Web of Science Group

A Clarivate Analytics company

Highly Cited Researchers

2019

Identifying top talent in the sciences and social sciences.

Researcher Recognition

Highly Cited Researchers are among those who have demonstrated significant and broad influence reflected in their publication of multiple papers, highly cited by their peers over the course of the last decade.

These highly cited papers rank in the top 1% by citations for a chosen field or fields and year in *Web of Science*.

Of the world's population of scientists and social scientists, the Web of Science Group's *Highly Cited Researchers* are one in 1,000.

Overview

The list of *Highly Cited Researchers* 2019 from the Web of Science Group identifies scientists and social scientists who have demonstrated significant broad influence, reflected through their publication of multiple papers frequently cited by their peers during the last decade.

Researchers are selected for their exceptional influence and performance in one or more of 21 fields (those used in *Essential Science Indicators*,[1] or *ESI*) or across several fields.

6,216 researchers are named *Highly Cited Researchers* in 2019 – 3,725 in specific fields and 2,491 for cross-field performance. This is the second year that researchers with cross-field impact have been identified.

The number of researchers selected in each field is based on the square root of the population of authors listed on the field's highly cited papers. The number of those with cross-field influence is determined by finding those who have influence equivalent to those identified in the 21 fields.

For the *Highly Cited Researchers* 2019 analysis, the papers surveyed were the most recent papers available to us – those published and cited during 2008-2018 and which at the end of 2018 ranked in the top 1% by citations for their *ESI* field and year (the definition of a highly cited paper).

The threshold number of highly cited papers for selection differs by field, with Clinical Medicine requiring the most and Economics & Business the fewest.

A second criterion for selection is a count of citations by a researcher's peers to highly cited papers that ranks the individual in the top 1% by total citations in an *ESI* field for the period surveyed.

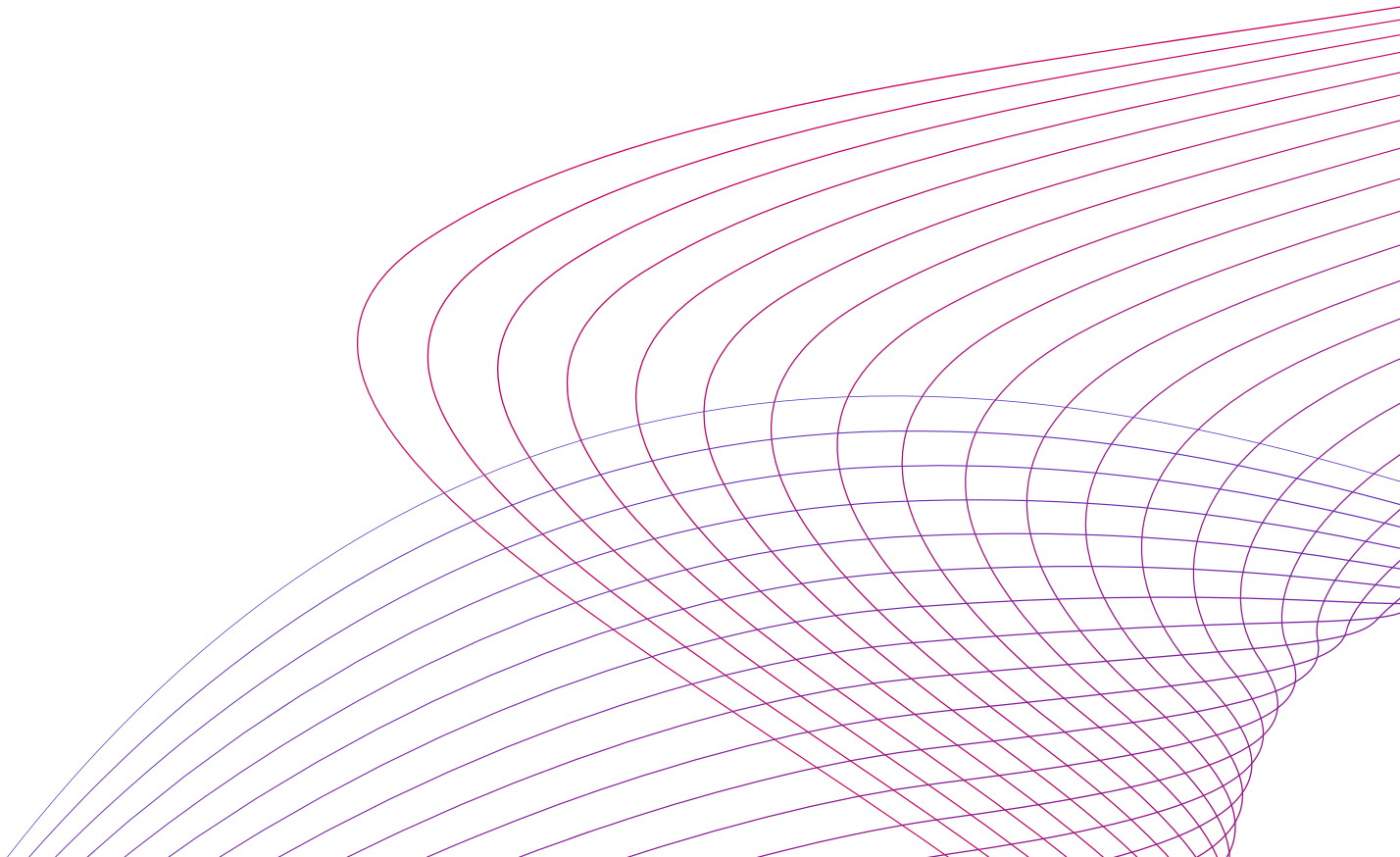
[1] clarivate.com/webofsciencegroup/solutions/essential-science-indicators/

There is no unique or universally agreed concept of what constitutes extraordinary research performance

To identify researchers with cross-field impact, highly cited paper and citation counts are normalized through fractional counting according to the thresholds required for each field (thus, each Clinical Medicine paper has a smaller unit fraction, or counts less, than one in Economics & Business). Citation counts are treated in a similar manner. If the sum of the fractional publication counts and the sum of the fractional citation counts for a researcher equals 1.0 or more, the individual exhibits influence equivalent to a researcher selected in one or more *ESI* defined fields and is therefore selected as a *Highly Cited Researcher* for exceptional cross-field performance.

