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Critical Thinking Skills Motivated by the Study of Hume's Problem and Confirmation Paradoxes

Habilidades del pensamiento crítico motivadas por el estudio del problema de Hume y las paradojas de la confirmación

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Abstract

The ways of dealing with paradoxes have value in the educational context because they imply the use of critical thinking strategies by learners. Precisely, the important thing about this research is that it points out which critical thinking skills allow studying the problem of induction and the paradoxes of confirmation, specifically that of Hempel's crow and Goodman's *grue*. The objective of this paper is to highlight the way in which the different solutions (or non-solutions) proposed for both the case of induction and the challenge of confirmation develop certain critical thinking skills. The methodology of this work is qualitative and is based on the search for information and analysis and interpretation of data found in books, articles, dictionaries, theses, among others. However, formal logic is also used. As results these are the following findings: Hume's problem alerts us that there are several philosophical reasons for not trusting in inductive reasoning; likewise, the analysis of two paradoxes (Hempel's and Goodman's) do the same with the concept of confirmation. As a main conclusion it can be stated that 22 critical thinking skills have been found that can be developed by the solution of these issues.

Keywords

Induction, Hume's Problem, Analysis, Hempel's Paradox, Goodman's Paradox, Critical Thinking.

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Resumen

Las formas de enfrentar las paradojas tienen valor en el contexto educativo porque implican el uso de estrategias del pensamiento crítico por parte de los aprendices. Precisamente, lo importante de esta investigación es que señala qué habilidades de pensamiento crítico permiten desarrollar el estudio del problema de la inducción y las paradojas de la confirmación, específicamente, la del cuervo de Hempel y la *verdul* de Goodman. El objetivo de este escrito es destacar el modo en que las distintas soluciones (o disoluciones) propuestas, tanto para el caso de la inducción como para el desafío de la confirmación, desarrollan ciertas habilidades de pensamiento crítico. La metodología de este trabajo es de orden cualitativo y se basa en la búsqueda de información, análisis e interpretación de datos encontrados en libros, artículos, diccionarios, tesis, entre otros. No obstante, también se recurre a la lógica formal. Como resultados se tienen los siguientes hallazgos: el problema de Hume nos alerta de que hay varias razones filosóficas para no confiar en el razonamiento inductivo; asimismo, el análisis de dos paradojas (Hempel y Goodman) hacen lo propio con el concepto de confirmación. Como conclusión principal puede afirmarse que se han encontrado 22 habilidades de pensamiento crítico que la solución de estos asuntos puede desarrollar.

Palabras clave

Inducción, problema de Hume, análisis, paradoja de Hempel, paradoja de Goodman, pensamiento crítico.

Introduction

The most important difference between deductive and inductive inferences lies in the degree of relationship between the premises and the conclusion. In a deductive inference, the conclusion necessarily follows from the premises. In contrast, in an inductive inference, the conclusion does not necessarily follow from the premises: they only make it probable (Hernández & Parra, 2013; García, 2012b). For example, if a soccer team wins two games in a row, it is likely to win the next game.

In this regard, inductive logic seeks to develop an adequate concept of correctness to characterize inductive inferences that are somehow justifiable or acceptable. However, according to Da Costa (2000), there are many types of inductive inferences, such as: induction by simple enumeration, analogy, statistical inference, Bacon-Mill elimination methods, the hypothetical-deductive method, and probabilistic inference. Abduction can be added to this list.

Amidst such variety, it is difficult to specifically characterize what an inductive inference is. And if adding Hume's problem, according to which there is no adequate foundation for induction, the issue becomes even more complex. However, apart from induction, the concept of confirmation also represents a challenge at the logical level. Specifically, we seek to address the issue of the *verdul* and crow paradoxes, as well as the problem of induction raised by Hume.

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Our goal is to highlight how the different solutions (or dissolutions) proposed—both for induction and for the challenge posed by confirmation paradoxes—develop critical thinking skills. Although induction is a resource widely used by science, it has problems. On a philosophical level, some troubling questions have been raised. For example, how reliable is induction if, knowing that *a* is lead, *b* is lead, *c* is lead, *d* is lead... and *z* is lead, it is not possible to necessarily conclude that «all objects are lead»? Furthermore, what about the reverse process called «confirmation»? Every time it is stated that «all reptiles are green,» is it reliable to confirm this generality by observing that *a* is a green reptile, *b* is a green reptile, *c* is a green reptile, *d* is a green reptile... and *z* is a green reptile?

