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About Misinformation, Disinformation, and Scientific Consensus

From a member of the Scientific and Medical Advisory Committee

Since the beginning of the COVID-19 crisis, I have spent a lot of time thinking about the meaning of particular words that have become very popular in the media but are often abused in a scientific context. These words are "misinformation," "disinformation," and "consensus."

The reason why it is important to examine the deeper meaning of these words, beyond their strict dictionary definitions, is because they have been confused with how the practice of scientific work has misguidedly transformed into what it is today. This transformation has probably affected clinical and biomedical sciences the most; basic sciences, of the type practiced in a wet lab, may have been less affected than clinical disciplines (at least that is my hope). This confusion that I am referring to, did not start with the COVID-19 crisis, but long before, and has been accelerating over the last few decades.

For several years now, scientists have not only been complacent, but also active contributors to a way of working that is not favoring the free and objective (to the degree that objectivity is possible) pursuit of knowledge, with everything that it entails, honest mistakes included. In this essay, I will make the case that this misguided (or perhaps I should say perversive) way of working is what has favored the exploitation and instrumentalization of the concept of scientific misinformation, disinformation, and scientific consensus. Additionally, it has also led to the politicization of science and handicapped critical thinking and debate.

The definition of misinformation and disinformation given by the Merriam-Webster dictionary is as follows: misinformation is "*incorrect or misleading information*," and disinformation is "*false information deliberately and often covertly spread (as by the planting of rumours) in order to influence public opinion or obscure the truth*." The trouble is that truth is an elusive concept in science, more so in clinical and biomedical sciences where we need to quantify phenomena in complex beings such as us humans. Therefore, scientists rarely talk about the pursuit of *truth*. Instead, they talk about the pursuit of *knowledge*, which is generated by application of standardized principles and procedures, known as the scientific method. While the general public may interpret the most current, accepted, and publicized scientific knowledge (*i.e*., information) as "the truth," scientists know very well (or at least they ought to know well enough) that this is not the case. That information (*i.e.,* knowledge) is only the most current interpretation of data produced by a scientist, or a group of scientists, applying the scientific method to the best of their ability. However, the application of the scientific method, which continues to be the best approach to self-correct knowledge as new data is collected or is reanalysed and reinterpreted, may often be very tricky.

The first step in the scientific method consists in defining a question to investigate. Classically, scientific questions have come from observation and data collection of a phenomenon that has captured the scientist's attention, or a phenomenon perceived as problematic, as it is the case of diseases. Ideally, the observation of the phenomenon should not follow any pre-determined interest, or incentive, nor should it be unduly influenced by another scientist's research findings and conclusions. However, more frequently, researchers start with data that are produced in other published reports. Meta-analyses using data from multiple publications are a blend of selected articles, with data generated from different methodologies and criteria. So, instead of observing and collecting data themselves, many researchers build upon what others have observed and interpreted, mainly because they consider the results of their peers trustworthy enough, so they start from there, for the sake of efficiency. If to this way of commencing a research project (*i.e.,* based on other researchers' results) we also add the fact that a lot of what is published in medical science is very hard to reproduce, then we have a perfect recipe for a snowball effect of mistakes and bias, with some accurate information in the mix. This fallible way of generating current scientific knowledge is responsible for the information that people receive and accept as "the truth." However, if another scientist using the scientific method (in an equally fallible way) finds contradictory information, then one scientist's information can be considered as misinformation or false information.

Since the generation of scientific knowledge is prone to errors and bias, and (even when not erroneous or biased) is self-actualising all the time, then yesterday's information is destined to become today's false information. This dynamic characteristic of the scientific knowledge has had an interesting consequence. It has shifted the focus from the importance of the information itself, which constitutes the message that the public receives, to the importance of the messenger delivering the information. This shift has been capitalized and probably collaborated to the abuse of the concept of disinformation, which is not merely false information (that would keep the focus on the message, now false), but "*false information deliberately and often covertly spread (as by the planting of rumours)*." The use of the words "covertly spread" and "rumour" in the definition of disinformation puts the emphasis on the messenger transmitting the information and doing so in a particular manner. The calling out of misinformation and disinformation by the messenger may in fact hinder the scientific method, which requires constant re-evaluation of prevailing knowledge (*i.e.*, information) based on new data or concerns about the validity of the methods used to generate older data.

