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ESSAY

A journey towards the pot of gold

What is the role of a scientific researcher within society? This question has probably arisen in your research journey before, particularly when you may have felt limited in your societal impact. We hope this essay will help you come to peace with these frustrations.

When asked about our profession, answering “I’m a researcher” provokes a variety of responses, from polite interest to real admiration. Though some may even think “this clever individual selflessly devotes their days to creating new knowledge”, this should never draw us away from questioning what we do and why we do it. Have you ever taken the time to consider the role scientific researchers play within society? We are often prompted to respond to this in the context of our specific field of research but not so much on a “meta” level. We would like to invite you on an exciting journey to ponder this question with us.

A first obvious objective of scientific researchers is to address problems faced by society. This is achieved by delving deep into their mechanisms to develop solutions which society may apply to overcome the obstacles. Researchers’ primary role, which possibly motivates them to enter the field and stimulates funding bodies to support them, is to be society problem solvers. One can say with confidence that, indeed, this is what we do. Thanks to the development of a successful vaccine, smallpox (which existed for over 3000 years) is now considered totally extinct, with no naturally occurring cases since 1949. While tuberculosis was the second leading cause of death in 1900, the steep decrease in deaths due to such an infection can be largely attributed to the introduction of antibiotics in the middle of the century. Developing our understanding of DNA has catapulted medical knowledge, treatments and has even transformed how we solve crimes. And these very few examples are only for the biology domain.

Though we have proven to hold our promise to equip society to overcome obstacles, this process is not as straightforward as it may initially appear. If we only consider ourselves as problem solvers for society, we immediately perceive the limits of our impact. While one may enter research expecting, or hoping (for those less outwardly ambitious), to change the world, very few researchers have the luxury of achieving this in their lifetime. Why may that be?

Because research is a game of patience, of placing one stone after the other, contributing to a collective garden of cairns and hoping that one of these will reach that pot of gold at the end of the rainbow one day. Japanese scientist Yoshinori Ohsumi won a Nobel Prize in Physiology or Medicine for his work on the genes involved in autophagy only two decades after his work was published. Indeed, the role of autophagy in everything from cancer to Parkinson's disease was only understood upon reflection and after other studies contributed their stone. Thankfully, researchers become so engrossed in their own stone, that simply placing it amongst the others is often enough to bring a sense of achievement. And in the excitement of our stone, we forget our initial ambition, though our work is undoubtedly still contributing to the same objective. It is only when faced with the question "So what is the latest big discovery in Alzheimer's disease?" that we realise we can't justify exactly how much our stone is of help. We are filled with guilt, possibly even dissatisfaction with our stone, because the pot of gold is far from visible. Have we maybe even taken a longer route to reach it? In fact, did we take this route because of its opportunity to reach the pot of gold?

Or because it was the "hot topic" of the moment? Let's face it: avoiding the temptation of using the most recent technology at the expense of our true objective can be hard. Becoming an expert in the latest imaging technique to impress the community with your geeky skills, or because such work can be published in high impact factor journals: is this the most efficient path to answering scientific problems? A *Brain* editorial[1] emphasised this issue regarding the ever-growing appetite for the use of functional MRI despite some caveats concerning its true clinical application. Indeed, some pitfalls inherent to fMRI technique limit the interpretation of results. Moreover, beautiful contrast images should not mask their potential vanity (by the way, let us remind you "showing that activation patterns or functional connectivity motifs differ significantly is, on its own, insufficient justification to occupy space in *Brain*").

As chasing a pot of gold can at times feel unrewarding, researchers sometimes drift from their ethical duty, damaging the potential impact of collective scientific efforts. We can feel compelled to inflate our contribution by making our results tell a "sexy" narrative. Various internal and external drivers cause a tendency to "big up what you're doing, to argue that it is earth-shattering even when it just may be important." [2] We should feel proud of any hard work because simply producing a line of questioning, a method and "important" results will often lead to further investigations and actually contribute to long-term discoveries. People's expectations of researchers can be that we provide clear-cut definitive answers to concrete

questions. We must be aware that such expectations can push us to generate flashy results, drawing attention from both the research community and public. Studies demonstrate that a large proportion of scientific work published in press releases include exaggerated statements.[3] Though science “should not be political, it is, and denying that is daft, and damaging.”[4] Distorting our scientific work for the purpose of political prescription goes against our role as researchers. The philosophy of positivism views the role of a researcher to be limited to data collection and interpretation in an objective way, with only “factual” knowledge gained through observation to be trustworthy.

