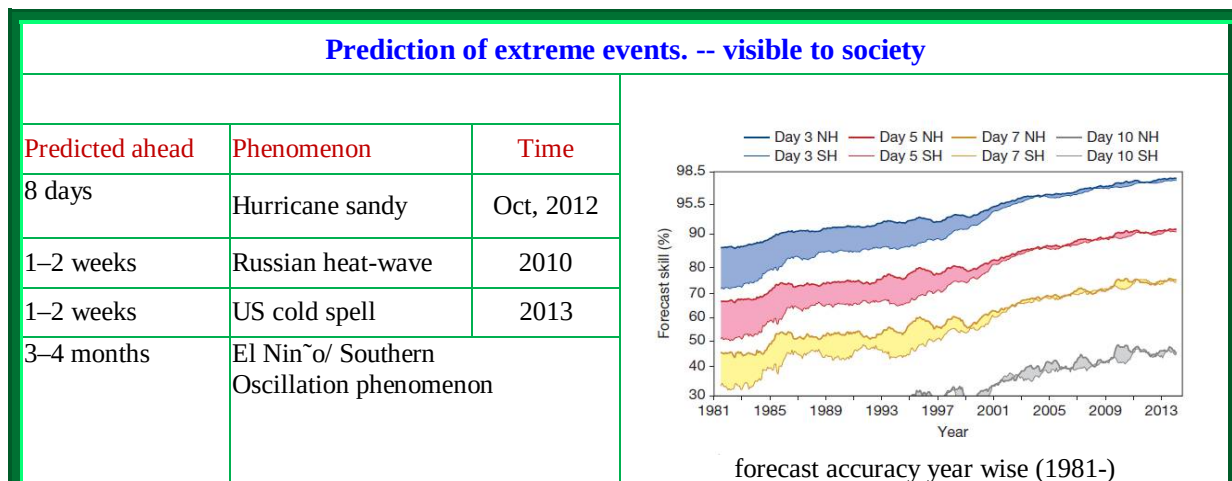
- ! Why do we have periodically recurring ice ages?
- ! Is there a more general mathematical description of chaos and turbulent systems?
- ! How do patterns arise in a murmuration of thousands of starlings? etc.

All the diversity of multiple-unique-disciplines was brought under a single umbrella that simple behaviours give rise to complex collective molecular-nano-micro-mega-giga-scale

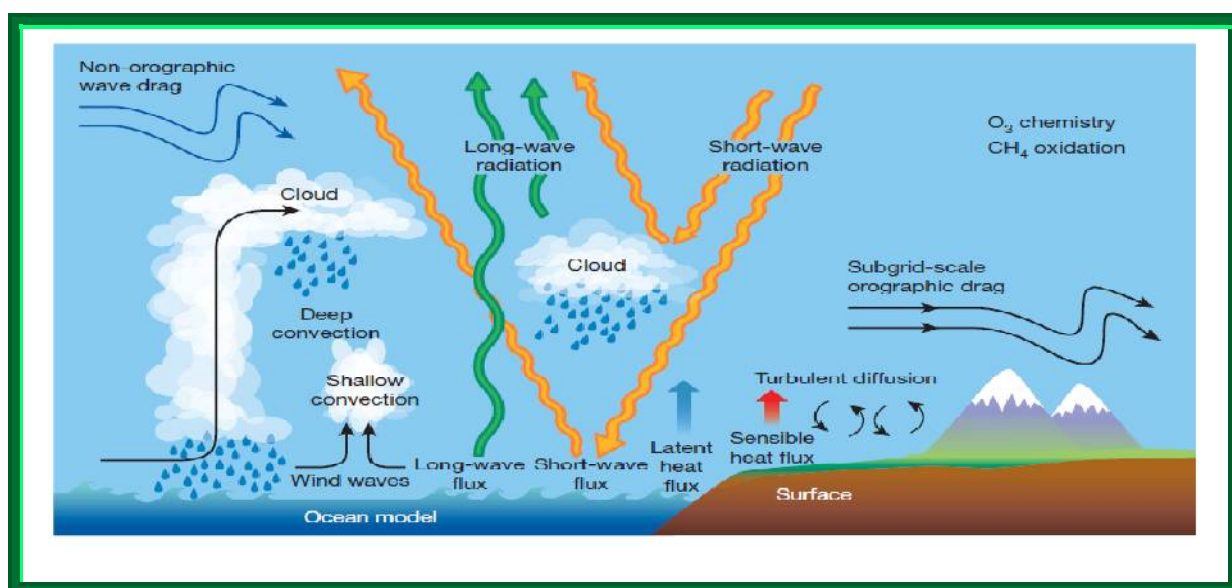


processes/interactions/behaviours (Arnaud Montagud, Miguel Ponce-de-Leon<sup>1</sup> and Alfonso Valencia, Systems biology at the giga-scale: Large multiscale models of complex, heterogeneous multicellular systems, Current Opinion in Systems Biology 2021, 28:100385, doi.org/10.1016/j.coisb.2021.100385)

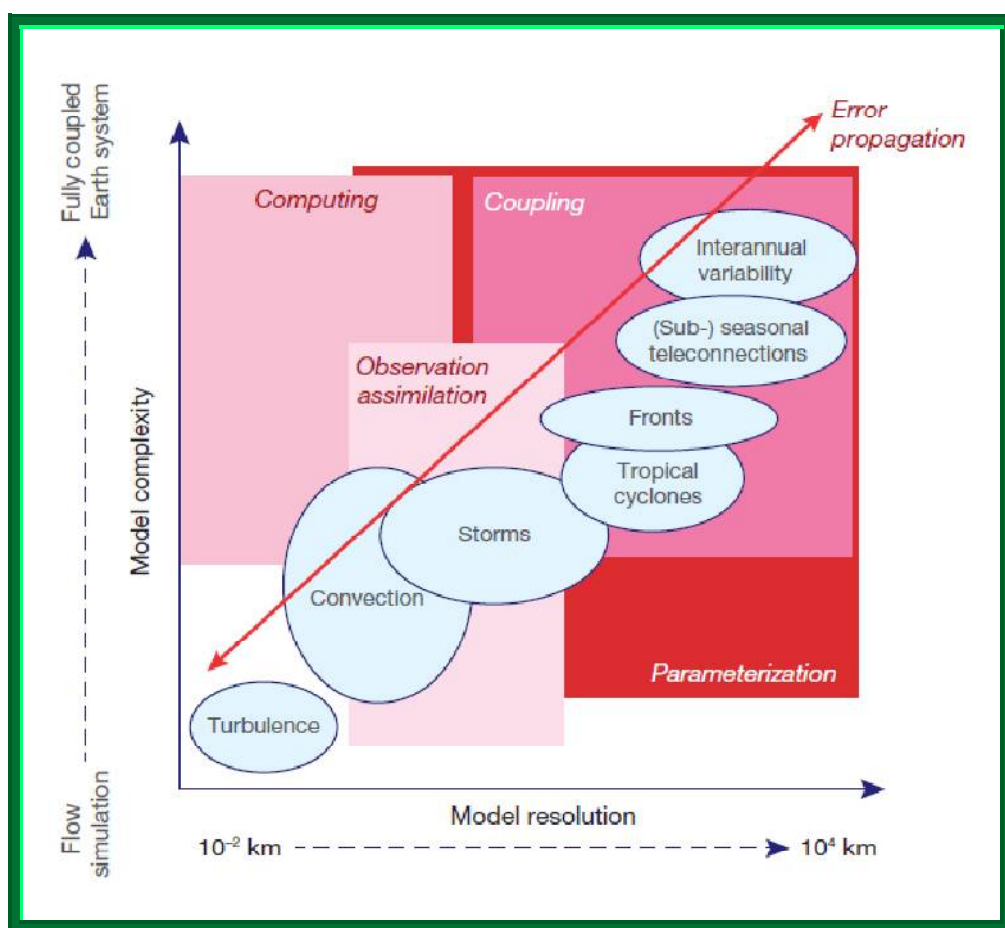
**Forecast accuracy over last few decades:** The comparison of the weather forecast figures with what actually happens every day is a measure of accuracy of state-of-knowledge-of tools. In this decade, 6-day forecast is as accurate as the 5-day forecast ten years ago and prediction in Northern and Southern hemispheres is almost equal.



