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Relations between science and culture: 20 years of the Spiral of Scientific Culture^a

As relações entre ciência e cultura: vinte anos da Espiral da Cultura Científica

Interview with

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THE COVID-19 PANDEMIC has thoroughly altered the relationship between science and society. It has brought forward new demands and opportunities for faster and more comprehensive sharing of scientific information. Scientists and science communicators played an active role in stimulating the debate with the public. Responding to high societal demand, they have informed non-scientists in Brazil about the results of ongoing research on the pandemic and have participated in decision making processes, behavior modulations and development of public policy.

Such a task was neither exempt of tensions or unidirectional (from scientists to society in a one-way process). Scientific knowledge was integrated in Brazilians' daily routines and was applied to the particularities of a myriad of lifestyles while also impacting scientists and research institutions which had to cope with new demands. In sum, this mutual influence between science and society is the fabric that makes up the scientific culture.

The interactions among different social actors that either produce or consume scientific information and who codify and decodify its language in order to make communication more efficient are represented in the Spiral of



Scientific Culture. The Spiral is a science communication model developed by linguist Carlos Vogt 20 years ago.

To rethink the spiral following the emergence of a new respiratory disease that caused a global public health crisis allows us to reflect on the relevance of both the circulation of scientific information in the public sphere and the ways in which the incorporation and development of such knowledge has emerged from interactions between science and society.

Vogt has been working on developing Science Communication practices in Brazil for over 30 years. At 80 years old in February 2023, he has been unstoppable throughout his leading participation in ambitious and pioneering projects to further the public access to scientific knowledge. He has a Master's degree in General and Stylistic French Linguistics from the University of Besançon (France) and a PhD in Sciences by Campinas University (Unicamp). Vogt was also one of the founders of the Laboratory of Advanced Studies in Journalism at Unicamp (Labjor), which was created in 1994 with the aim of becoming a research cluster for studies on media.

For 24 years Labjor has been offering a free Graduate Certificate in Science Journalism and a Master's degree in Science and Culture Communication, the latter about to complete its 15 years of history comprising over 200 successful dissertations. Vogt has also led the creation of Agência Pesquisa Fapesp, which has become a key source of science news in the country. Moreover, he is also a poet with seven published pieces.

Vogt has worked in several prominent institutions for national scientific production: he was the Dean at Unicamp between 1990 and 1994 and president of the São Paulo Research Foundation between 2002 and 2007. He is one of the founders of the Virtual São Paulo State University (Univesp), of which he was also the president between 2012 and 2016. Vogt worked as São Paulo State Secretary for Higher Education (from 2007 to 2010) and currently holds both the 23rd Chair in the Campinas Academy for the Letters and 15th São Paulo Education Academy. He is the co-founder of *ComCiência*, an online magazine published by science journalists in training and was also the Executive director of *Ciência e Cultura* magazine for over a decade. During his time at *Ciência e Cultura* the publication regained its status as a prominent science communication venue.

The concept of scientific culture is of great importance to understand Science Communication as part of larger social and cultural phenomena through which science gets established. To describe the mutual and dynamic workings of different phases for production and diffusion of scientific knowledge, Vogt distinguishes four overarching quadrants through which the Spiral of Scientific Culture gets constituted. In each one of them science fits distinct paradigms, plays varied

roles and dialogues with different types of publics. Moreover, the model also highlights scientific culture's intrinsic democratic characteristic: it assumes that science is a fundamental democratic exercise. "In order to have a scientific culture one does not need to be a scientist necessarily (...). It is about being a citizen, in the broader sense of contemporary societies)", he emphasizes at some point during this interview.

The spiral was created amidst discussions about how science communication can contribute to democratic exercise. To that end, the language it assumes is of high relevance. When we move from quadrant 1 of science production to the other 3 quadrants, the language of science becomes more didactic and affectionate. The ongoing shaping of linguistic codes progresses to the point where technical data and expressions are modified to better become integrated to culture. Therefore, the language used throughout the quadrants in the spiral provides the means to which citizens come to contact with science and incorporate it, thus maintaining their participation in socio political issues.