This is the part where information and misinformation (focusing more on the message), and disinformation (also focusing on the messenger) make an interesting parallel with the way scientists work. This way of working has become increasingly misguided, because scientists (long before the words misinformation and disinformation became popular) have been paying too much attention to the "container" instead of the "content." Too much attention to the "who" (*i.e.,* messenger), "where", and "how" (all different flavours of "containers") instead of the "what" ("content"), *i.e.*, the information, the knowledge, the message. *Where* something is published may weight more than *what* is being published. For example, consideration of the platform where a video is broadcasted may be more important than the information contained in the video. The analyses coming from certain countries, or certain institutions, may be considered more or less reliable, because of where they originated, as opposed to what the analyses show. The format and the way of delivering a presentation may be regarded as more important than the content of the presentation. More importantly, part of this happens probably unconsciously, for example if a presentation is hard to follow and the figures are difficult to read, we tend (not on purpose) to devalue the presentation, which in turn devalues the content, the message, the information presented.

Let's further consider how the "who" diffusing the information may impact the consideration of the veracity of that information. By diffusing the information, "who" constitutes the messenger... and we know what may happen to the messenger. This is not entirely a bad thing, because when a scientist is known to repeatedly present model predictions that do not become true, then we should be skeptical (or at least cautious) of the scientific claims of that person. Unfortunately, this is not always the case, and scientists who have been spectacularly wrong in the past (presenting wrong information, or misinformation by today's standard definition) continue to be trusted when producing similar types of information, largely perhaps because of the status that they may hold in a government or academic institution or because the message serves political ends. Moreover, scientists who have been repeatedly right in the past about a certain type of information, may be considered as wrong (or even fringe) when presenting the same type of information, due to other factors influencing the assessment of the veracity of the information, for example, because that information may not favor the implementation of certain guidelines.

Paying attention to the "who/where/how" is not necessarily wrong. This consideration is not black or white. For example, the format and delivery of a presentation, in other words how the information is presented, helps to correctly understand the message, so it is of high value. But that value must never supersede the value of the information itself. The message should supersede the messenger and the "medium", or the "container." Early on Professor Marshall McLuhan recognized this issue, stating that the "medium" is the "message" in modern society, and with the explosion of the Internet, in terms of both the freedom and censorship possibilities that it entails, information has become increasingly confusing to the lay public and even scientists who are not critically assessing new knowledge, but simply trusting their peer-reviewed published reports in reputable journals. What's more, the internet and social media as "mediums" have revolutionized the speed at which the information (continually changing) reaches the audience, an audience now larger than ever before. And since it is impossible for humans to sort through the 24 hour-avalanche of constantly changing information, then it is only natural that the messenger takes a more relevant role. If we only need to pay attention to a single trusted source of information, we do not need to use our energy analysing what other sources have to say.

Over the years, these phenomena of "container" and "content" in biomedical sciences has amplified or combined in a particular way (or I should say in a bad way), specifically the part of *who* says something, *where* the something is published or broadcasted, as well as *where* the *who* is employed. This would translate into: we want that the message (*i.e.,* the scientific information) appears in a high impact factor journal, written by a recognised (with prizes, or other objects of merit) group of scientists, who work in a highly ranked institution, to consider the information as credible. This has become the ideal source of scientific information, to the point that there are professors telling master and doctoral graduate students that before reading a paper they should first look at the journal where it is published and who the authors are. In principle, considering a highly reputable journal as a source of credible information is not bad, but the question is: up to what point may this consideration bias the critical reading of an article? Aren't we forgetting the critical importance of reading the content of a scientific article blindly, to assess the information based exclusively on the scientific merits (including validity of the methods), or are we giving precedence to *who* wrote the article and *where* it was published? Additionally, many of the leading journals derive heavy advertising revenues from large pharma and other companies that support the health care industry. This puts into question the peer-review system in place, which is responsible to ensure the veracity of the scientific information. Is the review process always done blindly, or papers that are sent for review show who the authors are and where they work? Sometimes (depending on the journal) the names, the "who's", are readily available in the document, or they may be easy to infer from the content and references of the paper. This way of working does not seem to strengthen a critical and objective review of the scientific information.