There is no unique or universally agreed concept of what constitutes extraordinary research performance and elite status in the sciences and social sciences. Consequently, no quantitative indicators will reveal a list that satisfies all expectations or requirements. Moreover, a different basis or formula for selection would generate a different – though likely overlapping – list of names. Thus, the absence of a name on our list cannot be interpreted as inferior performance or stature in comparison to those selected. To understand both the meaning and the inevitable limitations of our analytical approach, a careful reading of the methodology is required:

recognition.webofsciencegroup.com/highly-cited



"*Highly Cited Researchers* wield a vastly disproportionate influence on their fields."[2]

John N. Parker (US National Science Foundation and Arizona State University), Christopher Lortie (York University), and Stefano Allesina (University of Chicago)

[2] John N. Parker, Christopher Lortie, Stefano Allesina, "Characterizing a scientific elite: The social characteristics of the most highly cited scientists in environmental science and ecology," *Scientometrics*, 85 (1): 129-143, October 2010. DOI: 10.1007/s11192-010-0234-4

Who would contest that in the race for knowledge it is human capital that is fundamental?

Talent – including intelligence, creativity, ambition, and social competence – outpaces other capacities such as access to funding and facilities, although these are typically also needed for success.

Recognition and support of the scientific elite, both fully formed and incipient, represents an important activity for a nation or an institution's plans for efficient and accelerated advancement.

The *Highly Cited Researchers* 2019 list from the Web of Science Group contributes to the identification of that small fraction of the researcher population that contributes disproportionately to extending the frontiers of knowledge and gaining for society innovations that make the world healthier, richer, more sustainable, and more secure.

Citations: Pellets of peer recognition

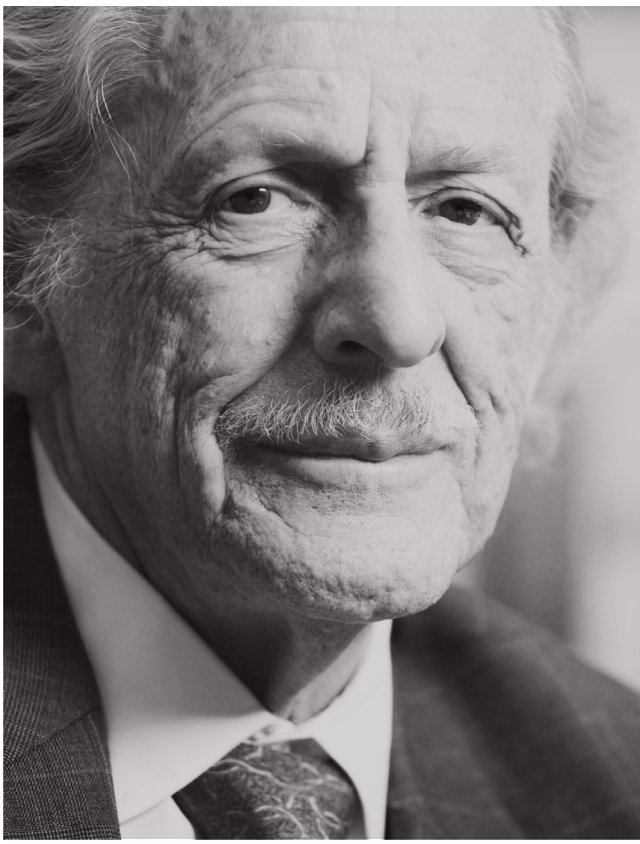
When Eugene Garfield produced the first *Science Citation Index* in 1964, he did so to make searching the literature more efficient and effective. He called his creation an "association-of-ideas index."[3] And the connections he captured between topics, concepts, or methods discussed in indexed papers could be trusted, he argued, because they were based on the informed judgments of researchers themselves, as recorded in the references they appended to their papers.

Thus, the network of citations linking items in *Web of Science* offers a cognitive road map for those seeking to follow the progression of a finding or advancement – a map sometimes leading to unexpected regions that can turn research in a new, promising direction.

The *raison d'être* of *Web of Science* is and always has been to help researchers find the information they need to carry out their investigations. And today the Web of Science Group continues the work of Garfield by providing trusted insights and analytics to enable researchers to accelerate discovery.

A secondary use of a citation index for science evolved in the decade after its introduction: analysis of research performance. Citations, when tallied and especially at high frequency, reveal influence and utility (determining importance and quality, however, requires expert judgment). In 1972, the US National Science Foundation included publication and citation data in its first *Science Indicators* report, which permitted comparisons of national research activity, focus, performance, and growth. In the 1980s, and in Europe particularly, publication and citation data were harvested and deployed for analysis of the research performance of universities.

New Public Management, introduced in universities in the United States, the United Kingdom, and Australia in the 1980s and 1990s, applied business management methods to academia and emphasized performance indicators and benchmarks. Academic scientists and social scientists, who previously rejected evaluation by outsiders and insisted on traditional peer review, have gradually accepted bibliometric assessments because opportunities and rewards tied to such assessments have become institutionalized. Some researchers now list citation data on their CVs and websites, such as a total citation count or an h-index.



Eugene Garfield

[3] Eugene Garfield, "Citation indexes for science: A new dimension in documentation through association of ideas," *Science*, 122 (3159): 108-111, July 15, 1955. DOI: 10.1126/science.122.3159.108

The practice of citing another researcher's work and the interpretation of citation statistics has been debated for many years.[4] Some assert that they convey impact or popularity; others say they function largely as rhetorical devices and collectively create a socially constructed reality. The late Robert K. Merton, the 20th century's leading sociologist of science, called the citation "a pellet of peer recognition."[5] Citations, he said, were repayments of an intellectual debt to others. He emphasized that citation was an essential part of normative behavior among researchers, that it was a considered, formal, and obligatory activity, one that included a moral imperative to cite *others* when appropriate. It is largely this perspective that supports citation analysis to identify research influence. In most fields, there is a moderate positive correlation between peer esteem and citation frequency of papers and people, shown in a variety of so-called validation studies.