In this interview Vogt updates the concept of the Spiral of Scientific Culture in light of the new discussions on the science and society relationship brought forward by the Covid-19 pandemic. This was a period characterized by the enlargement of public access opportunities to scientific knowledge. Such access became more widely available due to open science initiatives such as peer-reviewed articles available without paywalls, shared databases and preprints. In other words, during the pandemic science was opened to actors outside the scientific community, a process that illustrated the high speed and the dynamics between science and culture on which the spiral theorizes. In Vogt's words, "Science moves away from a behavioral particularism and gradually becomes increasingly universal. It is at this point that it becomes a fully cultural phenomenon".

MATRIZes: Open Science and Open Access are themes usually framed within the concerns from the scientific community. On the other hand, science communication is a way to open scientific knowledge to other publics as they allow free access to scientific publications. With new open access policies such as the determination by funding agencies that research funded with their grants must be published in open access, it seems that there is a new aspect of the scientific culture. What are your thoughts on these issues?

Carlos Vogt: It is like the case of generic drugs. There is a proprietary regime, that is, patents, and there is an international movement to break them. This way, you grant access to a specific medication and health technology. Immediately, companies like Sandoz, Pfizer and others start offering generic options. This is the flexibility made possible by capitalism and it is



important to highlight this because it is an issue of propriety in some aspects. It is a sophisticated issue but it is still about somehow maintaining properties. So important questions include: how does the system adapt? How does it reinvent itself? How does it maintain its fundamental goal i.e., profiting over a product or service?

Aaron Swartz¹ tried to change this intellectual property structure made available through the economic handling of journal articles. What were the consequences of this to big institutions that are aware of property and control issues of such publications? In his case, there was not only the tragic consequence of his death but there were also technological and cultural consequences if we consider the scientific culture and the payments-to-a-propriety issues?

This is not to say that the whole system has changed as the economic system is powerful – there is a thing called capitalism and it is powerful. The fundamental of capitalism is property so changing this will be difficult. I think this is an important matter. I think that reflecting on Open Science means reflecting also about all of this.

MATRIZES: Could you recall the ideas that influenced you when you created the spiral 20 years ago?

CV: I remember exactly how the creation happened in 2003. I was thinking about Science Communication and I recalled something John Ziman² said at some point during the 1980s that communication is an essential element of science, it is one of its fundamental features.

There is the science literacy issue at hand too, which prevailed for some time in the United States and subsequently in Europe as well. The model stated that those who know something ought to teach it to those who do not know it. Hence, the role science communication plays would be to take information from one place to another straightforwardly, not to incorporate information. This idea has since been criticized and it is within such criticism that I have built the concept of scientific culture.

Through it, there is an attempt to see this communication relationship as a more complex activity that concerns not only education, but, above all, the broader social upbringing within this scientific culture. That is, in order to have a scientific culture one does not need to be a scientist necessarily. One can be [a scientist], naturally, but not necessarily. It is about being a citizen, in the broader sense of contemporary societies.

The concept of scientific culture emerges from this context in my conception because seeing science as culture is precisely exposing it to an “other” meaning that it demands that there is an exterior element. This “other” in science is the

¹ Aaron Swartz (1986-2013) was a programmer and activist for the democratization of access to information who participated in the creation of numerous pioneering initiatives, such as Creative Commons (which defines copyright policies) and Reddit, a social news aggregator. He was arrested in 2011 for using the Massachusetts Institute of Technology (MIT) system to download millions of scientific articles from the JSTOR digital repository, which charges the access to part of the publications. In January 2013, Swartz was found dead after committing suicide.

² John Ziman (1925-2005) was an English physicist and professor, working with condensed matter physics. He dedicated part of his career to the popularization of science and to studies on the philosophy of science and the social responsibility of scientists.

individual to which science communications aims to talk, to the ones it wants to reach. Put differently, the “other” in science is the non-scientist.

MATRIZES: However, science often gets communicated to reach solely those already trained in its specific scientific codes and language.

CV: Indeed, the ways in which you talk to a non-scientist has changed from the moment that science has become a phenomenon highly codified and abstract that it cannot be understood solely through images and analogies. Science got increasingly distanced from the analogy world and entered a realm of an autonomous code that has its own logic, consistency, efficacy and so forth.

The mathematical languages are continuously transformed into the language of the world or, more precisely, into the language with which one gets to understand the world, especially if we consider Physics and Biology. It so happens that this language gets so abstract that if you use it with a non-scientist, it is not possible to illustrate the concept using analogies. However, science still aims to describe the world.