The vision of routine running of models at 1 km horizontal resolution for now-time-prediction is a hope of near future (say a few decades). At the moment, many of processes are represented via parameterizations, which describe contributions of happenings in terms of mass, momentum and heat transfers from sparse (experimental/simulated) data. The desirable targets of global/regional weather/climate forecasts are achievable considering air-land-ocean-sea-ice-berg system to the extent possible. Big-and-complex-data-fusion and fourth-paradigm--experiment-theory-computations are the two-eyes of science which enhanced perception of simple-to-complicated processes in nature. The third eye (knowledge/ super-intelligence/ consciousness) enabled deep-learning with machine-learning-tools to be not-far-away-from-true happenings in-and-around animate-/inanimate species-world (systems).



The need of hour is high end achievements in numerical weather prediction (NWP) surmounting the challenges in observations (from satellites, instruments on our planet) over smaller time/space grid, more understanding of physics-based-/physico-chemical/chemical-/bio-/bio-physical-chemical processes in wider concentration scales, mapping of processes into mathematical space, solution of model equations, not-methods-that-work---but- methods-that-are-more-than-adequate, sensitivity of information space, ensemble-/hierarchical-/network of model-work flow-strategies, high-performance computing-with-as-yet-unknown-implementable-technology, man-to-computer- and computer-to-computer communication and so on.



This saga is similar to

- ➔ Simulating the neurological connectivity of the human brain (silicon brain, chemical brain)
- ➔ Evolution of the galaxies in the cosmos (dark matter, dark energy)
- ➔ Synthetic biology processes etc.

<https://www.nobelprize.org/prizes/chemistry/2021/summary/>

## 2021 Nobel Prize in Chemistry

Dr (prof) Benjamin List and Dr (prof) David W.C. MacMillan shared the Nobel prize in Chemistry of 2021 (NP.Chem.2021) for the introduction and nurture of asymmetric organocatalysis

in the single/multi-stage modern preparation/synthesis of chemical compounds. Building chemical molecules through preparation, synthesis in man-made-laboratories is a continuous sustained billion-dollar activity. It happens in the back-drop of accumulated knowledge/wisdom and simple-to-robotic-tools available to human-experts. Whether this is Art, craft, Science in human domain, or intelligent/consequence of consequences nature's evolution, it has profound influence on animate-/inanimate material universe in spatio-temporal fabric.

The organocatalysts of wide applicability are small organic molecules with stable framework of carbon atoms and active chemical groups containing oxygen, nitrogen, sulphur or phosphorus atoms. This newer group of catalysts (organocatalysts, not organo-metallic compounds) are inexpensive, green, and devoid of harshness of metal/metal-ion bearing chemical moieties of yester years, a menace to human health and environment serenity. One more desirable, but hard to achieve (save nature made enzymes through evolution) characteristic of noble-prize winning catalyst is straight stereo-specificity of products, which had taken pharmaceutical industry into a new world. Johan Åqvist, chair of the Nobel Committee for Chemistry, exclaims 'why and how experts in basic chemical sciences didn't think of it earlier? The out-of-box-thinking/perception and sustained-perseverance and ingenious-experimental-plan-execution of List and MacMillan made it to happen as required (dreamt). The other products of this curious-venture like molecules that can capture light in solar cells promote the greatest benefit to humankind instantaneously and in far-of-future.

**Table 2.1 Focal theme of Nobel Prize for Chemistry in 2021**

|                             |                                                    |  |                                                                                                                                                                                                               |
|-----------------------------|----------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Methods in Catalysis</b> | <b>!</b> Development of asymmetric organocatalysis |  |  Benjamin List<br> David W.C. MacMillan |
| <b>Benefit</b>              | Green-chemistry                                    |  | <b>Necessity</b> Metal ion catalysis involves a harsh chemical process                                                                                                                                        |

| <b>Affiliation</b>                                                           | <b>Nobel Laureate (Chem)<br/>Photo, Date &amp; place of birth</b>                                                                            | <b>Share</b> |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Max-Planck-Institut für Kohlenforschung,<br><br>Mülheim an der Ruhr, Germany | Benjamin List<br><br>11 January 1968, Frankfurt, Germany | 1/2          |

| Affiliation                                 | Nobel Laureate (Chem)<br>Photo, Date & place of birth                                                                                         | Share |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Princeton University, Princeton,<br>NJ, USA | David W.C. MacMillan<br><br>1968, Bellshill, United Kingdom | 1/2   |