Evaluating the research performance of individuals is the most contentious application of publication and citation data. Apart from being an emotionally charged exercise, difficulties include finding comparable researchers or research publications to enable fair comparisons, expecting that influence and impact can be detected quickly when it may require many years, and selecting appropriate indicators, ones in alignment with the agreed priorities and values of a research program. A specific hazard is false precision – making distinctions without any meaningful differences – which frequently arises in dealing with small numbers so often encountered in analyzing the work of an individual rather than that of an institution or nation.

When, however, a researcher's record exhibits top-tier status quantitatively, demonstrated by the production of papers in the top 1%, top 0.1%, or even top 0.01% of a citation distribution, one can be more certain of having positive and reliable evidence that the individual under review has contributed something of utility and influence. Having multiple contributions of this type increases confidence in attributing substantial influence to a researcher's oeuvre.

Still, the *application* of the data (or of the designation 'Highly Cited') – for example in the context of appointment or promotion decisions or in awarding research funds – demands informed interpretation.

This perspective is consistent with two of the recommendations of the Leiden Manifesto (2015): that "quantitative evaluation should support qualitative, expert assessment," and that "assessment of individual researchers [should be based] on a qualitative judgement of their portfolio."[6]

One should never rely on publication and citation data as a substitute for reading and assessing a researcher's publications – that is, for human judgment.

[4] Dag W. Aksnes, Liv Langfeldt, and Paul Wouters, "Citations, citation indicators, and research quality: An overview of basic concepts and theories," *Sage Open*, 9 (1): article number 2158244019829575, February 7, 2019. DOI: 10.1177/2158244019829575

[5] Robert K. Merton, "The Matthew Effect in science, II: Cumulative advantage and the symbolism of intellectual property," *Isis*, 79 (4): 606-623, December 1988. DOI: 10.1086/354848

[6] Diana Hicks, Paul Wouters, Ludo Waltman, Sarah de Rijcke, and Ismael Rafols, "The Leiden Manifesto for research metrics," *Nature*, 520 (7548), 429–431, April 23, 2015. DOI: 10.1038/520429a

Beyond questions of evaluation, Garfield was fascinated by the power of citations to discriminate the typical from the truly exceptional researcher. The power-law nature of the citation distribution allows one to rapidly focus on a small number of top-end 'events,' both papers and people. Over the years he produced many lists of most-cited researchers in almost every field of inquiry. And he took special interest in using citation data to forecast Nobel laureates by identifying a group of researchers he termed 'of Nobel class.'[7]

The Web of Science Group's *Highly Cited Researchers* list extends Garfield's work in recognizing investigators whose citation records position them in the top strata of influence and impact. This year's list includes 23 Nobel laureates, including three announced this year: Gregg L. Semenza of Johns Hopkins University (Physiology or Medicine), John B. Goodenough of the University of Texas at Austin (Chemistry), and Esther Duflo of the Massachusetts Institute of Technology (Economics).

Also included in this year's list of *Highly Cited Researchers* are 57 Citation Laureates;[8] individuals recognized by the Web of Science Group, through citation analysis, as 'of Nobel class' and potential Nobel Prize recipients.

Nobel laureates identified as *Highly Cited Researchers* 2019

Name	Category and year
James P. Allison	Physiology or Medicine 2018
David Baltimore	Physiology or Medicine 1975
Elizabeth H. Blackburn	Physiology or Medicine 2009
Angus Deaton	Economics 2015
Esther Duflo	Economics 2019
Ben L. Feringa	Chemistry 2016
Albert Fert	Physics 2007
Andre K. Geim	Physics 2010
John B. Goodenough	Chemistry 2019
Theodor W. Hänsch	Physics 2005
James J. Heckman	Economics 2000
Alan J. Heeger	Chemistry 2000
Brian K. Kobilka	Chemistry 2012
Robert J. Lefkowitz	Chemistry 2012
Edvard I. Moser	Physiology or Medicine 2014
May-Britt Moser	Physiology or Medicine 2014
Konstantin Novoselov	Physics 2010
Gregg L. Semenza	Physiology or Medicine 2019
Phillip A. Sharp	Physiology or Medicine 1993
Fraser Stoddart	Chemistry 2016
Thomas C. Südhof	Physiology or Medicine 2013
Susumu Tonegawa	Physiology or Medicine 1987
†Roger Y. Tsien	Physiology or Medicine 2008
Shinya Yamanaka.	Physiology or Medicine 2012

[7] Eugene Garfield and Alfred Welljams-Dorof, "Of Nobel class: A citation perspective on high-impact research authors," *Theoretical Medicine*, 13 (2): 117-135, June 1992. DOI: 10.1007/BF02163625

[8] clarivate.com/webofsciencegroup/solutions/citation-laureates/

Highly Cited Researchers and 2019 Nobel laureates

Esther Duflo
2019 Nobel laureate in Economics

John B. Goodenough
2019 Nobel laureate in Chemistry

Gregg L. Semenza
2019 Nobel laureate in Physiology or Medicine

Esther Duflo, shown with her research partner Abhijit Banerjee. Photo: Bryce Vickmark

Esther Duflo
2019 Nobel laureate in Economics

Esther Duflo is only the second woman to be named a Nobel laureate in Economics. She is also at 46 the youngest to receive the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel, to give the award its precise title.

With her fellow Nobel Prize recipients Abhijit Banerjee, also of MIT, and Michael Kremer of Harvard University, the trio were cited "for their experimental approach to alleviating global poverty." Together and separately, Banerjee, Duflo, and Kremer introduced field experiments including randomized controlled trials to study economic conditions and their determinants at a microlevel. "In less than two decades, the empirical microeconomic approach pioneered by Banerjee, Duflo and Kremer has changed how development economists conduct their research," the selection committee stated. "The research carried out with their experimental approach has uncovered a large body of new substantive results and keeps improving our ability to mitigate global poverty."[9]

Duflo is one of 17 researchers who have been named *Highly Cited Researchers* in Economics each year since 2014, and among these the only woman.