This issue will be analyzed later, but for now, it is worth noting that both induction and confirmation pose problems at the philosophical level. The aim is to explore the different approaches that have been taken to these problems so that, through these attempts at solutions, we can glimpse the different critical thinking skills that motivate philosophical proposals.

The topic is therefore important at the educational level, since educators who seek to motivate critical thinking in their students will need strategies to succeed in this task, and one of those strategies could consist of selecting problems such as those mentioned above. The topic is also current, since Hume's induction, as well as the paradoxes of confirmation, have not received a definitive and unique solution. The issue remains under discussion, and its approach even involves interdisciplinary connections.

The methodology of this work is qualitative and is based on the search for information and the analysis and interpretation of data found in books, articles, dictionaries, theses, among others. It focuses especially on logical analysis through the use of various theories such as propositional logic, class logic, first-order logic, and the reconstruction of arguments as tools to study the problem of paradoxes. It also points out which elements of critical thinking have been put into practice in an attempt to find a solution to these complex paradoxes and shows that there is no single way to approach these problems, as each of the ways of understanding paradoxes develops certain aspects of critical thinking that are essential for education.

To develop these ideas, first, the different types of induction are presented; then, Hume's problem of induction is raised; the confirmation paradoxes are also formulated: Hempel's ravens and Goodman's *verdul*; Mill's proposal to try to substantiate induction is then analyzed; each of the suggestions that have been designed to address the two aforementioned paradoxes is reviewed; finally, the critical thinking skills that have

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been reinforced by reflecting on Hume's problem and the two aforementioned confirmation paradoxes are indicated.

Theoretical basis

The theoretical foundations necessary to understand and adequately resolve the problem posed are detailed below.

Induction by simple enumeration or simple induction

If $_{a1}$, $_{a2}$, a_3... a_n are elements of class A and it is found that all of them also belong to another class B, then, assuming that no element of A is known that does not belong to B, it is concluded that all of A is B. However, for this inference to be correct, certain conditions must be met: the sample ($_{a1}$, $_{a2}$, a_3... $_{an}$) must be representative and the number of its components must be appropriate, etc. Later on, we will see how Hume's problem questions this type of procedure.

The analogy

The structure of the analogical argument is as follows:

1. A is similar to B (in certain respects).
2. A has property C.
3. Therefore, B probably has property C (Weston, 2006).

For example, Ernest Rutherford made a comparison between the solar system and atoms. The solar system is similar to the atom (since both have a structure in which other things orbit around a nucleus). In the solar system, the Sun has much more mass than the planets. Therefore, in the atom, the nucleus contains most of the mass. This was the basis of Rutherford's model of the atom (Solís & Sellés, 2008). It should be noted that the risk of this variant of induction is that it can fall into the fallacy of false analogy (Bordes, 2011).

Statistical inference

This consists of parameter estimation, hypothesis testing, and decision theory. Its logical form is the so-called statistical syllogism: K% of A are B; *x* is A, therefore *x* is probably B.

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For example, during May 2011, at the Aragón School in the city of Tacna, after the summer holidays, it was cautiously observed that 95% of students had symptoms of anorexia. It is known that Adrian studies at that school and lives in the city of Tacna. Therefore, it is likely that he suffers from anorexia. Similarly, it should be noted that the risk of this type of induction is falling into statistical fallacies (Ruiz Matuk, 2023).

