



## Philosophy of Science

# The Two Cultures Problem

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**ABSTRACT:** Many post World War II thinkers have been perplexed by the problem of how or even whether people from different cultures can understand each other. The problem arose when we started to think of culture as formative of language and thought. The common assumptions of most theorists of language are that language is fundamental to thinking and culture; and language, thought, culture or humanity is a natural product of biological evolution. Karl Popper and Michael Polanyi—seen as diametrically opposed—both independently criticize these assumptions and provide alternative theories of humanity (i.e. culture, thinking, and language) whereby cross-cultural understanding is a real problem that can be broached through engaging in the pursuit of scientific knowledge. So, though language and culture creates hurdles for achieving cross-cultural understanding, the pursuit of science transcends the limitations of culture.

## Introduction

Many post World War II thinkers have been perplexed by the problem of how or even whether people from different cultures can understand each other. The problem arose when we started to think of culture as formative of language and thought. The main solutions to this problem have followed either Noam Chomsky's approach or W. V. O. Quine's and Nelson Goodman's approach. Chomsky's approach is to think of language and thought as fundamentally universal because they are based on innate and deep linguistic structures. Quine's and Goodman's approach is to think of language and thought as fundamentally variable. For Chomsky, all people have an ability to understand each other regardless of language and culture because all languages are based on the same set of deep grammatical rules. For Quine and Goodman, people from different cultures cannot understand each other because culture and language constructs reality. In both cases, the problem of how people from different cultures can communicate dissolves. In the case of Chomsky, the problem dissolves because the difference is not fundamental. In the case of Quine and Goodman, the problem dissolves because cross-cultural understanding is impossible: understanding and reality are relative to cultures and can only occur within cultures.

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other philosophers Karl Popper and Michael Polanyi who are seen as diametrically opposed both independently criticize those assumptions. Moreover, both provide alternative theories of humanity (i.e. culture, thinking, and language) whereby cross-cultural understanding is a real problem that can be broached through engaging in the pursuit of scientific knowledge. So, though language and culture creates hurdles for achieving cross-cultural understanding, the pursuit of science transcends the limitations of culture. For Popper, science follows the methodology of rational dialogue which transcends culture; for Polanyi scientists use tacit knowledge to make scientific discoveries by joining the distinctive culture of science.

Many dismiss Popper's views for being too naive. They argue that science is part of Western culture, and as part of Western culture, it produces knowledge which is relative to Western culture. Science does not transcend culture. Rather, science is an artifact of a specific culture and as an artifact of Western culture produces a language and form of thinking that constructs a reality relative to Western culture. Popper replies to this criticism in his essay, "The Myth of the Framework." Popper's argument is that frameworks can be criticised in the same way all theories can be criticised. However, Popper seems to miss the main point of his critics argument which is that frameworks both define theories and set the procedures for criticising theories within the frameworks. All criticism occurs within frameworks, and hence both depends upon and reinforces the framework. The question here is whether and to what degree, if at all, theories are formed by frameworks?

Ironically, it is Polanyi's theory of how science creates knowledge through the use of personal knowledge that provides an answer to that question. Science forms a distinctive culture with a distinctive framework that transcends Western culture. Science is an autonomous culture. So, those who want to break the barrier of the framework, need only to join the culture of science and thereby transcend ethnic cultures. However, as an autonomous culture with a distinctive framework, science again re-creates the barrier of the framework in the form of C. P. Snow's "Two Cultures Problem." Science is a distinctive culture which is not understood by literary people; and literary people form a distinctive culture which is not understood by scientists. So, have we returned to the original problem, if only in a slightly altered form? How can people, if at all, from different cultures (i.e. science as opposed to art) talk with one another?

I think the resolution to this problem of scientists and artists can talk with one another lies through seeing how Polanyi and Popper form complementary theories of scientific knowledge and the science culture.

Most ignore Polanyi, or mistakenly equate his views with T. S. Kuhn, who thinks that scientific revolution is the replacement of incommensurable paradigms. Science in a revolutionary state consists of competing paradigms or cultures each defined by their own paradigm where one culture becomes dominant-usually the paradigm of the younger generation. However, from the perspective of Polanyi's theory of tacit knowledge, the theory of paradigms is at best a partial description of how scientific knowledge is created. I think it is Polanyi's theory of the creation of scientific knowledge through the use of tacit knowledge which overcomes the limitations of frameworks. The framework or paradigm is an aspect of personal knowledge.