[9] Committee for the Prize in Economic Sciences in Memory of Alfred Nobel, "Understanding development and poverty alleviation," October 14, 2019. nobelprize.org/uploads/2019/10/advanced-economicsciencesprize2019.pdf

John B. Goodenough
2019 Nobel laureate in Chemistry

John B. Goodenough, at 97, is the oldest person ever to be named a Nobel laureate. Goodenough, M. Stanley Whittingham of Binghamton University, New York, and Akira Yoshino of Asahi Kasei Corporation and Meijo University, in Japan, received the Nobel Prize in Chemistry "for the development of lithium-ion batteries."

Plainly, this prize recognizes an invention that, in the words of Alfred Nobel's will, qualifies as an "important chemical discovery or improvement." It is an award similar in type to the recent Nobel Prizes in Physics for the invention of blue light-emitting diodes in 2014 and for the development of fibers for optical communication in 2009. The selection committee for this year's Chemistry Prize noted that, "lithium-ion batteries have revolutionized our lives since they first entered the market in 1991. They have laid the foundation of a wireless, fossil fuel-free society, and are of the greatest benefit to humankind."[10]

Goodenough was selected as a *Highly Cited Researcher* in 2001, the first year we issued a *Highly Cited Researchers* list. The methodology used at that time identified individuals based on total citations to their publications since 1981. Goodenough then appeared in the field of Materials Science whereas this year he is selected in Chemistry.

Photo: Cockrell School of Engineering, The University of Texas at Austin

[10] Royal Swedish Academy of Sciences, "The Nobel Prize in Chemistry 2019," (Press release), October 9, 2019. nobelprize.org/uploads/2019/10/press-chemistry-2019-2.pdf

Photo: Johns Hopkins Medicine

Gregg L. Semenza
2019 Nobel laureate in Physiology or Medicine

The 2019 Nobel Prize in Physiology or Medicine was awarded jointly to William G. Kaelin Jr. of Harvard University, Sir Peter J. Ratcliffe of Oxford University and the Francis Crick Institute, and Gregg L. Semenza of Johns Hopkins University "for their discoveries of how cells sense and adapt to oxygen availability."

Each of the three has published papers on this subject cited more than 3,000 times; only about 2,300 out of some 47 million papers (articles and proceedings papers only) indexed in *Web of Science* since 1970 have been cited at this level. Together Kaelin, Ratcliffe, and Semenza were honored with the 2010 Canada Gairdner International Award, the 2014 Wiley Prize in Biomedical Sciences, and the 2016 Albert Lasker Award for Basic Medical Research, all so-called precursor prizes for the Nobel Prize in Physiology or Medicine.

Gregg L. Semenza is one of this year's *Highly Cited Researchers* in the cross-field category, as he was last year when we introduced this category to recognize scientists who have contributed highly cited papers in several different fields. That he qualifies in the cross-field category fits the nature of his research. "Th[e] ability of animal cells to sense different concentrations of oxygen and, as a result, re-wire their gene expression patterns, is essential for the survival of virtually all animals[…]. These molecular pathways pervade numerous physiological processes, ranging from organ development and metabolic homeostasis to tissue regeneration and immunity, and play important roles in many diseases, including cancer."[11]

[11] Nobel Assembly at Karolinska Institutet, "Scientific background: How cells sense and adapt to oxygen availability," October 7, 2019. nobelprize.org/uploads/2019/10/advanced-medicineprize2019.pdf

Highly Cited Researchers 2019

Highly Cited Researchers from the Web of Science Group is an annual list recognizing influential researchers in the sciences and social sciences from around the world.

The 2019 list contains about 6,200 *Highly Cited Researchers*, some 3,700 in 21 fields of the sciences and social sciences and about 2,500 *Highly Cited Researchers* identified as having exceptional performance across several fields.* The list focuses on contemporary research achievement: only highly cited papers in science and social sciences journals indexed in *Web of Science Core Collection* during the 11-year period 2008-2018 were surveyed. Highly cited papers are defined as those that rank in the top 1% by citations for field and publication year.

Using our *InCites* analytics tool, the data are derived from the *Essential Science Indicators (ESI)* database, which reveals emerging science trends as well as influential individuals, institutions, papers, journals and countries. The fields are also those employed in *ESI* – 21 broad fields defined by sets of journals and exceptionally, in the case of multidisciplinary journals such as *Nature* and *Science*, by a paper-by-paper assignment to a field based on an analysis of the cited references in the papers. This percentile-based selection method removes the citation advantage of older papers relative to recently published ones, since papers are weighed against others in the same annual cohort.

***Essential Science Indicators* fields**

- Agricultural Sciences
- Biology & Biochemistry
- Chemistry
- Clinical Medicine
- Computer Science
- Economics & Business
- Engineering
- Environment/Ecology
- Geosciences
- Immunology
- Materials Science
- Mathematics
- Microbiology
- Molecular Biology & Genetics
- Neuroscience & Behavior
- Pharmacology & Toxicology
- Physics
- Plant & Animal Sciences
- Psychiatry/Psychology
- Social Sciences
- Space Science

Researchers who, within an *ESI*-defined field, publish papers that are then highly cited by their peers are judged to be influential, so the production of multiple top 1% papers is interpreted as a mark of exceptional influence. Relatively young and early career researchers are more likely to emerge in such an analysis than in one dependent on total citations over many years.

* The number of unique *Highly Cited Researchers* is 6,008, including 3,517 in the *ESI* fields and 2,491 in the cross-field category. The analysis reported here is based on appearances of *Highly Cited Researchers* in specific fields, and a small number are selected in more than one *ESI* field.

To be able to recognize early and mid-career as well as senior researchers is one of the goals in generating *Highly Cited Researchers* lists. The determination of how many researchers to include in the list for each field is based on the population of each field, as represented by the number of disambiguated author names on all highly cited papers in that field, 2008-2018. The *ESI* fields vary greatly in size, with Clinical Medicine being the largest in terms of highly cited papers and Space Science the smallest; likewise, Clinical Medicine is largest in terms of researchers whereas Mathematics is smallest. The square root of the number of authors in each field indicated how many individuals should be selected.