<https://www.nobelprize.org/prizes/medicine/2021/summary/>

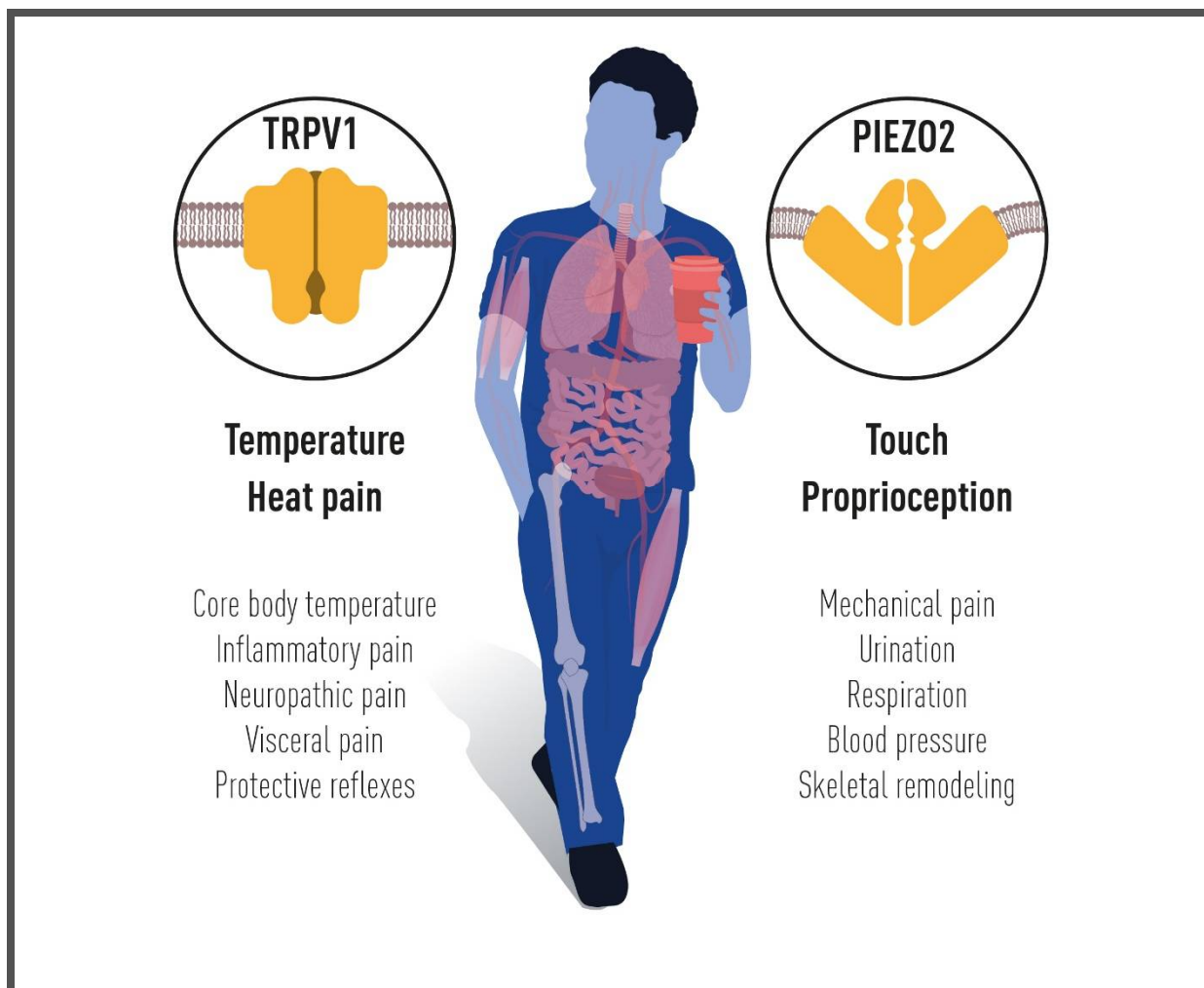
## 2021 Nobel Prize in Physiology or Medicine

This year's Noble prize, NP.Med.2021, is shared between David Julius of University of California and Ardem Patapoutian of Scripps Research for the brain-bending ingenious finding of receptors (ion-channels; genes) in human being in sensing thermal-energy-as-temperature (warmth, cold, chill), taste/burning of Capsaicin and feel of touch (affectionate, discriminative, pain, mechanical). A historical/ early science perspective and state-of-knowledge perseverance follow (vide infra). Narasinga Rao and Sambasiva Rao described the highlights of NP.Med.2021 in a micro-review [under publication].

<https://www.nobelprize.org/prizes/medicine/2021/summary/>

**Table 3.1 Focal theme of Nobel Prize for Physiology or Medicine in 2021**

|                    |                                                                                                                                                                                                                                                                            |                                                                                                         |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>! Discovery</b> | <ul style="list-style-type: none"> <li>☞ Receptors for Temperature: [Warmth, hot, cold, chill]</li> <li>☞ Capsaicin [taste; hot]</li> <li>☞ Touch, pain               <ul style="list-style-type: none"> <li>○ Genes. Ion-channel molecular sensors</li> </ul> </li> </ul> |  David Julius      |
|                    |                                                                                                                                                                                                                                                                            |  Ardem Patapoutian |



<https://www.nobelprize.org/prizes/literature/2021/>

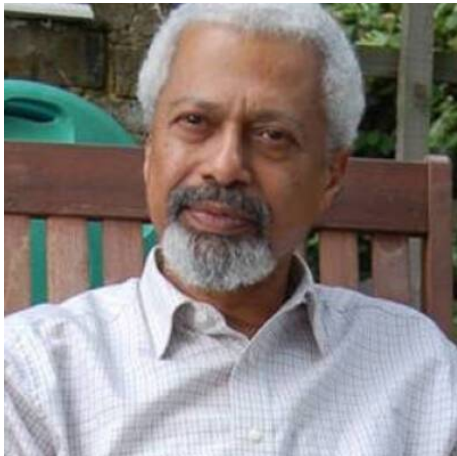
## 2021 Nobel Prize in Literature

The Nobel prize for Literature of 2021 (NP.Lit.2021) is conferred on Abdulrazak Gurnah for his novels mirroring the fate of refugees (dwellers of colonization) amidst the existing gulf between cultures and continents. The moral of how to bridge the gap between what it should be and how now prevailing is one step forward to change life style in the direction of greatest possible benefit to this grief-stricken mankind. Nobel Prize in Literature (NP.Lit) is considered the pinnacle of achievement for creative writers, and Gurnah is the first Tanzanian to win. Wole Soyinka in 1986 and Toni Morrison, in 1993 were the two African writers who won Nobel prize earlier in literature.

**Table 4 Focal theme(a) of Nobel Prize Literature in 2021**



|                     |                                                                                                                                                                                                                                       |                                                                                                       |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Obj_achieved</b> |  Uncompromising and compassionate penetration of the effects of colonialism and the fate of the refugee in the gulf between cultures and continents. |  Abdulrazak Gurnah |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|

| Residence at the time of the award | Nobel Laureate (Literature)<br>Photo, Date & place of birth                                                                | Share |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------|
| England                            | Abdulrazak Gurnah<br><br>1948, Zanzibar | 1/1   |

**Abdulrazak Gurnah** was born in 1948 in Zanzibar, a semi-autonomous island in the Indian Ocean, lying 35 km off the coast of east-central Africa. In 1964 Zanzibar, Pemba and a few other smaller islands were joined with Tanganyika on the mainland forming United Republic of Tanzania. Kiswahili was his first language but Arabic and Persian poetry (especially *The Arabian Nights*) and *Quran's surahs*, *works of Shakespeare to V. S. Naipaul* were significant wellspring in getting touch with literary flavor. Gurnah went to Christchurch College Canterbury Britain as a student in 1968. He started writing in English when he was twenty-one years old. He is now Professor Emeritus of English and Postcolonial Literatures at the University of Kent, after retirement from formal faculty position in 2017. The focus of his research principally is around writers viz. Wole Soyinka, Ngũgĩ wa Thiong'o and Salman Rushdie

Gurnah has published ten novels, number of short stories, edited Essays on African Writing (two volumes) and 'A Companion to Salman Rushdie' (Cambridge University Press). His main academic interest is in postcolonial episodes and reality perception with intra-/inter displacement, migration, colonialism concerned with people of Africa, the Caribbean and India.

|                                                                                                                                                                                |  |                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Works of Abdulrazak Gurnah</b><br><i>Memory of Departure</i> 1987<br><i>Pilgrims Way</i> 1988<br><i>Dottie</i> 1990<br><i>Paradise</i> 1994<br><i>Admiring Silence</i> 1996 |  | <b>Awards. Abdulrazak Gurnah</b><br>2006 Commonwealth Writers Prize (Eurasia Region, Best Book)<br>2001 Los Angeles Times Book Prize (Fiction)<br>1994 Booker Prize for Fiction |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



**Mapping (representation) of External (social) world of colonization in the brains of settlers and public:** The inner motto of Gurnah's exposition with literary tools is to drive the society with Pareto-optimal changes for the greatest benefit to humankind in undesirable but investable colonization prevailing for over two centuries. The characters in the fiction are constantly negotiating between their lives in new place with their past experiences in their birth/childhood time. The characters do not have any contact with their past families. The premise is migration to a new geographical and social context has a shattering impact on character's identities. This is because the conditions of the outsider are different, may be as a result of ethnic, religious, moral or social inequalities. Gurnah points out that migration and colonization consequences were the order of day reflecting profiles of lives, and definitely not his autobiographical experience. Although, travelling far away from home exposes to broader perspective of new environmental and socio-cultural life-style, it intensifies recollection which is the writer's hinterland. This is followed by continuously re-constructing a newer identity for themselves to reorient with maximum permissible fitness in their new environments.