As the journey progresses, our obvious role as societal problem solvers becomes... less obvious. Beyond the issue of researchers pursuing hot topics or sexy narratives, our impacts within society are highly limited by society’s receptivity to the solutions we may offer. Even in the case of very applicable science, is it really that easy to apply and does society take notice? Livingston and colleagues[5] recently showed that the percentage in dementia prevalence reduces by 8% if hearing loss is eliminated. Will this lead to significant campaigns and solutions against such an important risk factor? We must understand that society’s assimilation of solutions and their progressive application will decide what is a “significant finding”, not us. For example, RNA vaccines became a significant contribution when the COVID-19 pandemic broke out. Moreover, society’s acceptance of scientific solutions depends on the extent of people’s interest and trust in research.

The quality of the relationship between society and research has possibly been jeopardised. Charles Darwin, Dmitri Mendeleïev, Louis Pasteur, Thomas Edison, Marie Curie... (apologies that we cannot respect gender balance in this short-list!) are only a few examples of all the researchers who became universally recognised by their contemporaries. These days, who even knows last year’s Nobel Prize winners? Who knows the name of the researcher whose work on mRNA was vital in the development of efficient vaccines against COVID? It is very likely that most individuals, even within the scientific community, have never even heard the name of Katalin Kariko. Researchers have historically faced criticism and resistance (in particular those who were bold enough to say that the Earth was round!) but not indifference. Have we reached the end of a golden age of research? Is the world of research starting to resemble Hermann Hesse’s utopic Castalia[6], where an elitist order of intellectuals spend most of their time playing a sophisticated game exploring all fields of human knowledge while cultivating

rigorous reasoning? They are so fully dedicated to this game that they lose interest in creation and become totally disconnected from the rest of the world.

As the involvement of society is so crucial to employ the results of research for long-term impacts, we should constantly fight the constitutional cleavage between research and society. Maybe we can find our most important societal role, alongside our fundamental scientific work, in paving a bidirectional interaction with society. We spend so much time on promoting the very specific shade of our own stone within the narrow community of researchers with stones of a similar colour. With these stones, let's not build a wall between the two worlds. Let's build a bridge, with both worlds contributing stones. Each of us may invest more time in improving the organisation of research as a system interacting with society. Initiatives can be created to include those from outside research at each step of our work, from the definition of a scientific question to the communication of results. Let us mention the idea suggested by *Frontiers for Young Minds* which created a unique interface for children to work with scientists directly. In this very unusual journal, children get the opportunity to be reviewers (with supervision from a mentor) of articles submitted by distinguished scientists.

We should not fool ourselves though: trying to include new participants in our academic world is certainly useful, but maybe more to us than to them. Being engaged in society can go far beyond that. We all have the power to make society change beyond the strict boundaries of our research work. Every researcher accumulates knowledge of at least one domain, more or less directly connected with society's concerns. Although science itself should not be prescriptive, researchers are entitled to use their experience to develop their own opinions and defend them. Russian physicist Andreï Sakharov was certainly famous among scientists as the father of sovietic H-bomb, but he turned into an international hero, winning a Nobel Peace Prize, when he became concerned about the moral and political implications of his work and started advocating for peaceful use of nuclear technology.

The impact of researchers on society may occur on another level still: that of philosophical and spiritual inspiration. By spirituality, we refer to Bergson's concept, defined as the characteristic of the constantly developing mind, able to draw from itself more than it contains. By attracting people's attention towards the world of thoughts and feelings, psychologists and neuroscientists in particular may endorse a spiritual role, fostering dreams, emotions and intuitions over intellect and rationality. To this end, they must invest their creative power into adapted formats, closer to art than to academic pieces. Researchers can construct part of their

identity as “artists of knowledge” without blushing. There is no shame in recognising Leonardo da Vinci as a model. Contemporary researchers and best-selling authors like Angela Duckworth or Antonio Damasio are also great sources of inspiration. And this is totally independent from the purely scientific quality of their work. For instance, by arguing that grit (i.e., the personality trait behind perseverance) matters more than inherited talent and intelligence on the road to success[7], Angela Duckworth conveys a philosophical message in line with Sartre’s existentialism (i.e., the theory that what you do determines what you are and not the opposite). Thus, she invites the reader to fully reconsider their role as a free agent of their own life.

We have maybe reached the true pot of gold: as researchers, we are free to determine how we wish to be useful to society and there are many possible paths. Even though the use of our work is mostly determined by society itself, we should never indulge in a feeling of futility justifying a cynical view of our societal importance. It is our responsibility to take the time to escape from the publication routine, think, and define our own way to interact with society, while still respecting our ethical duty as a scientist. We hope to have fulfilled our inspirational role by triggering some reflection on how we can individually, as well as collectively, bridge the relationship between research and society. Of course, this is not only about writing best-selling books but about grasping opportunities to take a closer look at the “real world” and enjoy the journey!

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Figure legends

Image 1 [no caption]

Image 2 Andreï Sakharov attending a demonstration for human rights.