Bacon-Mill elimination methods

Bacon proposed a particular inductive method. This begins by ordering the facts according to three tables: a table of presences (facts in which that nature or phenomenon occurs), a table of absences (facts in which it does not occur), and a table of degrees (facts in which it varies). The following is a historical example that illustrates the above. Gregor Mendel was a 19th-century Austro-Hungarian botanist and monk who conducted experiments that led to the discovery of genetics (Solís & Sellés, 2008). In the table of presences, Mendel could note that when crossing pea varieties, certain hereditary traits were maintained in the offspring. In the absence table, Mendel would mention those traits absent in the progeny. Finally, to complete the degree table, Mendel would observe how other factors such as flower color, seed shape, etc., would be maintained or not despite the different initial conditions. In this conditioned example, Mendel uses Bacon's inductive method to study the basis of the laws of inheritance. Through systematic observation and the exclusion of variables, he concludes that there is something in peas (now known as genes) that is responsible for the variety of traits in offspring. The problem with this method is that it lacks rigor; for example, there may be confirmation bias on the part of the researcher or omission of variables that are decisive in confirming a particular issue.

Mill's five inductive methods

Mill proposed five inductive methods: concordance, difference, indirect difference, residue, and concomitant variants. Each of these methods is explained below according to Piscoya (2009).

Given certain requirements as satisfied, the *method of concordance* provides us with complete rigor, with the necessary conditions for a phenomenon. If, among the cases under investigation, a single factor is found to be common, it can be assumed that this factor is the cause of the phenomenon under study. For example, if a new teaching method is applied to a group of chemistry students and another to a group of geography

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students, and a significant improvement in learning is obtained in both cases, then it can be assumed that the cause of the improvement lies in the application of the new method mentioned above.

Similarly, the *method of difference* leads us to sufficient conditions. If one circumstance among several causes certain phenomenon, and the phenomenon occurs differently when that circumstance is omitted, then that circumstance is the cause of the phenomenon. Example: all the members of the hiking group got sick except Ana, so the doctor asked them what they ate. This was the report:

Table 1
People and foods

	Peach in syrup	Cheese	Canned shrimp	Dried meat	Canned beans	Tuna	Orange juice	Sausage
Liz	x	x		x	x	x		
Pablo	x	x	x	x	x			
Álvaro			x		x	x	x	x
Ana	x			x		x	x	x

Therefore, looking at the table, it can be concluded that the canned beans caused the illness, because Ana, who did not get sick, was the only one who did not eat them.

The *indirect method of difference* is a combination of the concordance and difference methods. Mill (1917) describes this method as follows:

> If two or more cases in which the phenomenon occurs have a single circumstance in common, while two or more cases in which it does not occur have nothing in common other than the absence of this circumstance, the circumstance by which the two groups of cases differ is the effect, or the cause, or a necessary part of the cause of the phenomenon (p. 376).

A historical example illustrating the indirect method of difference is the case of John Snow and the cholera outbreak in London in 1854. It could be argued that John Snow, an English physician, used this method to investigate the cause of the spread of cholera. He observed that most cases were near a public water source, the Broad Street pump. By comparing two groups of cases, those who obtained water from the pump and those who did not, he noticed that the only common circumstance among the cholera cases was the use of the water pump. By convincing the authorities to remove the pump handle, he managed to stop the spread of the

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outbreak and laid the foundations for the development of public health measures and the understanding of waterborne diseases (Borghi, 2018).

The residue method can also be mentioned. According to Mill (1917): «Separate from a phenomenon the part that is known, by previous inductions, to be the effect of certain antecedents; the residue of the phenomenon is then the effect of the remaining antecedents» (p. 379). Imagine that you are researching plant growth and have identified two factors that could affect it: sunlight and water. After conducting experiments, you discover that you can accurately predict plant growth based on these two factors. However, when applying Mill's residual method, it is found that there is still unexplained growth. This suggests that there may be other factors, such as soil nutrients or temperature, that have not yet been considered. Mill's residual method encourages exploration and discovery of these additional factors that may influence plant growth.

To apply the *concomitant variants method,* variations in one phenomenon must be made and then detected which other phenomenon also varies. If found, that phenomenon can be considered the cause being sought. Example: if in Mexico, between 1970 and 1991, for every 100,000 inhabitants, the number of alcoholics had increased from 22.83 to 43.4, and at the same time, the incidence of cirrhosis had increased from 23% to 45% during those years, then it could be assumed that one factor causing the increase in cirrhosis in Mexico is alcoholism. All of these methods are more rigorous and refined than those proposed by Bacon.