For centuries, Europeans had been streaming out into the world. Nothing new and it is not a news. But, people from Africa coming to Europe is a relatively recent. An un-noticed, ignored or dormitory fact is they are not completely empty vessels. A lot of them are talented, energetic, who have something useful to give, although they cross the borders empty handed. The receiving country also, first provides succour to people who are in need. Then, the poverty-stricken individuals infuse into energy production to their competence though not in bigger ventures (save exceptions).

<https://www.nobelprize.org/prizes/peace/2021/summary/>

## Nobel Prize in Peace 2021

The Nobel prize for Peace of 2021 (NP.Peace.2021) is shared between Maria Ressa and Dmitry Muratov for their courageous verbal fight through journalism to safeguard freedom of expression in their home lands namely Philippines and Russia, These two peace activists, in fact, voice the mind/practice of all journalists who stand up for this noble ideal in a world, where, press faces increasingly adverse running conditions in delivering news to the common public with happenings as-and-when-they-crop-up. Democracy within a country, disarmament, promotion of fraternity between nations, are sustained with their true spirit in time and space, if and only if (iff) unconditional/uncompromised freedom of expression of thoughts/inferences prevails in the social/political front. It is a precondition for ever-lasting peace to humankind.

**Table 5 Focal theme(a) of Nobel Prize for Peace in 2021**

|                                                                                                                                   |                                                                                                                                                       |                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <b>Obj_achieved</b>                                                                                                               | <ul style="list-style-type: none"> <li>Efforts to safeguard freedom of expression, which is a precondition for democracy and lasting peace</li> </ul> | <ul style="list-style-type: none"> <li>Maria Ressa</li> <li>Dmitry Andreyevich Muratov</li> </ul> |
| <a href="https://www.nobelprize.org/prizes/peace/2021/ressa/facts/">https://www.nobelprize.org/prizes/peace/2021/ressa/facts/</a> |                                                                                                                                                       |                                                                                                   |

**Maria Ressa:** Maria was responsible for CNN's Manila Bureau for nearly a decade in nineteen eighties in investigating terrorism in South east Asia. During 1995-2005, she opened the network's Jakarta bureau and brought to light the seeds of terror.

Ressa heads Rappler, a digital media company for investigative journalism, which she co-founded in 2012. She is a fearless defender of freedom of expression and brought to light the episodes of murderous anti-drug campaign, disinformation, fake news, harassing opponents and manipulating public discourses of the Governness. Maria's focus is on exposing abuse of power, use of violence and growing authoritarianism, misuse of social media for a cool-spread of mis-information/distorted facts and slogans of choice in the Philippines, her motherland. Rappler, continues to be the leading top digital-news-site striving hard to uphold freedom of press under the stewardship of Maria as CEO and president in spite of the fact she endured arrests and constant political harassment.

| Role       | Nobel Laureate (Peace)<br>Photo, Date & place of birth | Share |
|------------|--------------------------------------------------------|-------|
| Journalist | Maria Ressa                                            | 1/2   |



2 October 1963, Manila, Philippines

| Typical Awards of <a href="#">Maria Ressa</a>                                                                                                                                                                                 |                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Free Media Pioneer Award</li> <li>Sergei Magnitsky Award for Investigative Journalism</li> <li>Journalist of the Year-2020 award</li> <li>John Aubuchon Press Freedom Award</li> </ul> | <ul style="list-style-type: none"> <li>Most Resilient Journalist Award</li> <li>Tucholsky Prize</li> <li>Truth to Power Award</li> <li>Four Freedoms Award</li> </ul> |
| Name of Award                                                                                                                                                                                                                 | Received from                                                                                                                                                         |
| ✓ Golden Pen of Freedom                                                                                                                                                                                                       | ▶ World Association of Newspapers and News Publishers                                                                                                                 |
| ✓ Knight International Journalism Award                                                                                                                                                                                       | ▶ International Center for Journalists                                                                                                                                |
| ✓ Gwen Ifill Press Freedom Award                                                                                                                                                                                              | ▶ Committee to Protect Journalists                                                                                                                                    |
| ✓ Shorenstein Journalism Award                                                                                                                                                                                                | ▶ Stanford University                                                                                                                                                 |
| ✓ Columbia Journalism Award                                                                                                                                                                                                   | ▶ International Press Institute                                                                                                                                       |
| Maria Ressa Named as                                                                                                                                                                                                          |                                                                                                                                                                       |
| ! Time Magazine's 2018 Person of the Year                                                                                                                                                                                     | ! One of 100 Most Influential People of 2019                                                                                                                          |
| ! One of Time's Most Influential Women of the Century                                                                                                                                                                         | ! BBC's 100 most inspiring and influential women of 2019                                                                                                              |
| ! Prospect magazine's world's top 50 thinkers                                                                                                                                                                                 |                                                                                                                                                                       |

[Dmitry Andreyevich Muratov](#): Novaja Gazeta is an independent newspaper running in the foot-steps of fact-based journalism with a critical eye on misuse of power, maintaining at the same time professional integrity. It was started in 1993 by Dmitry (five years after leaving Komsomolskaya Pravda, a popular daily paper) with a group of fifty like-minded people. It was a lofty startup with two computers, one printer, two rooms, and no money for salaries. The former Soviet President Mikhail Gorbachev, donated part of his 1990 Nobel Peace Prize money to support computers and salaries. Thus, the paper survived, subsequently, there was rise in circulation from 70,000 to 100,000 copies by 1996. In 2018, it celebrated silver-jubilee event in spite of several hurdles and paying the price of lives of six journalists devoted to the paper. Dmitry Andreyevich Muratov remained editor-in-chief since 1995, although he wished to close the activity yet times. His fact-revealing straight forward critical watchful eye mirrored high-level corruption, human rights violations, abuse of power, police violence, unlawful arrests, abuse of power, lies, electoral fraud, war

propaganda and "troll factories" to the use of Russian military forces both within and outside Russia. Dmitry committed to his conscientious agenda of adhering to independent policy in transmitting news, and point blank uncompromising editorial line. This saga was continued complying with the professional ethical standards of journalism at the same time. He could pull on the cart till to date without succumbing to authority in spite of suffering all the harassment, threats, violence and even killing of his dedicated co-workers horribly. One million readers now share the values of real democracy and not its imitation-to-the-advantage-of-governance.

| Role       | Nobel Laureate (Peace)<br>Photo, Date & place of birth                                                                                                             | Share |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Journalist | <b>Dmitry Muratov</b><br><br>1961, Kuybyshev (now Samara), USSR<br>(now Russia) | 1/2   |

<https://www.nobelprize.org/prizes/economic-sciences/2021/summary/>

## 2021 Nobel Prizes in Economics

The Nobel prize in Economics of 2021 (NP.Econo.2021) is shared between David Card (Univ. of California), Joshua D. Angrist (MIT) and Guido W. Imbens (Stanford Univ) for empirical approaches, and methodological analysis of causal relationships in labor economics.