One of two criteria for selection is that the researcher must have enough peer citations to his or her highly cited papers to rank among all authors in the top 1% by total citations in the *ESI* field in which that person is considered. Authors of highly cited papers who meet this criterion in a field are ranked by number of such papers, and the threshold for inclusion is determined, as mentioned, using the square root of the population represented by the number of disambiguated authors names on the highly cited papers in a field. All who published highly cited papers at the threshold level are admitted to the list, even if the final list then exceeds the number given by the square root calculation.

In addition, and as a concession to the somewhat arbitrary cut-off, any researcher with one fewer highly cited paper than the threshold number is also admitted to the list if total peer citations to his or her highly cited papers rank that individual in the top 50% by total citations of those at the threshold level or higher. The justification for this adjustment is that it seems to work well in identifying influential researchers, in the judgment of the Web of Science Group's citation analysts.

Of course, there are many highly accomplished and influential researchers who are not recognized by the method described above and whose names do not appear in the 2019 list. This outcome would hold no matter what specific method were chosen for selection. Each measure or set of indicators, whether total citations, h-index, relative citation impact, mean percentile score, etc., accentuates different types of performance and achievement. Here we confront what many expect from such lists but what is unobtainable: that there is some optimal or ultimate method of measuring performance.

The only reasonable approach to interpreting a list of top researchers such as ours is to fully understand the method behind the data and results, and why the method is used. With that knowledge, in the end, the results may be judged by readers as relevant or irrelevant to their needs or interests.

Researchers with cross-field impact

In 2018, for the first time, *Highly Cited Researchers* introduced a new cross-field category to identify researchers with substantial influence across several fields during the data census period. As mentioned above, 2,491 researchers with cross-field impact now join some 3,725 who have been selected in one or more of 21 broad *ESI* fields. The addition of cross-field selectees last year yielded a substantial increase from those chosen in the 21 *ESI* fields only, but the current 6,216 still represent a very small fraction of all scientists and social scientists actively publishing today.

Since introducing *Highly Cited Researchers* in 2014, the Web of Science Group has received the suggestion from many that limiting the methodology for selection to only those with a required number of highly cited papers in a single field, as defined in *ESI*, discriminates against researchers who publish highly cited papers in several fields but not enough in any one field to be chosen.

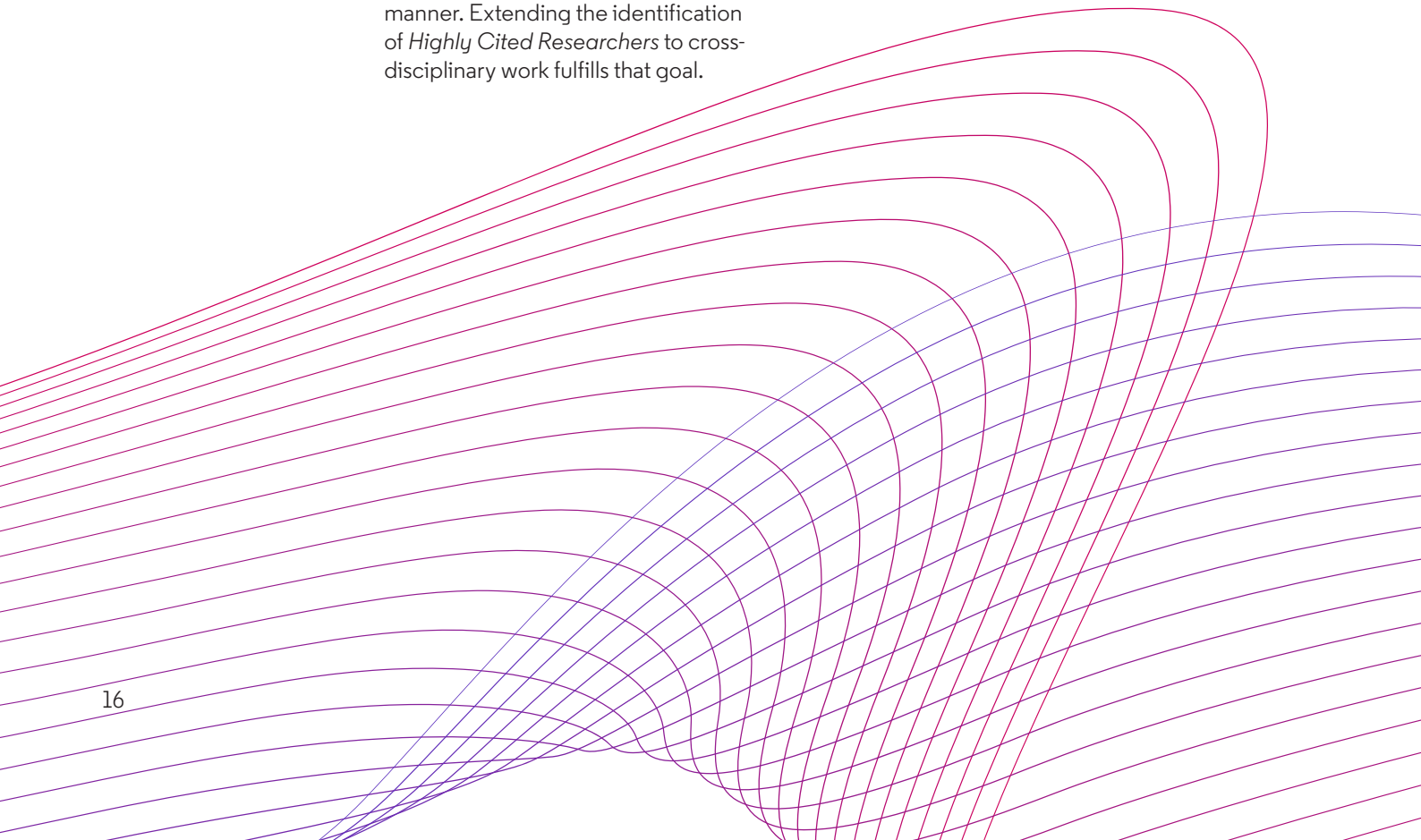
We responded to this concern last year. In line with recommendations on best practice, we wanted to ensure that any metrics or analyses that we produce are structured and presented in a responsible manner. Extending the identification of *Highly Cited Researchers* to cross-disciplinary work fulfills that goal.

