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Implicit Theories Influencing Researchers: A Field for the Psychology of Science to Explore

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What traits in a student do researchers believe characterize a good future scientist? To what degree do these beliefs influence the selection of candidates? These are fundamental questions that resonate in the work of Caitlin Donahue Wylie (2018). As part of a qualitative ethnographic study, an interview was given to two engineering professors working as principal investigators (PIs), as well as to their respective groups of graduate students, most of whom were already working as new researchers. The total sample consisted of 27 people.

Results indicate that, among this class of researchers, interest, assertiveness, and enthusiasm for one's own field of study are commonly regarded as key signs of a good future researcher. Moreover, the interviewees believe enthusiasm to be related to a desire to learn and a strong work ethic. Lastly, the research suggests that possible, unintentional exclusions may occur during candidate selection due to biases on the part of the PIs, reflecting preferences for features belonging to majority groups (such as ethnicity, religion and gender). This essay offers some ideas that may help minimize such biases.

Implicit Theories Undergirding Research

Essentially, the work of Wylie (2018) demonstrates that experienced scientists base their selection process for new researchers on implicit theories. While this may at first appear to be a rather modest contribution, the core of Wylie's research is substantial and of great relevance to the psychology of science for at least three reasons.

First, studying such matters offers different angle from which to investigate and attempt to understand the scientific psyche: studying the psychology of scientists is one of the central areas of research in this subdiscipline (Feist 2006). Second, although the research question addresses a well-known issue in social psychology and the results of the study are thus quite predictable, the latter nevertheless constitute new data and are therefore valuable in their own right. Indeed, they enrich theoretical knowledge about implicit ideas given that, in science and scientific reasoning, it is essential to differentiate between tests and theories (Feist 2006).

Finally, because in the way it is currently being applied, the psychology of science cannot turn a blind eye to the fact that if scientists' implicit beliefs are mistaken, those beliefs may have negative repercussions for the population of current and future researchers (Wylie 2018).

In his role as psychologist of science (Anaya-Reig and Romo 2017), Ramón y Cajal mused upon this issue over a century ago. In "The Investigator as Teacher," chapter IX of his work *Reglas y consejos sobre investigación científica* (1920), he noted:

¿Qué signos denuncian el talento creador y la vocación inquebrantable por la indagación científica?

[What signs identify creative talent and an irrevocable calling for scientific research?]

Problema grave, capitalísimo, sobre el cual han discurrido altos pensadores e insignes pedagogos, sin llegar a normas definitivas. La dificultad sube de punto considerando que no basta encontrar entendimientos perspicaces y aptos para las pesquisas de laboratorio sino conquistarlos definitivamente para el culto de la verdad original.

[This serious and fundamentally important question has been discussed at length by deep thinkers and noted teachers, without coming to any real conclusions. The problem is even more difficult when taking into account the fact that it is not enough to find capable and clear-sighted and capable minds for laboratory research; they must also be genuine converts to the worship of original data.]

Los futuros sabios, blanco de nuestros desvelos educadores, ¿se encuentran por ventura entre los discípulos más serios y aplicados, acaparadores de premios y triunfadores en oposiciones?

[Are future scientists—the goal of our educational vigilance—found by chance among the most serious students who work diligently, those who win prizes and competitions?]

Algunas veces, sí, pero no siempre. Si la regla fuera infalible, fácil resultara la tarea del profesor, bastaría dirigirse a los premios extraordinarios de la licenciatura y a los números primeros de las oposiciones a cátedras. Mas la realidad se complace a menudo en burlar previsiones y malograr esperanzas. (Ramón y Cajal 1920, 221-222)

[Sometimes, but not always. If the rule were infallible, the teacher's work would be easy. He could simply focus his efforts on the outstanding prizewinners among the degree candidates, and on those at the top of the list in professional competitions. But reality often takes pleasure in laughing at predictions and in blasting hopes. (Ramón y Cajal 1999, 141)]

Returning to Implicit Theories

Let us briefly recall that naïve or implicit theories are stable and organized beliefs that people have formed intuitively, without the rigor of the scientific method; their content can be accessed only with great difficulty, given that people are unaware that they have them. This makes not only modifying them difficult but also leads those who possess them to search for facts that confirm what they already believe or, in other words, to fall prey to confirmation bias (Romo 1997).

People tend to identify and organize regularities in their environment thanks to implicit or incidental learning, which is based on associative learning, due to the need to adapt to the varying situations with which we are faced. We formulate naïve theories that help us comprehend, anticipate and deal with the disparate situations confronting us in the best way possible. Indeed, we are surrounded by a such an overwhelming amount of information that

formulating implicit theories, learning which things seem to appear together at the same time, is a very effective way of making the world more predictable and controllable.

Naturally, human behavior is no exception to this rule. In fact, the content of implicit theories is fundamentally of a social nature (Wegner and Vallacher 1977), as is revealed by the fact that a good portion of such theories take the form of so-called Implicit Personality Theories (IPT), a category to which the beliefs of the researchers under consideration here also belong.

IPTs get their name because their content consists of personal qualities or personality traits. They are idiosyncratic, even if there indeed are certain coincidences among members of the same social group.