Many of the followers of Polanyi and Popper, mistakenly think that Polanyi's views are radically opposed to Popper's views. Though Polanyi's theory of tacit or personal knowledge is seen as opposed to Popper's theory of objective knowledge, Polanyi views

objective knowledge and rational criticism as part of the explicit or articulate dimension of science which is guided by the tacit dimension. Hence, from the perspective of the tacit dimension, Popper's theory of objective knowledge is a description of how the explicit aspect of personal knowledge functions. However, I think that Polanyi mistakenly minimizes the role of objective knowledge in his explanation of scientific discovery. By fully explaining the function of objective knowledge and its relationship with tacit knowledge, I suggest that we will explain both how to break the barrier of the framework and how science creates knowledge.

My theory is that by integrating the views of Popper and Polanyi, we will produce a solution to the two cultures problem, in specific, and to the problem of cross-cultural understanding, in general. The easy part to this integration of Popper's and Polanyi's views is that both agree that it is not language but science which is the key to understanding thinking. All knowledge follows the pattern of scientific knowledge. Language is a tool for thinking; a very important tool, but only a tool. Also, both agree that science, thinking, and culture-or humanity in general-forms a distinctive realm or eco-niche for human evolution. Culture is not a mere organ like the brain or eye but forms an eco-niche for human physical or biological evolution. According to Popper's theory, culture is part of world three which interacts causally with the physical realm. According to Polanyi's theory, culture forms an upper hierarchical level that has its own operational principles but whose principles are conditioned or restricted by the lower levels. Hence, both Popper and Polanyi agree that human culture is distinctive but have alternative views on how human culture interacts with the other realms. The difficult part of the integration of their views is that both seem to disagree over the nature of scientific discovery and the role of methodology. For Popper, articulate questions, theories and argument is what constitutes science. For Polanyi, personal knowledge or commitment to one's views in the face of difficulties is what constitutes science. Popper seems to be for critical detachment; and Polanyi seems to be for a-critical attachment. However, I will argue that both theories of science are interdependent and need to be integrated in order to fully explain how science creates knowledge.

There are three questions concerning my attempt to integrate the views of Popper and Polanyi with respect to the two cultures problem that I will address in the following:

1. How does science create knowledge?
2. How do science and art form distinctive cultures?
3. How do scientific and artistic creation allow for breaking the framework barrier?

### **I. How Does Science Create Knowledge?**

Popper and generally critical rationalism holds that knowledge develops through a process of conjecture and refutation-question, alternative theories, and critical discussion. However, this viewpoint best answers the question of how knowledge as objective grows. This approach intentionally does not address the question of how people produce alternative theories. The question of the genesis of theories, and criticisms, is a question of psychology or sociology or history as opposed to a question of philosophy. Philosophy poses questions about the logic of knowledge: whether scientific inference is logically valid. Popper solves the problem of induction where generalizations are invalidly induced from singular

statements by arguing that scientific inference is deductive not inductive. Scientific inference uses *modus tollens*. General theories are refuted by singular statements when predictions are disconfirmed. The problem with this approach is that when we concentrate on the objective dimension of knowledge, we really cannot explain the growth of knowledge. Though we want to explain the growth of knowledge, by focussing exclusively on the objective side, without looking at how individuals produce theories, we only explain the structure of knowledge, not its dynamism.

Polanyi looks at the dynamism of science: how do scientists find new theories? Scientists generate new theories by applying their tacit knowledge. The explicit or objective dimension of scientific knowledge can only be understood from the framework of a body of tacit or personal knowledge. The scientist relies on tacit knowledge to understand the articulate theories and formulae. Also the scientist uses tacit knowledge to resolve difficulties, puzzles, and problems. The scientist makes discoveries by using tacit knowledge as the means for extending the known to understand the unknown. The problem with this approach is that the role of the objective side of science is made peripheral to scientific knowledge. However, scientists communicate through publications and conferences. They discuss and criticize each other's views. So by concentrating on the tacit dimension, the importance and function of theories are overlooked. But this is what the genesis of theories is for: the production of theories for presentation and discussion. Hence, by concentrating on the tacit and personal side of science, Polanyi leaves out the purpose for the genesis of theories.