To make matters of scientific publication more complex (or I should say more muddy) we have to acknowledge the possibility that some scientists may try to block the publication of certain concepts (information), either because they go against the concepts that they are trying to put forward, or because they do not consider these concepts of merit due to *who* or *where* the information comes from, or even worse, just for fun, to quantify how many papers they reject per year. Also, the potential loss of advertising revenues with the publication of information that may challenge private interests (*i.e.,* pharma companies) cannot be ignored by journal editors. Of course, eventually, contradictory/opposite scientific concepts are published, but this generally happens with a quantitative imbalance between the number of articles in reputable journals expressing one concept and the number of articles in reputable journals expressing the opposite concept. So, scientists, who are human beings as fallible as any, and who need a certain number of publications per year to keep their career advancing, may end up enlarging the ranks of those who do not want to contradict the concepts published by notorious figures, in highly reputable journals. Is it so inconceivable to think that a scientist might rewrite a part of an article to not ruffle the feathers of another scientist/professor? Or that a scientist may consider changing the objective/hypothesis of a project, so it does not oppose most results published by highly respected colleagues in highly respected journals? Or that a scientist pursues a particular angle of research because it follows the lead of a research collaborator who is providing the data? Or that a scientist starts a new project to apply for a government grant offered to answer specific questions considered of public interest? After all, the colleagues whose feathers are to be kept unruffled, or with whom the scientist wants to collaborate, or whose views of a topic may be at odds with the views of the scientist, are the peers who review and decide whether the paper of the scientist will be published. And scientists who want to publish concepts opposite to concepts repeatedly published by others in highly reputable journals (and sometimes not so highly reputable), have trouble finding positive peer reviewers, who frequently demand a much higher level of proof of this new concept. Why? Because it goes against the majority of what is published, it goes against the scientific consensus. The Merriam-Webster first definition of consensus is that of *"general agreement"*, but in science a general, universal agreement is very difficult to attain, so the agreement of this majority of published scientists (which goes along with the second definition of the Merriam-Webster: *"the judgment arrived at by most of those concerned"*) is what prevails as the scientific consensus on any given subject. And when this scientific consensus is the information that people receive; it becomes "the truth" for the public.

Unfortunately, the scientific consensus is only a notion of numbers, not necessarily of truthfulness of the concept. It does not mean reproducibility either, since most of what is published, due to methodological variations and differences in samples (among other factors) may not be reproducible or comparable. The notion of scientific consensus, representing this higher number of publications saying similar things or going in the same direction, is now considered as the most solid evidence of veracity of a concept. And of course, if there are a handful of articles offering different or opposite information, it is easy to completely disregard them, because the number of those publications is not high enough. If any scientist uses this smaller number of articles to even generate a hypothesis or ask a question, the person is accused of cherry-picking, just because there are fewer cherries in one field than in the other. This is as if the truth of a given scientific concept was a matter of popularity.

To add another factor to this situation, often articles belonging to a minority viewpoint are heavily criticized methodologically, although the papers expressing the view of the consensus may have similar or larger methodological flaws. Why is this? Because there is not such a thing as a perfect paper that does not have some weak aspect in the methodology. Once that weakness is found, it is easy (and tempting) to discredit the article, not because of its weaknesses but because it goes against of what is agreed as true. Consensus has been elevated to Gold Standard of veracity, and a smaller number of opposite views have been condemned to poor quality science by default. Or, in other words, scientific consensus generated by repeated publications with the same line of thinking equals valid information, and a smaller number of publications contradicting that thinking is simply mis/disinformation. "Facts checkers" generally operate on this basis: if they can find some component of a study that is weak, they then make the case that all of the other valid points of the study can be ignored, and that the "messenger" is a spreader of mis/disinformation and cannot be trusted.

Yet, some of the most extraordinary scientific breakthroughs were regarded as incorrect in the beginning. They were opposite to the consensus of the time when they were first put forward, and they would have been considered mis/disinformation by today standards. We just need to remember Dr. Semmelweis for example, whose observation about the importance of handwashing before the delivery of babies was not well received by his scientific colleagues of the time. Even when the application of his observation decreased the number of infections related to the delivery of infants, he was heavily opposed by his colleagues, who had no problem (and apparently no ethical dilemma) in disregarding objective observable data.

Sadly, the concept of scientific consensus is not only a fallacy, but it is also dangerous territory. It cannot be stressed enough that concepts do not become true based on the number of people who agree on them. History is full of other examples, some are more consequential than others, and some are simply terrifying. For example, at some point in time, scientists who had the legitimacy given by a government said that a certain group of human beings were the vectors of typhus and dangerous to be in contact with. A concept that history ultimately proved wrong, but that was the consensus at the time and very consequential to the people accused of being vectors of the disease. Similarly, lobotomies were previously recommended as the best treatment for certain psychiatric conditions, but if that information was put forward today, it would be considered disinformation.

The considerations above do not incorporate the extra layer of complexity that economic interests (or incentives) add to the matter of considering a scientific concept as true or false. Particularly in the clinical field where true concepts (the scientific consensus) may easily generate an important economic gain. Our current quandary is that companies in the health-disease businesses, aka Pharma, (who may benefit from record profits by selling a given product shown to be safe and effective by scientific consensus), as well as governments looking to influence people behaviours in a particular way (vote for a party that defends the scientific consensus of protecting people's health) know all of the above very well. They know that who presents the information/consensus is key, where these scientists work is important, and in which journals or broadcasters the information is diffused is essential. And both, businesses and government, have sufficient financial resources at their disposal to help scientists involved in the generation of a specific consensus, institutions who employ them, as well as scientific journals that publish them, in their pursuit of knowledge (*i.e.*, valid information or their scientific consensus). Considering that pharma and government are the predominant financiers of biomedical research, it is difficult for scientists to ignore (consciously or subconsciously) the interests of these providers in order to advance their careers in the sector.