Understood broadly, IPTs can be defined as those beliefs that everyone has about human beings in general; for example, that man is by nature good, or just the opposite. Defined more precisely, IPTs refer to those beliefs that we have about the personal characteristics of specific types of people. For example, we frequently assume that a writer need be a cultured, sensitive and bohemian sort of person (Moya 1996).

It should be noted that implicit theories, in contrast to those of a scientific nature, are also characterized by their specificity and incoherence, given that they are based on simple, linear coincidences, are composed of ideas that are habitually interconnected, and seek only verification and utility. Still, this does not necessarily mean that such ideas are necessarily mistaken or useless (Pozo, Rey, Sanz and Limón 1992). Although implicit theories have a limited explanatory power, they do have descriptive and predictive capacities (Pozo Municio 1996).

Some Reflections on the Subject

Scientists being led by their intuitions...what is going on? Then again, what is wrong with that? Why must researchers behave differently from other people when engaged in selection processes? Scientists behave as we all do in our daily lives when it comes to all sorts of things. Any other way of proceeding would not just be unprofitable but also would be, in cognitive terms, costly and exhausting.

All things considered, researchers, no matter how rigorously scientific they may be, are still people and as such intuitively seek out answers to problems which influence their labor in specific ways while not in themselves being the goal of their work.

Moreover, we should not be surprised either when different researchers, whether novice or seasoned, share identical beliefs, especially if they work within the same field, since, as noted above, although implicit theories reveal themselves in opinions or personal expectations, part of their tacit content is shared by many people (Runco 2011).

The above leads one, in turn, to make further observations about the work of Wylie (2018). In the first place, as for implicit theories, rather than simply suggesting that researchers' selections may be guided by a perceptual bias, it must be affirmed that this indeed is the case.

As has been noted, implicit theories operate with confirmation biases which in fact reinforce their content.

Another matter is what sorts of biases these are: Wylie (2018) suggests that they often take the form of a possible preference for certain features that are characteristic of the majority groups to which the PIs belong, a conclusion based on several studies showing that white, middle-class men predominate in the fields of science and engineering, which may cause them to react poorly to students who do not meet those standards and indeed may even lead to the latter giving up because of the discomfort they feel in such environments.

This is certainly one possible interpretation; another is that the confirmation bias exhibited by these researchers might arise because they have observed such traits in people who have achieved excellence in their field and therefore may not, in fact, be the result of a preference for interacting with people who resemble them physical or culturally.

It is worth noting here that implicit theories need not be mistaken or useless (Poza, Rey, Sanz and Limón 1992). Indeed, this is certainly true for the beliefs held by the group of researchers. Aren't scientists, especially the best among them, passionate about their work? Do they not dedicate many hours to it and put a great deal of effort into carrying it out? Are they not assertive? Research has conclusively shown (Romo 2008) that all creative scientists, without exception, exhibit high levels of intrinsic motivation when it comes to the work that they do.

Similarly, since Hayes (1981) we have known that it takes an average of ten years to master a discipline and achieve something notable within it. It has also been observed that researchers exhibit high levels of self-confidence and tend to be arrogant and aggressive. Indeed, it is known that scientists, as compared to non-scientists, are not only more assertive but also more domineering, more self-assured, more self-reliant and even more hostile (Feist 2006). Several studies, like that of Feist and Gorman (1998) for example, have concluded that there are differences in personality traits between scientists and non-scientists.

On the other hand, this does not mean that people's implicit ideas are necessarily correct. In fact, they are often mistaken. A good example of this is one belief that guided those researchers studied by Wylie as they selected graduates according to their academic credentials. Although they claimed that grades were an insufficient indicator, they then went on to qualify that claim: "They believe students' demonstrated willingness to learn is more important, though they also want students who are 'bright' and achieve some 'academic success.'" (2018, 4).

However, the empirical evidence shows that neither high grades nor high scores on aptitude tests are reliable predictors of a successful scientific career (Feist 2006). The evidence also suggests that creative genius is not necessarily associated with academic performance. Indeed, many geniuses were mediocre students (Simonton 2006).

Conclusion

The psychology of science continues to amass data to help orient the selection of potentially good researchers for those scientists interested in recruiting them: see, for example Feist (2006) or Anaya-Reig (2018). At the practical level, however, this knowledge will be of little use if those who are best able to benefit from it continue to cling to beliefs that may be mistaken.

Therefore, it is of great interest to keep exploring the implicit theories held by researchers in different disciplines. Making them explicit is an essential first step both for the psychology of science, if that discipline's body of knowledge is to have practical repercussions in laboratories as well as other research centers, as well as for those scientists who wish to acquire rigorous knowledge about what inherent qualities make a good researcher, all while keeping in mind that the implicit nature of personal beliefs makes such a process difficult.

As noted above, subjects who are interviewed are often unaware that they possess them (Pozo, Rey, Sanz and Limón 1992). Moreover, modifying them requires a change of a conceptual or representational nature (Pozo, Scheuer, Mateos Sanz and Pérez Echeverría 2006).

Lastly, it may perhaps be unreasonable to promote certain skills among university students in general without considering the aptitudes necessary for acquiring them. Although it may be obvious, it should be remembered that educational resources, like those of all types, are necessarily limited. Since we know that only 2% of the population devotes itself to science (Feist 2006), it may very well be more worthwhile to work on improving our ability to target those students who have potential. Anything else would be like trying to train a person who has no vocal talent whatsoever to sing opera.

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