The new insights in conclusions drawn from natural experiments benefitted a section of working labor. The combined contribution of the Laureates, however, is larger than the sum of the individual parts. Thus, although they are separate, yet complementary. Peter Fredriksson, chair of the Economic Sciences Prize Committee says that the ingenious, innovative and intriguing research of the three laureates improved the ability to answer key causal questions. This is of great benefit to society in the labor market.

**Big questions:** Many of the big questions in economics (and other social sciences) appear obvious and had been answered by deterministic, stochastic, chaotic modelling methods. The other side of the coin is still, the questions themselves are incomplete, ill-understood, solution-methods are in the evolutionary phase from the stand-point of Fourth paradigm-Big data-complex-systems.



The basic approach in vogue since more than a century is based on the premise that effect (response) depends on a number of causal factors. How to choose factors, relationship between causes and effect in model equations ran in foot-steps of mathematical solution methodology. we have nothing to use as a comparison of model output.

| Big and natural queries |                                                                                                                                                                                                         |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>?</u>                | How does immigration affect pay and employment levels                                                                                                                                                   |
| <u>?</u>                | How does a longer education affect someone's future income                                                                                                                                              |
| <u>?</u>                | How does fertility affect parental labor supply                                                                                                                                                         |
| <u>?</u>                | What additional medical care is required for new-borns with a low birth weight (< 1,500 grams)                                                                                                          |
| <u>?</u>                | How many will return to specific educational programs or certain types of schools.                                                                                                                      |
| <u>?</u>                | Are there more chances to win the next election, just because he or she is in power                                                                                                                     |
| <u>?</u>                |                                                                                                                                                                                                         |
| <u>?</u>                | The underlying variation (i.e., the natural experiment) can come from policy changes, administrative rules, naturally occurring random variation (, or from unforeseen events (e.g., immigration flows) |

**Structural equation for Cause-and-effect models:** Many tasks in economics within the frame work of causal inference (effect) were solved by specification of systems of equations capturing behavioural relationships (Wright (1928) and Trygve Haavelmo (1943, 1944), Nobel Laureate in 1989). By the early 1980s, the difficulties associated with correctly specifying a structural model became clear. These findings provided an important impetus to this year Laureates' innovations

**Natural experiments:** It is an event or a situation, that is not under the control of the subjects under study, Natural experiments provide a powerful complement to controlled experimentation; uncover causal effects and is a rich source of knowledge The causative factors are influenced by naturally occurring variables (birth dates, weather shocks), unforeseen events (immigration flows) or policy changes of institutions administrative rules. They are judiciously selected and considered as random variables. A study design invoked for each task on hand and variations in effect (response) are monitored. It generates variation in the variable of interest that is as if it had been randomly assigned.

**Quasi-experimental:** The variation comes from many experiments provided by nature, administrative borders, institutional rules, and policy changes.

**The design-based approach:** It features a clear statement of the assumptions used to identify the causal effect and validation of these identifying assumptions. This approach has become dominant within economics and has also spread to the other social sciences The design-based approach uses mainly quasi-experimental, but also experimental variation to estimate the causal effect of interest.

| Table 6.1 Focal theme of Nobel Prize for Economics in 2021 |                                            |            |
|------------------------------------------------------------|--------------------------------------------|------------|
| <b>Obj_achieved</b>                                        | Empirical contributions to labor economics | David Card |

| Affiliation                                | Nobel Laureate (Economics)<br>Photo<br>Date & place of birth                                                             | Share |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------|
| University of California,<br>Berkeley, USA | David Card<br><br>1956, Guelph, Canada | 1/2   |

**Card's research:** David Card and his group (Alan Krueger, who passed away in 2019, Angrist et al.) analyzed a number of core questions in labor economics using natural experiments. A typical instance is how minimum wages, immigration and education policy affects labour market. He faced that conventional wisdom was challenged during arriving at optimum solutions. Card resorted to an iterative process of replications, newer models/solution methods, and theoretical frameworks. The outcome played a crucial role in shifting the focus in empirical research using observational data towards more trust-worthy quasi-experimental variation in establishing causal effects.

There is glaring impact of Card's system of analysis, during last on two decades, in better understanding of how the labor market operates

**Table 6.2 Focal theme of Nobel Prize for Economics in 2021**

**Methodological contributions to the analysis of causal relationships**

- Joshua D. Angrist
- Guido W. Imbens

| Affiliation                                              | Nobel Laureate (Economics)<br>Photo<br>Date & place of birth                                                                         | Share |
|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------|
| Massachusetts Institute of<br>Technology, Cambridge, USA | Joshua D. Angrist<br><br>1960, Columbus, OH, USA | 1/4   |

|                          |                                                                                                                                                                                                            |     |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Stanford University, USA | <p style="text-align: center;">Guido W. Imbens</p>  <p style="text-align: center;">3 September 1963, the Netherlands</p> | 1/4 |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|

**Angrist and Imbens' research:** In the mid-1990s, they proposed a theoretical frame work for the analysis (answering) of empirical questions using data generated from either natural or randomized experiments even with incomplete compliance to the assigned treatment. The chance events or policy changes result in groups of people being treated differently, in a way that resembles clinical trials in medicine. It was possible to estimate a well-defined causal treatment effect under a minimal set of conditions, even if individuals are differently affected by the intervention and even if there is imperfect compliance. This approach has added advantages of estimating an average treatment effect (local average), drawing precise conclusions about cause-and-effect approach, using data from natural experiments, rendering nature of the identifying assumptions more transparent, performing sensitivity of empirical designs of causal effects and interpreting results. They showed that effect could be estimated by instrumental variables

**Last 30 years research:** This year's Laureates laid the ground for the design-based approach. The progressive advances in empirical, quasi-experimental and designed based workflows improved tremendously the ability (precision/accuracy/reliability) to answer causal questions in economics and implementation of social policies.