But scientific phenomena are carried by the cultural movement. Physics went through a thorough transformation towards the late 19th century and early 20th century. During this period, the clearly organized world described with the cause-and-effect laws of Newton gets invalidated by Einstein's and Max Planck's theories. From this moment on, Quantum Physics develops and postulates that things do not work as previously thought, that there are beings that are and aren't at the same time, that appear and disappear simultaneously.

So, how do you “capture this creature”? It changes everything and it promotes well known cultural consequences – fantastic and political consequences, such as wars, arise with the great changes that science paradigms will imprint. One may get surprised, if too attached to positivism, and may wonder “how is it possible?”.

What happened to science from this moment onward is fundamental to the creation of a scientific culture. This great phenomenon (Classical Physics and Modern Physics) put forward all-encompassing changes and their incorporation is multifaceted. The subsequent incorporation of Darwinism and Evolution theory also shakes things up and brings a sense of relativism.

It is a world that gets transformed and these movements also change the relationship between science and society. With time, the element of the “other” in science gets created, which is a fundamental element in the concept of scientific culture for it is about a goal-oriented and precise culture that is related to what science does, its practices and consequences but whose participants



are not necessarily scientists. All this means that we have to consider science communication in these processes.

MATRIZes: How have you developed the Scientific Culture Spiral concept with these issues in mind?

CV: Thinking about this phenomena, I have distributed different moments of the relationship between science and society in metaphoric quadrants that describe such moments.

There is the first moment which consists of scientific production and in which communication is essential but it is nonetheless a highly codified communication that happens between peers. It is a communication between people that have already been trained to know the codes, otherwise it is impossible to get in. This moment I call the first quadrant and it describes science communication through journal articles and conferences, for example.

The second moment is key because it is within it that science becomes educational. Here, the highly specific and codified language from the first quadrant gets simplified because the aim is to teach science. The relationship between science and society in these moments happens within schools and at different levels. Nonetheless it is a communication between people who know more, on one hand, and people who know less but will learn, on the other.

Hence, language history is fundamental in these distinctions because you have a highly specific and coded language to do science and simplified language that is predominantly geared towards understanding.

The next moment is the movement of trying to make people love science. I say that it is time for science amateurs: those who love science and are not professionals. This includes the birth of science museums in the 19th Century, science fairs, major events, exhibitions, among others. The intention is as follows: in a society that is transformed after the Industrial Revolution, based on the development of the steam engine, energy and coal – in which new challenges arise with the age of large machines and their social consequences – it is necessary to train people in the broadest sense and educate them, because you need manpower to manipulate these machines. So, you need to attract people to this matter, you need to awaken their love for this new reality.

There is a shift in the concept as we simultaneously cross into the fourth quadrant, in which there is the need to take science to non-scientists. This is inevitable within the framework of scientific culture as it solely in relation to an “other” that a culture gets established. So dating back to at least the 19th century, we can think of the French and English science popularization magazines, curiosity magazines, but that also worked on that issue.

Particularly in the 20th Century following major changes in scientific paradigms, the science literacy issue emerges. It is not about training future scientists but to allow people to become interested in science instead so that they are not bored and do not turn away when science starts to hit the front pages of newspapers and ultimately the science sections within the news and, later, on editorials.

It is this big movement that closes these quadrants dynamics. I mean, science moves away from a behavioral particularism and gradually becomes increasingly universal. That's when it becomes fully cultural. Then the spiral advances and returns to the same axis, although not in the same place because, theoretically, people are transformed, there are new discoveries. As a result, a new cycle begins. As it is about communication, I think that, in all of this, a fundamental thing is the issue of language.

MATRIZES: Why is language so important?

CV: The language in each of the quadrants is not steady and nonetheless the same, although there are similarities. The language of communication between peers, as I said, is coded, abstract and in jargon-form. Consequently, it is absolutely esoteric in the sense that Aristotle thought about esoterism, to the point where it becomes exoteric with an 'x' (that is, concerned with communication). I think that it is interesting to at least mention the characteristics of such language given that we are discussing communication issues.

You move from a closed (esoteric) universe to an open universe of communication (exoteric). One of the things that characterize these phenomena is if you look at science communicators that are scientists and see their effort to transform a closed and restrictive code to an open code, which is the common language. Ultimately, they transform the codes in a way that it still preserves the essential components of the concepts being discussed.