And here is the cherry on the cake. Over the last few decades, the partnership between the public (government) and private sectors (*e.g.*, Pharma) has exponentially increased to allow more "coordinated and efficient" scientific progress. This entails huge benefits (not only financial, but also social: more status in careers for example) for scientists, and the institutions that employ them, helping to solve health or biological crises that affect the entire population, in the fastest possible way, generating "true" answers to the problem at hand, always through "scientific consensus." This partnership also has the financial resources to fight mis/disinformation (which is simply the smaller volume of published concepts that contradict the consensus) and the "misguided scientists" who produce it, no matter how highly reputable these scientists may have been in the past.

It is not surprising then, that well trained scientists, who would normally abide by basic ethical principles, such as not accepting money from companies that become immensely rich by selling a given product, may end up generating the information that backs up the efficacy of the said product, thereby having their careers improved in the process. Just because scientists are not directly funded by pharma and are salaried employees of academia or government, it does not mean that they are not influenced by their employers who may receive funding from these venues for their operations, where their own retention and advancement is dependent upon grant-funding. Moreover, scientists who have not forgotten basic ethics, may find convenient explanations to convince themselves of the soundness of their ethical stands (maybe the "greater good" of the society) and exonerate themselves from any action that could be considered morally reprehensible. Or they simply do not see the ethical dilemma, because we live in times where moral relativism rules, so they consider their actions as being ethical from their own standpoint. Nowadays, for example, the ethical standard practice regarding the existence of conflicts of interests in science consists in declaring them. As if the admission of receiving money from a given pharmaceutical company (commonly referred as disclosure of conflict of interests) would automatically translate into objectivity and ethical integrity of the scientists and their work. The disclosure practice, which probably originated by the interest of taking a given scientific interpretation with a grain of salt (in other words, to allow the audience to assess the potential existence of bias in each scientific interpretation), has become a cleansing practice that seems to guarantee incontestable objectivity and ethical soundness.

Furthermore, the ethical or unethical behaviour in research may be viewed, and explained, as a problem of the institution who employs the scientists or how the health systems work. Haven't we all heard the phrase "it is the fault of the system, it's not the person, the person just works there trying to do his/her best" ("there" being a university, hospital, corporation, or government). And there may be truth in that phrase, because individuals may change their behaviour when they are part of large, organised groups, where rewards are given to encourage certain actions (maybe not completely ethical, but ethically justifiable enough in the name of some more important result) and punishments serve to discourage (or eliminate) other actions, maybe more ethically sound but less profitable. This implies that the dynamic processes of a system may fundamentally change the individual moral compass of the people who form it, and each person may end up not having a free choice, but a choice that makes them the perfect target for a punishment. To make matters more complex, ethical dilemmas may have different degrees of negative consequences, so scientists may look the other way thinking (rationalizing) that some ways of operating are not so bad, because the consequences are not that harmful. However, looking the other way may quickly become part of the job (and a dangerous habit), which ends up desensitizing scientists to increasingly serious breaches of ethical conduct.

In brief, blaming the system (regardless of the validity or veracity of the claim) is a very slippery slope, which may become the perfect justification to repeatedly breach basic moral principles, because certain important problems sufficiently justify the breach, and because the actual morality of those principles is considered relative. Unfortunately, we should keep in mind that moral relativism may be highly profitable in biomedical research and public health. Each scientist should consider taking responsibility for his/her ethical choices, and maybe in this way the systems could begin to change. Alternatively, they could abandon the systems when changes are no longer possible. Ultimately, if the most ethical researchers abandon certain practices and/or certain systems, wouldn't those practices/systems perish or be forced to transform for the better?

Thus, the ultimate question is: can/do we trust scientists, particularly those who quickly adhere to today's rapidly generated consensus and refuse to debate scientists who have considered contrary hypotheses from the same or additional data? Do we trust this fast-generated scientific consensus that is often politically and financially expedient to guide our existence? I know my answer is no, I do not trust scientists who rapidly adopt a "consensus" view and do not practice critical thinking in a landscape of continuous new data. I think that people should not blindly trust any scientist today. And I am a scientist myself. We are part of the problem, and we need to change how we work.

A concerned MD. PhD.