Hypothetical-deductive method

When there are several particular phenomena, laws, or hypotheses that need to be explained or unified, a more general hypothesis or theory is usually formulated from which the former are derived. Popper (1962) was the most notable scholar of this type of method. It has certain phases that will be illustrated with an example:

1. *State the problem*: at the end of the 19th century, astronomers Adams and Le Verrier discovered that the planet Uranus was behaving abnormally because it did not follow the orbit predicted by Newtonian laws.
2. *Formulate a hypothesis*: Le Verrier assumed that this irregularity was caused by the existence of another planet in an outer orbit that exerted a gravitational influence on Uranus.
3. *Deduce observable consequences*: following Le Verrier, it was thought that if such a planet existed, its mass and the point in

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the sky where it should be could be predicted and, therefore, it could be observed through a telescope.

4. *Verify*: in 1846, astronomer Johann Galle detected the planet they were looking for. They named it Neptune. Thus, the hypothesis was corroborated by the facts.

It can be said that the method follows an inductive process (in the observation of the problematic situation), a deductive process (in the formulation of the hypothesis and its deductions), and returns to induction for verification.

Probabilistic inference

In inductive reasoning, the premises do not logically imply the conclusion. However, according to various specialists, there is a probabilistic relationship between the conjunction of the premises and the conclusion: if the former are true, there is a certain probability that the conclusion is also true. For example: Darwin observed a series of pieces of evidence that led him to formulate his famous theory. Thus, if the assumptions of species diversity, adaptation to the environment, and modified descent are accepted, it is more likely that the conclusions of the theory of evolution by natural selection are correct (Solís & Sellés, 2008). Here, the problem lies in the fact that the concept of probability remains far from complete certainty that something will or will not occur. However, this case of inference is the most successful compared to the others.

Abduction

This is also known as «inference to the best explanation.» It consists of inferring which adequate explanation provides a better understanding of what is observed. The idea is to seek the hypothesis that is most probable and, in turn, makes it possible to understand why what is observed occurs (Blasco & Grimaltos, 2004). Mora *et al.* (2023) write:

> This argument puts forward a premise and a hypothesis to explain it. This is a line of reasoning similar to that used by detectives. In other words, it starts with clues, traces, or evidence, and from that data, the crime scene is reconstructed in order to solve the mystery. In this sense, it starts from the conclusion in order to construct the premise or premises (p. 296).

For example: Alfred Wegener, German geophysicist and meteorologist, observed that there were similarities in the shapes of the conti-

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nents' coastlines, that there were identical fossils in geographical areas far apart from each other, and that different continents had coincidences in relation to their geological formations. This led him to hypothesize that all the continents had been joined together in the past in what was called Pangea. This is known as the theory of continental drift (Solís & Sellés, 2008). In this case, the risk lies in the fact that the researcher's reconstruction may fit what has been observed and still be incorrect.

Hume's problem

Criticism of science comes from different areas. For example, according to Gazmuri (2022), scientific reason is believed to be infallible, and this has damaged the emotional side of human beings. Beyond anti-scientific points of view, it can be seen that scientific discourse has certain limits, without this implying any contempt for human beings. Thus, within the very processes of scientific reasoning, such as induction, it is possible to glimpse the limits of science. It was the philosopher David Hume who raised the problem of induction, but although his formulation relates to induction by enumeration, it applies to any type of induction in which the conclusion is probable. In short, this problem consists of trying to answer the following questions: How do we know that the sun will rise tomorrow? What is the reason for asserting that all men are mortal? Thus, the central problem of induction is to find some form of justification for all types of correct induction used or usable by science. As is well known, one can only move from particular premises to probable general conclusions. For example, if you observe 1,000 swans that are white, you can say that probably all swans are white. In logical terms, suppose that many particular cases have been found: $Pa \wedge Pb \wedge Pc \wedge Pd \wedge \ldots Pz$. From these, it is not possible to conclude necessarily that «all are P,» that is, $(\forall x)\ Px$. At most, one can conclude that «some are P,» that is, $(\exists x)\ Px$. However, it can also be said that it is probable that $(\forall x)\ Px$. Nevertheless, we must remember the warning that there may be a million pieces of evidence supporting this or that generalization, but only one counterexample is enough to invalidate it (Hume, 1984; Popper, 1962).