Popper and Polanyi both fail in their goal to explain how science grows. Popper does not explain the genesis of scientific theory. Polanyi does not explain the purpose or function of creating scientific theories. Popper is concerned about what scientists do once they create the new ideas. Polanyi is concerned about how scientists can create those new ideas at all.

Popper and Polanyi commonly suppose that science forms a special culture where the goal is to create knowledge. The overall question for them both is how does science create knowledge. Once we take the viewpoint that they are actually discussing different dimensions of this creative process, we see that their views alone are incomplete. But together and as complementary, their views form a comprehensive theory of how science creates knowledge. Polanyi looks the origin of knowledge-how science as a culture creates its theories. Popper looks at the function of knowledge-how science as a culture processes its theories.

Popper, more so than Polanyi, explicitly adopts and adapts Darwin to develop an 'evolutionary epistemology'. Scientific theories when falsified are eliminated in the way that maladapted species are eliminated through natural selection. Likewise, those theories that incorporate the corroborated elements of falsified theories, and explain the events that falsified the failed theories are better 'adapted' theories. Moreover, theories as part of the objective dimension of knowledge provide an eco-niche which implicitly contain features-i.e., problems and consequences-unknown to their inventors. Here is where Popper, ironically merges with Polanyi. Polanyi's motto is that we know more than we can explicitly say. This knowledge is tacit and lies in the subjective sphere of our subsidiary awareness, of our embodied skills, and embodied understanding of traditions. This is akin to what Popper refers to as the implicit contents of objective knowledge. It is in both Polanyi's tacit dimension and Popper's implicit contents of objective knowledge that we find the solution to the Darwinian problem of how novelty is generated.

According to Darwin, new species form because individuals who are born with slight differences produce off-spring who inherit those differences and are better able to adapt to their environment. The Darwinian problem is to explain how those differences arise in the first place. Darwin explains the 'origin of species' but not the origin of mutated individuals. This was explained by genetic theory: there are random changes in the genes (DNA) which produce individuals with differences; also, various traits are dominant or recessive; hence, those once recessive traits or those random genetic changes which allow the off-spring of individuals to better adapt, originate new species. Similarly, Popper's Darwinian model of how theories evolve by trial and error faces the Darwinian problem of explaining how new theories are generated. The solution lies in, on one hand, Polanyi's notion of the tacit dimension, and in, on the other hand, Popper's notion that the contents of objective knowledge exceed the awareness of individuals. When individuals become aware of implicit problems and implicit consequences of theories, they use their tacit personal knowledge to generate new theories to solve the problems and incorporate the consequences.

The implicit dimension of objective knowledge and the tacit dimension or subjective knowledge which lies in the knower's embodied knowledge, function together to produce novel theories. The implicit dimension of objective knowledge contains the hidden problems and consequences of explicit theories. The tacit dimension contains the subsidiary and bodily aspects of what we explicitly know. Both dimensions—the implicit dimension of objective knowledge and the tacit dimension—interlock to produce novel answers to our emergent problems. The problems that emerge from the implicit contents of objective knowledge direct our subjective knowledge to produce solutions. As Popper among many other say, finding the problem is fifty-percent of the solution. This common saying can be explicated as follows: it is a short-hand way of saying that the process of making explicit the implicit contents of the objective dimension guides the uncovering of solutions from one's subsidiary awareness. Many discoverers have an 'aha' experience when coming up with the solution to a problem—it is as if one knew it all along. One does know it all along because the germ of the solution is just beyond one's focal awareness. As one shifts one's focal awareness, the solution pops into awareness.

For instance, after Einstein discovered the theory of special relativity, Poincare claimed that he was the real discoverer of that theory. It is unlikely that Einstein was a plagiarist and less than the original genius that he was. However, Poincare should not be dismissed as a disgruntled and ungenerous egomaniac. Rather, Poincare and Einstein independently articulated the same implicit content of the objective dimension of knowledge. However, Einstein's deeper tacit understanding of electromagnetism led him to produce the more direct and complete articulation of the theory of relativity. Similarly, though Lorentz was able to produce the mathematical equations for the transformations of distance and time between different frames of reference, he did not have a full grasp of the meaning and function of his formulae. Moreover, he did not see the problem as Einstein and Poincare saw it. Lorentz thought that he was working on the problem of how to explain the lack of any difference in the measurement of the velocity of light through the ether. Einstein and Poincare saw the problem as whether measurement has any independence from the observer; and also for Einstein, as how the laws of physics maintain uniformity throughout nature. The implicit content of this problem-situation has guided the formation of the main problems of physics since then and until now. We still want to know to what degree measurement is independent of the observer and how the laws of physics maintain