# Information Supplementary (Is)

## SI.1: First Response of Noble Prize Winners of 2021

|                          |                                                                                                                                                                |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interviewer (Telephonic) | Dr. Adam Smith (AS)<br>Chief Scientific Officer of Nobel Prize Outreach<br><a href="http://Nobelprize.org">Nobelprize.org</a> , the website of the Nobel Prize |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Nobel Laureate (2021)                                                                                             | First Response                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>David Julius</p>  <p>Med</p> | <p>! I talked to my mom on phone. that's very important</p> <p>☞ She's like overwhelmed,</p> <p>☞ 'This is just unbelievable,' she said,</p> <p>☞ 'but, you know, <b>you work so hard, you deserve it!</b>'</p> <p>■ AS: Good, she's behaving exactly as a mother should do, fantastic, yes</p> <p>! DJ: Exactly, right. So, she's very proud, and she's probably a little bit in shock, as we all are</p> |

| David W.C. MacMillan in lab 2016                                                                |                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>Chem</p> | <p>! Obviously for anyone, it's extraordinarily welcome news</p> <p>! I'm incredibly... i'm still trying to handle it</p> <p>! I'm sure you've talked to a lot of people in this position, and you get the same response</p> <p>! It's hard to get your feet underneath you,</p> <p>! To a certain extent, you're just trying to take it all in.</p> |

| <p>Benjamin List,</p>  <p>Chem</p> | <p>! It was like a... like a dream</p> <p>! I had to deeply breathe in and out; then</p> <p>! I felt like I had to feel composed enough at least</p> <p>■ AS: How lovely to be with the family when you get the call of Nobel award.</p> <p>! BL: Yeah, exactly. It was so beautiful, just my wife and I sitting in a coffee shop</p> <p>! She's been there all those years, from the end of my PhD until today.</p> <p>! So she was there when the discovery was made</p> <p>! She supported me over all those years</p> <p>! It's great to, to actually get the call when she is around</p> <p>! I'm happy to... I mean,</p> <p>! It's kind of... I know that comes with...</p> <p>! With this award, I'm happy to fulfil my duty</p> <p>! Because I consider it a duty also, right? I mean, this is kind of a... yep</p> |
|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| <p>Giorgio Parisi, Phys.</p>  <p>after delivering a lecture at Sapienza Università di Roma in 2018</p> | <p><b>Happy</b></p> <p>! I'm very happy for. for... also because</p> <p>! it's a recognition of the importance of the field on which I've been working for so much time</p> <p><b>Complex systems in physics</b></p> <p>! I have developed, because I was one of the founders of the study of complex systems in physics</p> <p>! So, I am very happy that all this lifelong work has been recognised by the Nobel Prize</p> <p>! not only by other prizes</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



| <p><b>Klaus Hasselmann, Phys.</b></p>  <p>  Employees from the Max Planck Institute for Meteorology,<br/>  German Climate Computing Center and<br/>  University of Hamburg, 5 October 2021         </p> | <p><b>Surprise</b></p> <ul style="list-style-type: none"> <li>! I'm completely surprised,</li> <li>! I can't quite understand it, but I get it. Okay, wonderful</li> <li>! "I'll wake up tomorrow morning and find out,"</li> </ul> <p><b>Happy</b></p> <ul style="list-style-type: none"> <li>! Well I'm very happy that they put the attention on the climate problem, which is very important</li> <li>! Whether they put the attention on myself; I don't know, we'll see what happens. Probably not. I forget so many things that the journalists will probably give up pretty soon, interviewing me</li> </ul> <p><b>Pure Science</b></p> <ul style="list-style-type: none"> <li>! yes. I can... I am a physicist, and I came to climate as a physicist so, this is true, yeah</li> </ul> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| <p><b>Syukuro Manabe Phys.</b></p>  <p>1997</p> | <p><b>Surprise</b></p> <ul style="list-style-type: none"> <li>! I never thought that I receive the Nobel Physics Prize for the work which I enjoyed very much to do throughout my lengthy career which last more than 60 years, and ...</li> <li>! but I have been doing science of climate change</li> <li>! nobody received physics prize for my kind of work.</li> </ul> <p><b>Appreciation</b></p> <ul style="list-style-type: none"> <li>! I really appreciate that the Swedish Academy of Science to choose this field – climate topics, climate change,</li> </ul> |
|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| <p><b>David Card, Econo</b></p> | <ul style="list-style-type: none"> <li>! Pardon me? My wife is here making... I'm standing here in my pyjamas – my wife's just taken a picture of me, kind of making fun of me.</li> <li>o AS: Well, you know</li> </ul> |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



what, she should... rather than making fun of you  
what I'd like her to do is to send me that picture!

**Guido Imbens, Econo**



Guido Imbens receiving phone calls  
on the morning of the announcement

**Excitement**

- ! "I'm sure that the adrenaline will get me through"
- ! [Laughs] Well, things have been hectic here anyway. I'm not getting much sleep.
- o AS: No, the day has... the day is well underway.
- ! GI: Yes, exactly.

**Econo**

Angrist celebrates with his wife Mira Angrist at home



11 October 2021: Day of the announcement of prize in economic sciences

**Surprise**

- ! It's wonderful, it's overwhelming. It's... you know,
- ! it's the beginning of the day here in the United States, and
- ! I'm trying to absorb it
- ! I am especially happy to be grouped with Dave Card and Guido Imbens, who are certainly worthy, and, you know,

**Gratitude**

- ! I'm lucky to have been able to work with them and learn from them.
- !
- o AS: Right, okay, great. Given that you're in the business of collecting evidence for causal relationships, yeah, you wanted to be certain.
- !
- ! JA: Yeah, I wanted to be sure ... yeah, I didn't really expect it, I suppose everybody says that, and you're supposed to say that. But I think in my case my lack of preparation is evidence that I didn't expect it

great ideas change the world  
MIT SCHOOL OF HUMANITIES ARTS AND SOCIAL SCIENCES



## SL2: Noble words of Nobel Laureates (2021)

(NL) David Julius & Prof Holly Ingraham



**Med**

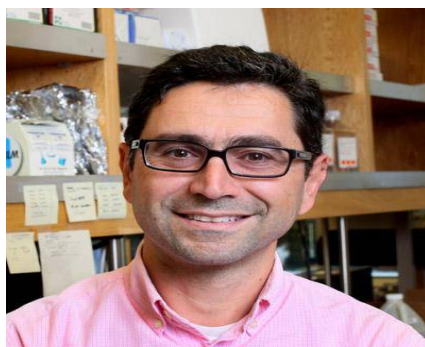
### **Open heart**

- ☞ The most beautiful experiment(s) I've ever done are the ones I did when I was a graduate student
- ☞ because I did with my own hands
- ☞ The other (results of **electron cryo-microscopy** gave) thrilling moments
  - Really beautiful moment to see the molecule that
    - one has been thinking about and
    - working on for some 20 years and
    - actually seeing it in the flesh (with third eye i.e. Science)

### **Scientists' scientific Success -- awards**

- ! You know there are so many great scientists there
- ! So many amazing discoveries
- ? What are chances
- ☞ Because there's so many great things happening in terms of discovery
- ☞ No matter what you think
- ☞ There's a lot of people out there who could be recognized by something like Nobel prize
- ☞ So, it is pretty astounded

Ardem Patapoutian, **Med**



[www.joac.info](http://www.joac.info)

**Environment : Men, material, Mind**

- ☞ In science, many times we focus on the big questions
- ☞ But the things that we take for granted that are of high interest
- ☞ I think it's the environment, the people around you, and just to, kind of, focus on big questions that can be answered
- ☞ But you have to ask it at
  - right place
  - right time
  - where the tools are present
- ☞ to answer those questions



**We looked  
everywhere**

David W.C. MacMillan, **Chem.**





- ➔ I think everyone, all scientists, have these kinds of wacky ideas along the way
- ➔ some of them work and some of them don't work

- ! And this was one that, you know, came and was successful and went forward,
- ! it sounds obvious to say we were lucky – but we were lucky
- ! there's way more... way more ideas fail than ever succeed, and this was one that, you know, we were very excited about at the beginning,
- ! we thought it had a very low probability of success, but it took off, and it took off like gangbusters. And that was, that was wonderful to see.