Experience does not confirm that the future must conform to the past. In other words, beliefs about the future based on the past are not sufficiently justified. In summary: the following formula expresses the logical invalidity of induction $(\exists x)\ Px \rightarrow (\forall x)\ Px$. The scheme is invalid because one cannot move from the proposition «something is toxic» to the proposition «everything is toxic.» At this point, to illustrate this situation,

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we recommend reading about Russell's inductivist turkey, mentioned by Chalmers (1990).

The paradoxes of confirmation

Also called «epistemological paradoxes» by Peña and Ausín (2012), these paradoxes are related to induction and arise when it is accepted that every generalization finds confirmation in its particular cases. Consider the question logically: if science and its laws are to be trusted, then every time it is stated that (∀x) Px, this generality can be confirmed by each particular case of the following conjunction Pa ∧ Pb ∧ Pc ∧ Pd ∧ ...Pz.

The raven paradox

This paradox was proposed by Hempel (1945). It is known that the logical form of a scientific law is (∀x) (Px → Qx) (R). However, if the notable equivalence known as «transposition» is applied, an equivalent formula can be obtained: (∀x) (~Qx → ~Px) (R-). This helps us understand the paradox of crows or confirmation. If we understand that «all crows are black» is logically equivalent to «everything that is not black is not a crow,» a problem arises. According to Clark (2009):

> It would seem that (R-), «Nothing that is not black is a crow,» is reinforced by finding things that are neither black nor crows, such as white pens. But the existence of white pens does not seem to corroborate «All crows are black.» Most of the things we see are neither black nor crows. Does each of them really contribute to reinforcing this generalization? (p. 75).
>
> Schematically, Hempel's paradox is posed as follows:
>
> - *Nicod's criterion*: the universal affirmative proposition is confirmed by an individual who fulfills the two properties involved.
> - *The equivalence condition*: what confirms statement A also confirms B to the same extent if and only if A and B are logically equivalent to each other.
>
> Therefore, a green pen confirms that «all crows are black.»

The Goodman paradox

This paradox was proposed by Goodman (1955). Consider the following predicate: «Green if examined before the year 5000 AD or blue if examined after.» Now replace this complicated predicate with the term *ver-*

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dul. With this, all the evidence that exists (for example, having seen 1000 emeralds) to say that something is green will also serve as evidence to say that it is *verdul*. So which of the two is it? It cannot be both, as they are logically incompatible. However, induction provides equal evidence to support both hypotheses. Therefore, it is impossible to choose between them based on induction. Next, this point is reinforced to better understand the situation using a table.

Table 2
Rules and predictions

Inductive rule	"Green" prediction	*Green* prediction
All previous F are G.	All emeralds before the year 5000 have been green.	All emeralds before the year 5000 have been v*erdul.*
Therefore, the next F will be G.	Then, the emerald seen after 5000 will be green.	Then, the emerald seen after 5000 will be *verdul.*

If a *verdul* emerald is found (before 5000 AD), it can be stated that it will appear green and not blue. Thus, if all emeralds examined before 5000 are green, after the year 5000, given the inductive rule, it should be predicted that the next emerald observed will be *verdul*. Therefore, even though we are aware of which prediction is genuinely confirmed (i.e., that it will remain *green*), it is also true that both can be considered confirmed (namely, that it will remain *green* and *verdul*).

Critical thinking

Critical thinking is the ability to analyze and evaluate information rationally and objectively. This type of thinking seeks to reflect on the validity of arguments, the identification of biases, contradictions, fallacies, and paradoxes in order to reach justified conclusions. Critical thinking means the ability to think clearly, logically, coherently, and based on evidence.

This type of thinking is fundamental to human development in all its dimensions. In the university setting, it promotes the ability to ask questions, critically evaluate accepted ideas, and make decisions based on available information. This is especially important in a world where misinformation and half-truths that seek to manipulate or mislead the unwary are increasingly prevalent (Bezanilla Albisua *et al.*, 2018; Cangalaya, 2020).