You cannot lose concepts, so how do you do it? You try to sensitize them. Which means that you do it by trying to transform concepts that can be digital into analogical ones, because without analogy there is no metaphor and, without metaphor there are no images capable of transforming a concept into a sensible thing. In other words, it is transforming a subject into something that seems to belong to the experiential order of each one. You read and, as you read, you experience – as the poet says – even what you have not lived, but you incorporate it as a lived thing. So, this is an interesting effort because it's when science gets closer to poetry and poetry to science. About that, I have not the slightest doubt.



MATRIZES: In 2002, you took part in the creation of Agência FAPESP, a news agency about studies funded by the São Paulo Research Foundation (FAPESP). Fapesp is one of the main sources of funding for national research, considering the volume of science produced in this State, and the agency guides journalists towards it. Through these materials, research reaches society. At that time were you already thinking about the Spiral model, was there a connection between the model and the practice?

CV: I created Agência Fapesp with a practical and a cultural motivation. The practical one was that we did not have any news agency in Brazil capable of establishing itself as a source of science for the mainstream news media. From a cultural point of view, if we managed to do this, we would have taken a big step towards shaping scientific culture because we would be working on a daily basis not only with information and the press, which is the broadest and most direct form of contact, but also with the configuration of that scientific culture in the country. So, when I created the Agency, it was with the idea of doing something different from [the existing] *Pesquisa Fapesp* magazine³.

[José Fernando] Peres himself, who was the scientific director [of FAPESP] at the time, questioned ‘are you going to do something that already exists?’ to which I replied that the agency was something completely different, first because it was purely virtual, not printed and whose cost consisted of content production costs. And secondly because of the idea that the agency should build a large mailing and activate it every morning – which it continues to do until today and it is a very significant mailing. In other words, I thought ‘why only [science journals] *Nature* and *Science* [can do it]? Let’s do that too’.

MATRIZES: The access to scientific information changed during the pandemic, which brought about major changes in the flow of information and promoted greater openness of knowledge due to an international agreement between major publishers to advance discoveries about Covid-19. In this scenario, the knowledge that belonged to quadrant 1, accessed exclusively by peers, began to be widely disseminated through preprints and accessed directly by patients and anyone with internet access and interest in these issues. How do you see these changes in relation to the spiral?

CV: What you are saying is impressive because at Unicamp [State University of Campinas], Unesp [São Paulo State University] and universities in general, the impact that this had on them directly provoked a scientific effort in the sense of improving not only the understanding and comprehension [of science], but [also] solutions that could ease and bring relief to [Covid-19] situations. Including the story of mechanical ventilators, [and] a lot of other things.

³The *Pesquisa Fapesp* magazine is published by Fapesp, it was launched in October of 1999 and was sold in newstands. It has around 30 thousand issues monthly printed and it can also be freely accessed online: <https://revistapesquisa.fapesp.br>

This caused and accentuated the phenomenon of transversality, which has been happening as an epistemological phenomenon. The transversality between the actions at different levels within universities and the multidisciplinarity are very large and have intensified enormously. So, this is a phenomenon that ended up being accelerated in this scenario of changes that were already ongoing and were, in fact, accentuated, rushed.

The changes were very big and what you are saying is also true, but it is part of this movement that was already happening because the number of scientists who start to worry about communication outside academia is very large. And the subject of interdisciplinarity, transdisciplinarity are also phenomena that were accentuated with the pandemic.

MATRIZes: Would you say that, in your initial model, the origin of scientific knowledge needs to be in the first quadrant? Because, the pandemic made clear that it can happen anywhere.

CV: I think so. It can come from anywhere, it does not mean it has to be orthodox, canonical knowledge. However, it needs to be systematized knowledge. If it is not systematized it cannot acquire reference power.

MATRIZes: From the point of view of knowledge output, in which quadrants do you see the possibility of democratizing knowledge? Some theoretical lines will say that the formation of scientific culture does not occur at the end of a process, like the spiral spin, but throughout it.

CV: My idea is that the scientific culture as a cultural process is necessarily dynamic. This means that the parts that make up the model are parts that are actually only methodologically distinguished. As the process is dynamic, these parts only make sense when they work integrated. The very conceptualization of the culture is related to reading this movement by its parts. And what is the 'other' of quadrant 1? The other in quadrant 1 is quadrant 4, for two reasons: because it is the different other and because it is the other that integrates quadrant 1 to modify it, to transform it and to precisely make that movement and change the conception of science itself.