3,725

Highly Cited Researchers in specific fields

2,491

Highly Cited Researchers for cross-field performance



ESI field	First name	Last name	Number of HCPs	Citation to HCPs	Field citation threshold	Field paper threshold	Field paper score	Field citation score
Field 3	Joseph	Savant	1	98	1857	22	0.045	0.053
Field 6	Joseph	Savant	7	2937	946	8	0.875	3.105
Field 14	Joseph	Savant	3	663	676	6	0.500	0.981
Field 16	Joseph	Savant	4	3397	2223	16	0.250	1.528
Cross-field	**Joseph**	**Savant**					**1.670**	**5.667**

The challenge for us was finding a method that took account of the different threshold number of highly cited papers in each field so that those contributing papers in several fields could be compared in an equal manner with those selected in one or more *ESI* fields. The solution chosen was to fractionally count the credit for each highly cited paper such that a paper in a field with a high threshold number of papers was weighted less than a paper in a field with a lower threshold number of papers. The example at the top of this page illustrates the method.

The fictional researcher Joseph Savant published 15 highly cited papers in four *ESI* fields. Seven papers in Field 6, with a threshold number of eight for selection, earned Savant a credit of 0.875 (or 7/8ths). Three papers in Field 14, with a threshold number of six for selection, were worth 0.5. The sum of the fractional paper counts in each field yielded a total cross-field paper score of 1.67. A score of 1 or more indicates that the individual achieved equivalent impact to a researcher chosen in a specific *ESI* field.

The second criterion for selection as a *Highly Cited Researcher* is enough citations from other researchers to rank in the top 1% by citations for a field. Again, citations in different fields were fractionated in a similar manner to the treatment of papers. In the example above, Professor Savant earned more than five times the number of citations needed for selection as an influential cross-field researcher. Both criteria had to be met for selection as a cross-field *Highly Cited Researcher*, just as required for selection in one or more *ESI* fields.

Traditional field definitions are useful in some contexts but less so in others. Today, an immunologist may identify himself as a biochemist and a molecular biologist. Another researcher may be hard pressed to say whether she is a chemist, materials scientist, or engineer. Breaking through the artificial walls of conventional disciplinary categories helps to keep our *Highly Cited Researcher* list contemporary and relevant.

Moreover, as frontier areas of research are frequently interdisciplinary, it is even more important to identify scientists and social scientists working and contributing substantially at the cross-field leading edge.

"Is there a formula for managing discovery making? First, and most important, are the people involved."[12]

The late Nobel laureate Ahmed H. Zewail,
California Institute of Technology

The 6,216 *Highly Cited Researchers* of 2019 are unevenly distributed by field, in accordance with the size of each. The table below summarizes the number of researchers in each *ESI* field and in the cross-field category.

***Highly Cited Researchers* by *ESI* field and cross-field category**

***ESI* field**	**Number of *Highly Cited Researchers***
Agricultural Sciences	146
Biology & Biochemistry	212
Chemistry	237
Clinical Medicine	436
Computer Science	107
Economics & Business	113
Engineering	192
Environment/Ecology	169
Geosciences	153
Immunology	135
Materials Science	195
Mathematics	89
Microbiology	116
Molecular Biology & Genetics	238
Neuroscience & Behavior	198
Pharmacology/Toxicology	140
Physics	194
Plant & Animal Sciences	196
Psychiatry/Psychology	146
Social Sciences, General	204
Space Science	109
Total	**3725**
Cross-field	**2491**
Grand total	**6216**

[12] Ahmed Zewail, "Curiouser and curiouser: Managing discovery making," *Nature*, 468 (7322): 347, November 18, 2010. DOI: 10.1038/468347a

The following analysis is based on primary researcher affiliations, as specified by the *Highly Cited Researchers* themselves.

The United States is the institutional home for 2,737 of the *Highly Cited Researchers* 2019, which amounts to 44.0% of the group. By contrast, of all papers indexed in *Web of Science* for 2008-2018 the percentage with a U.S. author or co-author was 25.8%. Mainland China is second this year, with 636 *Highly Cited Researchers*, or 10.2%. The United Kingdom, with 516 researchers or 8.3%, falls to third from second in the last survey, trading places with Mainland China. Next, all with 100 or more *Highly Cited Researchers*, we list Germany (327), Australia (271), Canada (183), the Netherlands (164), France (156), Switzerland (155), and Spain (116).

The *Highly Cited Researchers* data represent nearly 60 nations, but 84.6% of all *Highly Cited Researchers* are from these 10 nations and 72.2% from the first five, a remarkable concentration of top talent.

While each nation pursues its own portfolio of interests, often reflected in numbers of *Highly Cited Researchers* in different fields, some nations appear to follow less traditional, more transdisciplinary lines of investigation, at least if their scientific elite is representative. Across the group, there are three *Highly Cited Researchers* in the 21 *ESI* fields for two in the cross-field category. We might expect, therefore, to see this 3:2 ratio for each country. Not so. Among nations with 20 or more *Highly Cited Researchers*, half or more from the following nations appear in the cross-field category: Israel (55%), Austria (51%), and Norway (50%). Singapore, Sweden, and Mainland China are also notable for strong representation in the cross-field category, with 49%, 48%, and 46%, respectively.

As noted, Mainland China has increased its share of *Highly Cited Researchers* significantly, from 483 or 7.9% in 2018 (covering the period 2006-2016) to 636 or 10.2% this year (for the period 2008-2018). In 2014, 113 *Highly Cited Researchers* were from Mainland China in the 21 *ESI* categories then surveyed, which amounted to 3.5% of the total of 3,216 *Highly Cited Researchers* that year. This year, 347 *Highly Cited Researchers* from Mainland China are represented in the 21 *ESI* categories, or 9.3% of the group, nearly a three-fold increase since 2014. The number of *Highly Cited Researchers* in the 21 *ESI* categories has grown somewhat over six years to 3,725, but that is a 16% increase only.