- o I think you have to gamble.
- o I think that's why scientists in my opinion have the greatest job in the world, because we get to show up everyday, we get to take these sort of risks, and we get to work on things that should never work.
- o And if you think about it, it's the stuff that should never work which is where all the good stuff is, because there's always... well, knowledge is incredibly important.
- o There's always parts of knowledge which are over-stated
- o or underappreciated too
- o so there's definitely things that people believe would never work
- o that have a fantastic chance of getting there, and I think, honestly, I'm one of those people, there's many like me, who think we've just scratched the surface on that kind of way of thinking.

- ! best ideas in science are often the ones with the least chance of succeeding
- o It's the stuff that should never work which is where all the good stuff is!"

Giorgio Parisi, **Phys.**

- ✓ AS: Do you choose problems that are seemingly almost impossible? How hard should the problem be?
- ✓ GP: Look, the problem may be relatively simple
  - ☞ But I mean there are very, very simple problems that are very hard to understand
  - ☞ but maybe, I mean, not impossible; but very hard... extremely hard to study
  - ☞ and we really don't... we are not able for the moment to understand precisely

#### Importance of the fundamental science behind understanding climate change

- + Because fundamental science is crucial for understanding everything, and will not go too much towards, only in applied science,

- + But it's important that applied science and fundamental science go together
  - + Because many times the application from fundamental science to applied science
  - + Applications that can be useful to humanity comes in some unexpected ways from your science
- 
- ! some countries like South Korea that spend a high percentage of money on fundamental science
  - ! Italy is very low level, but I hope and am confident that in the future this thing is going to change.

Syukuro Manabe, Phys.



### Importance of the fundamental research

- ! “The prediction of climate change without accompanying understanding of it
  - is no better than the prediction of a fortune teller
- ? interested in meteorology and the climate in the first place  
I went to graduate school of University of Tokyo. Then that was graduate school for geophysics, I decided to focus on meteorology
- At that time weather forecasting was more of an art, rather than science.
  - You know, look at the past weather map and make a forecast based upon the sort of country and experience
- ✓ Von Neumann, a pioneer of computers
- ! At that time at Institute of Advanced Study, Von Neumann, who is a pioneer of computers, among many other things, decided to do weather forecasting based upon laws of physics, which is the hydrodynamical equation, right? And so he started small groups and started studying weather forecasting
  - + And this is the beginning of daily weather forecasting, which has become indispensable for our daily life.

Guido Imbens, **Econo**

- ✓ I get up in the morning and I like going to work
- ✓ I like working with the students, working with young, smart people
  - + There's nothing better than that

**Joshua D. Angrist, Econo****Methodological analysis of causal relationships**

- ✓ I guess we didn't really know quite how important?
- ✓ We set out to kind of figure out
  - what instrumental variables,
  - which is the statistical technique that Guido and I have studied together most closely
- ➔ part of my applications, developed with his theoretical insights
- ➔ we went back and forth between applied questions and methodological questions
- ➔ came up with a whole framework
- In the beginning it was one paper, and then that paper didn't get published
- ✓ second paper that did get published
- ✓ then it developed further

- ✓
- ✓ People today call it the LATE framework

### SL3: Gratitude expressed by Nobel Laureates (2021)

#### David Julius, **Med.**



To  
 Doctoral advisor: Randy Schekman  
 Postdoctoral advisor: Richard Axel  
 Co-mentor: Jeremy Thorner

#### Characteristic energies

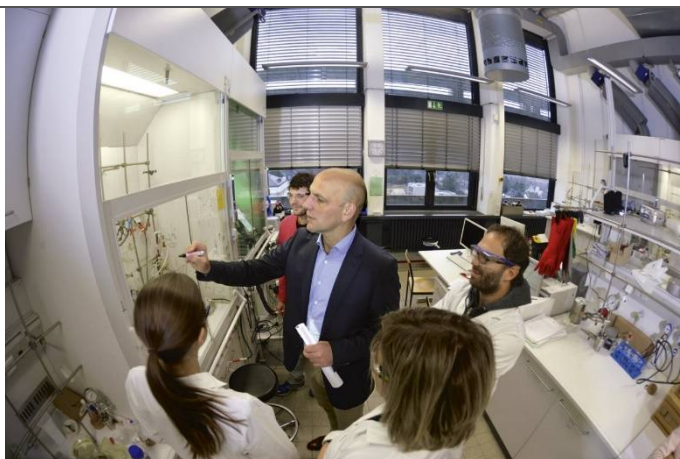
- + They're all unbelievably curious, that's the main thing
- + They're rigorous
- + Always... they have so much energy

#### Interactions with knowledge resources

- ✓ They're always intensely interacting with their groups, encouraging them to ask difficult questions
  - o You just sort of get a sense when you're with those people
  - o Where the bar should not be in terms of doing science →
- ✓ And really investing yourself in it
- ✓ I guess that's kind of what drew me to them in the first place; I figured that out even when I was young.

#### Curiosity

- ✓ But you know they have an intensity and a curiosity that's just really special

**Benjamin List in his laboratory in Mülheim, Chem****My host institution**

- ☞ Okay, now is a good moment
- to thank my, my host institution, and that's the Max Planck Society of course.
  - Because, like the Max Planck Society, I also believe that
- ! what it takes to, to do... to be creative is freedom.

**Funding agencies**

- ☞ A sort of the trust by your funding agencies.
- They think, okay,
  - 'this scientist has great ideas let's give him the space and the resources to fulfil his dreams'.

**Research students**

- ☞ my graduate students will not be opposed to what I'm going to say, but
- I think I'm not a slave driver,
  - I'm not saying 'work harder, work harder, work day and night' – it's not my philosophy.
  - I also encourage them to think
  - Promote to enjoy life
    - whenever we have something to celebrate, we celebrate it
      - like somebody has a nice little discovery, then we have a little party in our seminar room
    - Even if we, occasionally we may not have something to celebrate, we still do it.

**Wife**

- ☞ Yeah, exactly. It was so beautiful, just my wife and I sitting in a coffee shop, it's great to, to actually get the call when she is around
- ☞ You know, she's been there all those years, from the end of my PhD until today
- ☞ And so she was there when the discovery was made
- ☞ she supported me over all those years

**Giorgio Parisi, Phys**





After a lecture at Sapienza Univ di Roma in 2018

#### Mentor

- ! My mentor Nicola Cabibbo was usually saying
- ! We should work on a problem only if working on the problem is fun
- ! So i tried to work on
  - + Something that was interesting
  - + (I believed) had some capacity to add something

#### Joshua D. Angrist, Econo



#### Advisors

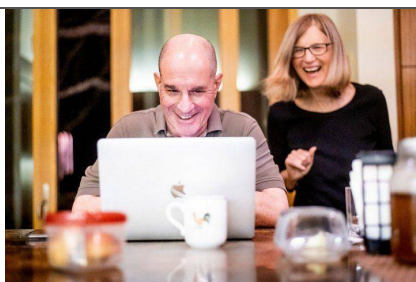
- ➔ I was one of David Card graduate students; he surely had a huge influence on me and my development as an empiricist.