Critical thinking can be developed through constant practice in analysis, evaluation, and problem solving. For example, if one wishes to develop this mode of thinking, one should discuss and debate, solve

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mental challenges, and reflect on one's own thoughts. In relation to logic, critical thinking focuses on the tasks of identifying premises and conclusions, detecting fallacies, constructing good arguments, defining concepts appropriately, and resolving paradoxes. And, in relation to science, critical thinking studies the empirical nature of evidence and the design of appropriate experiments to test hypotheses. Thus, it is necessary to emphasize the proper formulation of hypotheses, the correct interpretation of results, and the logical development of theories that are based on empirical reality and aim to make predictions.

Based on the above, what we want to know is which critical thinking skills are developed through the study and attempts to solve the problem of induction, as well as the paradoxes of confirmation.

Methodology

The methodology of this work is qualitative and is based on the search for information and the analysis and interpretation of data found in books, articles, dictionaries, theses, among others. This strategy seeks to develop an analytical and reflective perspective and to gain a thorough understanding of the theoretical and practical approaches used to address the issues raised, in the same way as analytical philosophy does (Borja *et al*., 2017). The important thing is to analyze the information collected in detail and thoroughly. Critical interpretation of the information is not neglected. This allows space to question one's own biases, assumptions, and prejudices in order to be open to perspectives other than one's own.

On the other hand, logical analysis will also be used. This means that various theories such as propositional logic, class logic, and first-order logic will be used, but at a very basic level (Mora *et al*., 2023; Piscoya, 2007). In this way, the truth value of disjunctions and conjunctions will be evaluated, Venn diagrams will be used to identify and analyze the four established zones when two classes are related, and quantifiers and predicates, among others, will be used to formalize certain statements related to the problem. In addition, the structure of inferences that separates the premises from the conclusion by means of a horizontal bar will be used frequently.

Analysis and results

In what follows, the problems raised will be analyzed and the attempted solutions found will be presented.

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On Mill and Hume's problem of induction

In *System of Deductive and Inductive Logic*, Mill (1917) defines deductive logic as the science that seeks the correct inference of some propositions from other propositions. On the other hand, inductive logic allows us to establish how certain propositions come from generalizations of observation and also provides rules for discovering the propositions needed in scientific research. According to Stuart Mill, logic (deductive or inductive) is concerned with studying the proof of the truth of propositions. But for an inference to be useful to science, its conclusion must establish a new truth in relation to what is stated in the premises. In other words, every legitimate inference must actually increase knowledge and, therefore, must be amplifying (García, 2012a).

With regard to the problem raised by Hume, Mill asserts that an inductive inference is logically justified when it is based on a particular case of the principle of uniformity. A regularity of the past can only be generalized to the future by trusting that nature always behaves in the same way. This is called the «principle of uniformity of nature» (PUN). This principle implies that what happened in the past is a reliable guide to what will happen in the future. Thus, the PUN can be considered the foundation of induction because it constitutes the logical justification that supports any inductive inference, i.e., this principle is a necessary condition for proving its logical validity. For example:

1. It has been proven 150 times that water boils at 100 °C.
2. Nature behaves uniformly (PUN).
3. Therefore, in the future, water will boil at 100 °C.

Now, premise 1 is true, but how do we know that premise 2, which is necessary for any inductive reasoning to work, is true? How do we arrive at the idea that nature behaves uniformly? Perhaps the following can serve as a basis:

1. We observe that fire «always» burns our skin.
2. We observe that the sun «always» rises in the east.
3. We observe that magnets «always» attract iron.
4. Therefore, nature will behave uniformly (PUN).

The above indicates that the principle of uniformity of nature has been obtained in turn by induction, generalizing particular cases, i.e., a general conclusion has been obtained. The problem is that the principle of uniformity of nature can only be obtained through another inductive

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reasoning. Therefore, inductive reasoning is explained by the principle of uniformity of nature, which is itself explained by another inductive reasoning. And, once again, inductive reasoning would be explained by that principle. This, which had already been anticipated by Hume (1945), represents a clear return to infinity and a case of *petitio principii* because it ends up assuming what needs to be proven. In conclusion, induction still lacks logical foundation. Bertrand Russell (1983), faced with so much controversy, argued that we must «pragmatically take it for granted that the inductive procedure, with appropriate caution, is admissible» (p. 73).