Of course, as Mainland China increases its share of *Highly Cited Researchers* other nations decline. Since last year, the United Kingdom has lost .7%, Germany .6%, and the Netherlands .5% of their shares of the world's *Highly Cited Researchers*. Other nations in the top 10 managed increases: The United States advanced .6%, Australia .3%, Switzerland .3%, and Canada .2%.

Nothing compares, however, to the advance of Mainland China, from 7.9% last year to 10.2% this year, a sizeable increase of 2.3%.

***Highly Cited Researchers* by country or region**

Rank	Nation	Number of *Highly Cited Researchers*	Percent of *Highly Cited Researchers*
1	United States	2737	44.0
2	China Mainland	636	10.2
3	United Kingdom	516	8.3
4	Germany	327	5.3
5	Australia	271	4.4
6	Canada	183	2.9
7	The Netherlands	164	2.6
8	France	156	2.5
9	Switzerland	155	2.5
10	Spain	116	1.9

The university with the greatest number of *Highly Cited Researchers* is once again Harvard, with 203, an increase from 182 last year.

***Highly Cited Researchers* by institution**

Institutions	Nation	Number HCRs
Harvard Univ	United States	203
Stanford Univ	United States	103
Chinese Acad Sciences	China Mainland	101
Max Planck Society	Germany	73
Broad Institute	United States	60
Univ California Berkeley	United States	58
Washington Univ St Louis	United States	55
Duke Univ	United States	54
Massachusetts Inst of Technology (MIT)	United States	54
Memorial Sloan Kettering Cancer Center	United States	54
Univ California San Diego	United States	54
Univ California Los Angeles	United States	52
Yale Univ	United States	51
Univ Cambridge	United Kingdom	50
Columbia Univ	United States	47
Johns Hopkins Univ	United States	45
Univ Oxford	United Kingdom	44
Cornell Univ	United States	42
Tsinghua Univ	China, Mainland	42
Univ College London	United Kingdom	40
Univ Pennsylvania	United States	39
King Abdulaziz Univ	Saudi Arabia	38
Univ North Carolina Chapel Hill	United States	37
Univ Paris Saclay	France	36
Univ California San Francisco	United States	36
Mayo Clinic	United States	35
Princeton Univ	United States	35
Univ Washington	United States	35
Icahn School of Medicine at Mount Sinai	United States	34
Univ Melbourne	Australia	34
Massachusetts General Hosp	United States	33
NIH National Institute of Allergy & Infectious Diseases (NIAID)	United States	33
Univ British Columbia	Canada	33
Univ Michigan	United States	33
King's College London	United Kingdom	32
Dana-Farber Cancer Institute	United States	31
Northwestern Univ	United States	31
European Molecular Biology Laboratory (EMBL)	Germany	30
NIH National Cancer Institute (NCI)	United States	30
UNSW Sydney	Australia	30
Nanyang Technological Univ	Singapore	29
Swiss Institute of Bioinformatics	Switzerland	29
Univ Queensland	Australia	29
Univ Texas MD Anderson Cancer Center	United States	29
Wellcome Trust Sanger Center	United Kingdom	29
California Institute of Technology	United States	27
Imperial College London	United Kingdom	27
Univ Minnesota	United States	27
Univ Toronto	Canada	27
National Univ Singapore	Singapore	26
Univ Chicago	United States	26
Ecole Polytechnique Federale de Lausanne	Switzerland	25
Univ Electronic Science & Technology China	China, Mainland	24
University Science & Technology China	China, Mainland	24

Among governmental and other types of research organizations, the US National Institutes of Health (including all individual institutes) ranks first with 145 *Highly Cited Researchers*, followed by the Chinese Academy of Sciences (101), the Max Planck Society (76), the Broad Institute (60), and Memorial Sloan Kettering Cancer Center (54).

Among the 3,725 researchers named as *Highly Cited* in the 21 *ESI* fields, 186, or 5%, appear in two *ESI* fields and only 11 (listed below), or .3%, appear in three fields. (Cross-field researchers, of which there are 2,491, qualify in only one category, or else they would have been chosen in one or more *ESI* fields.).

***Highly Cited Researchers* recognized across three *ESI* fields**

Name	Primary Affiliation	Fields
Jinde Cao	Southeast Univ, Mainland China	Computer Science, Engineering, Mathematics
Yi Cui	Stanford Univ, United States	Chemistry, Engineering, Materials Science
Hongjie Dai	Stanford Univ, United States	Chemistry, Materials Science, Physics
Noah Fierer	Univ Colorado, United States	Agricultural Sciences, Environment/ Ecology, Microbiology
Michael Graetzel	Swiss Fed Inst Technol Lausanne, Switzerland	Chemistry, Materials Science, Physics
Vinod Kumar Gupta	King Abdulaziz Univ, Saudi Arabia	Chemistry, Engineering, Environment/ Ecology
Rob Knight	Univ California San Diego, United States	Biology & Biochemistry, Environment/ Ecology, Microbiology
Robert S. Langer	MIT, United States	Biology & Biochemistry, Materials Sciences, Pharmacology/Toxicology
Kian Ping, Loh	National Univ Singapore, Singapore	Chemistry, Materials Science, Physics
Ju H. Park	Yeungnam Univ, South Korea	Computer Science, Engineering, Mathematics
Jun Wang	iCarbonX, Mainland China	Biology & Biochemistry, Molecular Biology & Genetics, Plant & Animal Sciences

It is important to understand the difference between selection as a *Highly Cited Researcher* in the cross-field category and selection in more than one *ESI* field. Both classes of individuals have demonstrated significant research influence across fields. Cross-field researchers, however, qualify for selection based on the ***sum*** of their highly cited papers and citations that meets a normalized threshold equivalent to selection in any one field whereas those named in multiple fields qualify outright in each field.