uniformity throughout the universe from sub-nuclear particles to black holes. During this period, dozens of theories have sprung from the minds of scientists; and most have been eliminated. But these theories arise from the subjective dimension: from bringing subsidiary awareness into focal awareness; and, from realigning their embodied skills and knowledge.

In sum: integrating Popper and Polanyi results in the solution of the Darwinian problem in science. Though scientific theories evolve through a process of elimination-i.e., through trial and error-how are scientific theories created in the first place? The solution is that the implicit content of objective knowledge when articulated produces new problems; and subjective knowledge is the source of potential solutions when the focus of awareness is moved along the horizon of tacit knowledge. We create new knowledge by articulating what we implicitly and tacitly know. But this knowledge is bound within science as a distinctive culture with its own traditions, instruments, implicit contents in its objective theories and problems, and embodied in skills and personal knowledge. Both Polanyi and Popper agree that science forms a culture and that the cultural element of science is crucial to the functioning of science. How, then, does science form a distinctive culture in contrast to the humanistic culture of the arts and literature?

## **II. How Science and Art form Distinctive Cultures?**

C. P. Snow brought to our attention what he named "the two culture's problem." The problem is that artists, or more generally, humanists, and scientists form two distinctive cultures and so cannot understand nor talk with each other. Is this a genuine problem? If so, can we resolve this problem?

This problem assumes that people from distinctive cultures either generally misunderstand each other, or always must misunderstand each other. Moreover, this problem assumes that for the most part, membership in the two cultures is mutually exclusive. These days very few challenge Snow's assumptions about cultures and about scientists and humanists. However, there has been a strong reaction to Snow's description of the problem; especially to his thesis that if literary types do not make an effort to understand science they will be left out of modern society and politics which tends towards dominance by the technology of technophiles and technocrats.

It seems that Snow's theory of the two cultures has turned into a prediction of contemporary post-modern society where techno-science and technocracy dominate. Humanists, in the broadest sense of the term meaning those who place a high value on human dignity, responsibility, and freedom, and who think that science and technology should serve and enhance humanity, are on the periphery of contemporary society. Firstly, the main model of humanity, social organizations, mind, and cognition is the information-processing model. Secondly, as the astute criticisms of some former AI theorists, Terry Winograd and Jerome Weizenbaum note: we first redefine human characteristics such as judgement and thinking in terms of computational models, and then we say that humanity is nothing more than computational machines. Everything that cannot be redefined is eliminated as folk-psychology or as mythology. Thirdly, most cultural commentators are unwitting Marxists because they tacitly adopt Marx's theory of technology leading social change. Karl Marx proposed the theory that when the means of production and the mode of production conflict, the mode of production is redesigned to fit the means of production. Today every major management theorist and economist, including neo-classical economists, have noted

that the means of production is Knowledge, which they define in information-processing terms, and the mode of production is industrial. So, even the mode of production-bureaucratic, hierarchical social organizations-is changing to match the means of production-information processing technology or Knowledge. This form of social organization involves the creation of a temporary work force who sell their service to consortiums, and who change jobs and careers according to the dictates of the market. Corporations are flat, as opposed to horizontal, and floating teams are formed across divisions on the basis of temporary projects. Furthermore, corporations are learning systems-they create Knowledge and this Knowledge as opposed to the hard consumer products which are based on this Knowledge is what they really produce and market.