This is not innocent. I mean, when you involve society, you involve the other, then you bring to science all the issues you are talking about: all the problems, all the traditionalism, the traditional cultures, which is exactly what will provide the strength to the concept of scientific culture. It is precisely this concept of movement, which does not stop and does not end. This means that each spin incorporates what is part of each moment. Of course, all this is didactic and methodological, but it is a phenomenon that aims to define science as a social phenomenon. Hence the concept of scientific culture.



It is necessary to understand, first, that the phenomenon is dynamic. Second, that the concept of scientific culture is not in quadrant 1, 2, 3 or 4; it is the spiral and it is in motion.

MATRIZes: When you pass the message from one quadrant to another, does it become more immortal? As you move from one quadrant to another, you refine the social aspect of the production of scientific knowledge and this has consequences for understanding how science is done. If we take the example of chloroquine, Didier Raoult⁴ published a scientific article that supposedly proved the effectiveness of the drug against Covid-19 and the fact that the production of science is not understood as a social phenomena made this paper be understood as if it was a proof of effectiveness of something that, in fact, would have needed to go through the process of social legitimation in the first quadrant but it did not. Sometimes there are these situations where the information generated in the first quadrant escapes.

CV: To take your example of Didier and chloroquine, it was taken from the altar in the fourth quadrant. This happened in the consequences that began precisely in a key social aspect of the scientific question, which is effectiveness. If it was a purely scientific discussion and not a cultural-scientific one, we would be oblivious to all of this, but in fact we were the ones who disclosed it. By 'we' I mean the cultural social phenomenon that brought this thing down. And this is key to showing how much these things are intertwined, how they are related because in each of these moments you obviously have different aspects. That means, in the first moment and above all, the thing for which the scientist is fascinated is required: beauty. Beauty means harmony, consistency, logical and mathematical efficiency of the subject. As you get out of that, the spiders, the bed bugs start asking not only about efficiency and beauty, but also about effectiveness and social relevance.

So science is not as immune to this as it thought it would be. On the contrary, it realizes this in a dramatic way because it starts to work necessarily and constantly with the relationship with the social. An interesting phenomenon is, for example, what has been happening universally around the world with funding agencies. All of them started to incorporate the need for diffusion, communication, dissemination of knowledge and so on. Not only because it is about passing on to society, but listening to society. It is about trying to establish feedback mechanisms. But that is it, the spiral spin is exactly a spin that does not leave science incognito because what transforms it into culture is exactly the coexistence with what science is not. This is what makes science cultural and therefore brings it closer to mortals.

⁴Didier Raoult is a French physician known for advocating the use of chloroquine as a treatment for Covid-19. The studies he published dealing with drug efficacy were the target of investigations by scientific publishers for violation of research ethics and misconduct of clinical trials.

MATRIZES: Do you agree that, as the flow of the spiral goes on, science is losing control of its verification processes, leading to these leaks?

CV: Totally, it is true. Do you remember the discussion about genetically modified food? Regulatory instances were created to mediate the relationship between science and society as a way of institutionally activating citizen participation. So, here in Brazil, years ago, the CTNBio [National Technical Commission on Biosafety] was created, precisely where the subject of food was discussed. And there were already visions that had nothing to do with science, but were part of the cultural process that concerns science.

This involved issues of science governance, participatory governance, and so on. There are a series of phenomena that relate to these great transformations and that does not mean that science does not maintain its particularities, but this commitment to knowledge as a public good is fundamental. This has to do with the topic of open science as well.

MATRIZES: Related to that, we noticed that in the 20 years of debates about open science and the need to open up scientific knowledge to the public, these practices did not leave quadrant 1. In other words, the goal of constituting science as a 'public good' remained as a mere justification, and was restricted to the scientific community. But the pandemic brought the urgency that open access of scientific information alone is not enough. It democratizes information among peers, but it is not enough to be socially appropriated. In this scenario, we have thought of science communication as a key tool to bring knowledge of scientific papers and preprints to society, since it brings the notion of democratizing knowledge at its core.

CV: That's right, I think the answer is along these lines. The whole motivation behind the concept of scientific culture, as I said, is in that. I mean, what turns science into culture is dissemination. It is at this moment, called dissemination of science, that the scientific culture materializes. ■

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