Finally, for the first time this year, a filter was applied to remove researchers whose level of self-citation exceeded, by far, the typical patterns of each field. This procedure has and will continue to help maintain the purpose of our selection process and the integrity of our data: to identify researchers with broad community influence and not those whose citation profile is narrow and substantially self-generated.

The foregoing is but a 'tasting' of the riches of the Web of Science Group's *Highly Cited Researchers* data. In early 2020, there will be a more detailed analysis of the 2019 data, with attention paid to national and regional activity and performance.

To see the full list of *Highly Cited Researchers* and read more about the selection methodology, please visit recognition.webofsciencegroup.com/highly-cited

Who we are

About the Institute for Scientific Information (ISI)

The Institute for Scientific Information (ISI) builds on the work of Dr. Eugene Garfield – the original founder and a pioneer of information science. Named after the company he founded – the forerunner of the Web of Science Group – ISI was re-established in 2018 and serves as a home for analytic expertise, guided by his legacy and adapted to respond to technological advancements.

Our global team of industry-recognized experts focus on the development of existing and new bibliometric and analytical approaches, whilst fostering collaborations with partners and academic colleagues across the global research community.

About the Web of Science Group

The Web of Science Group, a Clarivate Analytics company, organizes the world's research information to enable academia, corporations, publishers and governments to accelerate the pace of research. It is powered by *Web of Science* – the world's largest publisher-neutral citation index and research intelligence platform. Its many well-known brands also include *Converis*, *EndNote*, *Kopernio*, *Publons*, *ScholarOne* and the Institute for Scientific Information (ISI). The 'university' of the Web of Science Group, ISI maintains the knowledge corpus upon which the index and related information and analytical content and services are built; it disseminates that knowledge externally through events, conferences and publications and it carries out research to sustain, extend and improve the knowledge base. For more information, please visit webofsciencegroup.com.

About our Researcher Recognition Programs

Using our comprehensive, high-quality data from across the Web of Science Group, measuring both quantitative and qualitative results, we recognize the people behind the ground-breaking research efforts produced each year through four recognition programs:

- Eugene Garfield Award for Innovation in Citation Analysis
- *Highly Cited Researchers*
- Global Peer Review Awards, powered by *Publons*
- Citation Laureates

Learn more at: clarivate.com/webofsciencegroup/solutions/researcher-recognition/

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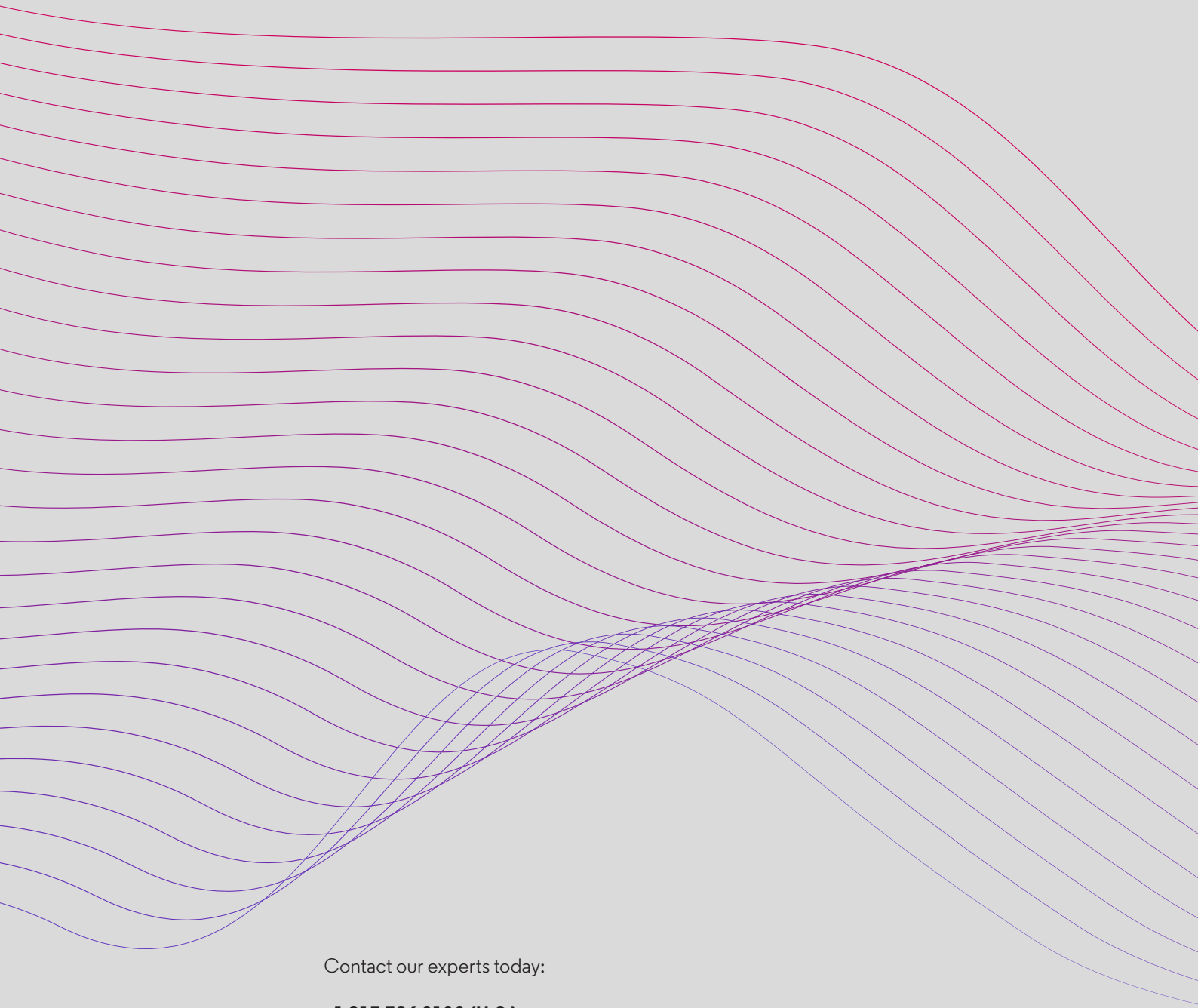

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