C. P. Snow's two cultures problem is now more severe than when he discovered it: humanists are not only unable to communicate with scientists, but are marginalized by contemporary technoscience. Let me give a concrete example of this marginalization of humanists in current corporations. Middle managers are being removed from corporations and replaced by information-processing functions. Middle management functions as humanists within corporations: they prepare reports for upper management; and interpret the policies and regulations developed by upper management to lower management. Front-line staff generally do their own report preparation by using canned electronic forms, spreadsheets, and report generating software. Upper management leave more discretion to front-line staff for interpreting policy and even provide opportunities for front-line staff to contribute their own views about the corporate 'mission' and 'vision'. However, the bottom line is that front-line staff are expected to understand and use computer technology. But what front-line staff often complain about to technology support staff is that the software is cumbersome, doesn't do the job of the older manual (or even mainframe) systems, and is unreliable. Technology support staff usually complain that the 'end-user' misuses the computer systems, misunderstand the functions of the systems, and expect it to perform tasks that were not built into the system. Here I think is where we have a concrete example of the classic two cultures problem: front-line staff are tacit humanists, they expect technology to serve them; and technology support staff are tacit scientists, they expect humanists to follow the impersonal laws of physical systems which are algorithmic and universal. That is, computer systems are designed to function according to fixed and finite procedures without deviation; but, human systems are designed to be open and infinite. So, the two systems clash.

### **III. How do scientific and artistic creation allow for breaking the two cultures barrier?**

My proposal is that an integrated Popperian-Polanyian theory of Knowledge, or more specifically, Knowledge Creation, can solve both the specific problem of the lack of communication between computer technology support staff, and computer-users and the general problem of the lack of communication between scientists and humanists. Knowledge creation must cross cultures because of the implicit contents of the objective dimension of Knowledge and the tacit dimension of embodied, subjective, personal knowledge. The implicit contents of created Knowledge as objective, and as open to the discovery of everyone regardless of background, transcends culture. However, created Knowledge is only originated through an intensely personal subjective or psychological process of changing one's focal awareness, of using and extending one's subliminal awareness and understanding. Though the scientist is culturally bound when he creates

knowledge because knowledge creation partially depends on culturally embodied knowledge. This process of knowledge creation ironically embodies the traditional or stereotypically humanistic or artistic processes of commitment, subjectivity, illogical leaping to conclusions, imagination, recognition, metaphor, irony...and so forth. Whereas the process involved in the evolution of objective knowledge conforms to traditionally or stereotypically scientific processes of detachment, neutral criticism, logic, analysis, and so forth. Thus, in some respects, the two cultures problem rests on misleading stereotypes; for the processes of knowledge creation and knowledge evolution apply both to the scientific and humanist cultures.

The two cultures problem in the current setting of techno-science has evolved into the problem of how technocrats and humanists can communicate with each other. The Popper-Polanyi theory of knowledge creation and knowledge evolution entails that humanists and scientists must communicate with each other. The objective problems implicit in the objective contents of scientific theory is open to everyone and transcends culture. These objective contents guide the subjective process of knowledge creation-the development of multiple theories which attempt to solve the problems. Thus to gain a better understanding of the driving problems of a situation, the more people that discuss and elaborate the problems, the more chance is there for the creation of new solutions. With respect to the lack of communication between those who support technology systems and those who use those systems, it is upto technology support staff to listen to the complaints of users and to interpret them as possible design flaws. The problems or bugs in technologies which in the terms of Donald Norman, 'make people stupid', can only be solved by technology developers who adopt the goal of attempting to 'make people smart': to develop systems which enhance our abilities rather than curb them.

Hence, the Popper-Polanyi theory of knowledge creation and evolution solves the two problems in its current or post-modern form as follows:

First, the cultures of scientists and humanists are not polar opposites but contain common elements. Scientists are humanists when they create knowledge: they rely on subjective, alogical processes of irony, metaphor, focus or perspective switching and so forth. Humanists are scientists when they elaborate problems, and critically discuss interpretation: hermeneutics, history, and philosophy involve problem posing, debugging or problem resolution, and criticism.

Second, the problems of contemporary society are implicit in our socio-technical systems as well as in theories, scientific and humanistic; and so, these problems transcend cultures. The more widely they are discussed, the more chance is there for us to solve them.

Third, the common goal in our technology imbued post-modern society of both technology users or humanists and technology developers or technoscientists is to become smarter: to create knowledge and use knowledge. Given that the two cultures have a common goal, this provides a direction for conversation among the members of the two cultures. Technology developers must listen to technology users when they mention the failures of specific systems. Technology users must attempt to be specific about the failures of specific systems.

Fourth, since most people to some degree are knowledge creators and knowledge users, we are steeped in both cultures and have a tacit ability to understand people from the other culture.