#### Collaborator

- ➔
- ➔ Guido Imbens was one of my first collaborators
- ➔ we embarked on a path of methodological work that proved to be very rewarding to us and, and influential.
- ➔ But Guido and I kept collaborating and we, we had started on something that we thought was interesting and important.

### SL4: How Noble prize award message reached the recipient

NL. David Julius, **Med**



**Professor Holly  
Ingraham, wife  
of Julius**

- ☞ Well it was actually quite strange.
- ☞ I was nicely asleep and my phone, which I had by my bed going 'rrrrrr', so I look at the you know 'what's this all about?' dinging, and
- ☞ there's a text in there from my sister-in-law who lives in California, in Santa Cruz, and she says, let's see, I'll look at the text, she says, I thought it was some kind of a prank, anyway it said, I don't know, it's buried back here now, I get so many texts.
- ☞ But it said something like 'someone's been trying to reach you by the name of Thomas Perlmann, and I didn't want to give him your phone number, so... but here's his phone number'.
- ☞ And she said, 'I looked him up on the web, he seems like a reasonable guy' or something like that. Anyway, so, then I said 'okay, well then...' It came on my wife's phone too so she kind of woke up.
- ☞ And I said 'what do you think about this'. So she called and he said, 'I've been trying to get a hold of David, so then I spoke to him, and he said 'I have about three minutes and I'm so happy to talk to you but I now have to go out and do the announcements, so call me back in an hour'. So I have to call him back in, you know, 20 minutes. Anyway, so that's how it happened
- ☞ Yeah I can't tell you how... 'It's a prank, don't call Thomas'. Anyway, oh then Thomas said, 'You should go to the YouTube and watch the announcement'. So that's the first thing I did, sat here in the kitchen and watched the announcement

Ardem Patapoutian, **Med.**

With his son

**Do not disturb on phone**

- ☞ I had 'do not disturb' on my phone actually
- ☞ So I didn't get phone calls from Thomas Perlmann (Secretary-General for the Nobel Assembly at Karolinska Institutet and of the Nobel Committee for Physiology or Medicine)
- ☞ Somehow found my father's phone, who's 92 years old, lives in Los Angeles
- ☞ My father called me.
- ☞ And so, I heard it from him, which was very special

**Prof. Dr. Benjamin List with his wife Dr. Sabine List**

- ☞ 60 seconds after the call from the Royal Swedish Academy of Sciences telling him the news about being
- ☞ Awarded the 2021 Nobel Prize in Chemistry
- ☞ 6 October 2021, Selfie by Benjamin List, **Chem.**

- ☞ AS: Tell me how you heard the news
- ☞ BL: Well, I was sitting in the coffee house with my wife. We were about to have breakfast
- ☞ And then the phone came and, on the display, it said Sweden
- ☞ we looked at each other in disbelief, like jokingly, 'is this the call?' you know.
- ☞ I went outside, and it was the call.
- ☞ So that was really... I don't know, it was like a... like a dream.

**David W.C. MacMillan, Chem.**



6<sup>th</sup> Oct, 2021

### Thought prank call

- ☞ MacMillan initially thought it was a prank,
- ☞ Bet his co-laureate, Benjamin List, \$1000 that it wasn't true, and went back to bed!
- ☞ AS: Did you actually get the call from Stockholm?
- ☞ DM: No, I didn't. I got a text from someone in Stockholm, where my name was wrong, and I assumed it was a prank call. I've had a lot of mischievous ex-co-workers over the years, I just assumed it was one of them having a prank,
- ☞ so I actually just went back to sleep.
- ☞ AS: And when did the news actually reach you?
- ☞ DM: Well the news reached me because, after I'd... Actually the other winner, Ben List, also was trying to contact me. I contacted him. He told me what was happening and I said I actually didn't believe him too. I thought maybe the same person was pranking him, so I basically bet him \$1,000 dollars that this was not happening, went back to sleep,
- ☞ and then woke up with my phone going crazy, and I was \$1,000 down but a very happy person
- ☞ Yeah, I mean the very first moment I came out of my driveway and there was press at the bottom of the driveway, which is... doesn't usually happen to me on a Wednesday morning, I would say. And then when I got to work there was press in the parking lot there too, so that was unique, and it's just been a sort of whirlwind ever since. But what's wonderful is these fantastic people sitting beside me, the communications folks at Princeton, who are just top, top range professionals at dealing with this kind of stuff, so they're keeping me in check, which is good.

### Klaus Hasselmann, Phys.

- ➔ I got a call about 10 minutes ago, which my wife took,
  - ✓ she explained that something was going to happen, which I didn't quite understand, and apparently this was this Nobel Prize
  - ! So I was quite surprised

!

AS: It sounds as if it's come from a real bolt from the blue for you

KH: Well it did, it's entirely the bolt from the blue.

I'm quite... I'm quite [unclear]

I can't understand this.

I'll wake up tomorrow morning and find out. Yeah. [Laughs]

Abdulrazak Gurnah, **Lit.**



Lectruing univ of Kent

**Thought prank call**

AG: He rang, I'm sorry, what's the name of the permanent secretary?

AS: Mats Malm.

AG: Yep. He just rang me about 10 minutes, 15 minutes ago, and I thought it was a prank.

I really did. Because, you know, these things are usually floated for weeks beforehand, or sometimes months beforehand, about who will the, you know, who are the runners as it were, so it's not something that was in my mind at all.

I was just thinking 'I wonder who'll get it'.

AS: Indeed, indeed. And okay, you took some convincing. How did he convince you?

AG: Well, he kept talking quietly, and I... and I... then he told me about the... the website, the Swedish Academy website, and I said well 'I'll go and check

in a minute, but just tell me some more'. So he just kept talking calmly, and I suppose in the end I was still thinking 'I'll wait until I see it, or hear it'. And that's what I came up here to do. So...

AS: Well, there it is. It's real.

AG: Yes, indeed. Yes, indeed it is, yeah.

David Card, **Econo.**





AS: And were you asleep when it came?

DC: No I just got, actually I just woke... I actually literally had flown back 20 minutes ago from the airport from a memorial for my grandmother who passed away recently

AS: I'm sorry

DC: I had just got my pyjamas on and was heading for bed

- Call from Stockholm came ... my home phone number
- We actually have a kind of weekend house
- We're actually there right now
- But the call forwarded to my wife's cell phone

Guido W. Imbens, **Econo.**



- ! I actually had a busy day yesterday – we went, I went biking, taking the kids on some orienteering trip
- ! so I was mountain biking myself, so I was pretty tired by the end of the day
- ! I'd managed to go to sleep

AS: Ah, and I think I hear the clanking of coffee cups around you, so maybe that's...

GI: Yes, I'm going to get some coffee here

Joshua D. Angrist, **Econo.**

- Well, I woke up early in the morning for no particular good reason
- I saw that my phone was flooded with text messages
- I had had it off because I was not expecting anything special this morning
- I had to look at the phone. And then I tried to find the phone number that I should call to figure out if it was true

AS: And, so you came through to Stockholm, to the Nobel Foundation offices

JA: Actually I called someone at MIT who had called me

AS: And, and so you spoke to someone who confirmed it

JA: Yes, our press office