Strawson (1952) considers that justification for induction should not be sought in the same way that justification for the legality of one's own country's law should not be demanded, since the idea is that the law is what justifies the legality of everything else. Similarly, asking for a justification for induction is asking for an explanation of one of the standards used to determine whether ideas about the world are adequate or not (Okasha, 2007).

About Hempel's paradox

It is necessary to state that, as Hempel himself argued, according to Łukowski (2011), although it may seem misleading to us that a «white shoe» confirms the proposition «all crows are black,» logically this is adequate, even though there are practical circumstances that try to dissuade us that this cannot be the case. For Hempel, the reason this is seen as a paradox is our imperfect intuition; logic must be respected.

For his part, Sainsbury (1988) argues that Hempel's paradox disputes two rational principles:

1. E1: If it can be known *a priori* that two hypotheses are equivalent, then any data that confirms one confirms the other.
2. G1: A generalization is confirmed by any of its instances.

And it is problematic to reject both principle E1 and G1. That is where the issue lies.

Blasco and Grimaltos (2004), based on the concept of abduction, offer a short but elegant solution. They argue that the generalization «all crows are black» can explain why this crow is black, but neither that generalization (R) nor its transpose (R-) can explain why this shoe is red. For that reason, the red shoe cannot be considered evidence that «all crows are black.»

On the other hand, Bunge (2007) wrote about Hempel's raven paradox:

> This paradox is resolved when we realize that anyone interested in crows will begin by restricting their universe of discourse to birds, so that they

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> will consider an encounter with a blonde [woman] irrelevant to their interest. In other words, since the ultimate reference class of «All crows are black» is the class of birds, only data about birds are relevant to the hypothesis in question. Any reasonable theory of reference that harmonizes with the way scientists treat predicates could have avoided the avalanche of publications generated by this riddle (p. 160).

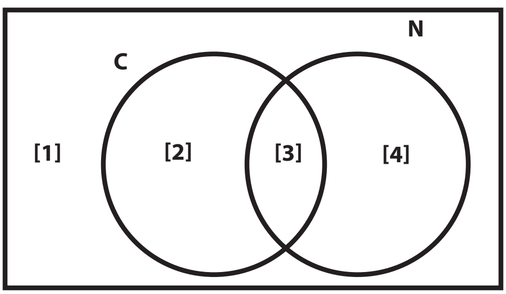
Bunge (2007) argues that a robust theoretical framework limiting scientific inquiry will prevent the search for negative objects such as «non-black things» or «non-crows.» If crows are not sought, then other types of birds must be sought. In this way, non-crows would not be understood as anything else that meets the condition of not being crows, for example, horses, since the theoretical framework is not referring to those animals.

Mosterín and Torreti (2010) consider the following:

> The mere observation of a black crow does not even suggest that they are all black. Only a representative sample of the world's crows, which are black without exception, could give weight to $(\forall x)\ (Cx \rightarrow Nx)$. The same weight would be given, incidentally by a representative sample of all things in the universe that are not black, if that sample did not contain a single crow. Since such things are more abundant and considerably more varied than crows, an adequate sample of the former is, of course, much easier to collect than a sample of the latter (p. 453).

What is debatable for these authors is the large difference between the number of «crow» entities and the number of «non-black» entities. On the same subject, Rescher (2001) argues that this situation can be better understood by analyzing it with Venn diagrams (where C is the class of crows and N is the class of black objects).

Figure 1
Crows and black objects



Source: taken from Rescher (2001, p. 225).

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On the one hand, the expression «all C is N» has the Boolean formula C = Φ, which means that from class C (i.e., [2] and [3]), part [3] must be removed so that [2] is considered the empty class. On the other hand, the expression «all non-N is non-C» has the Boolean formula C=Φ, which means that from the class non-N (i.e., [1] and [2]), the area in common with C must be found so that [2] is considered the empty class. When looking at this graphically, one realizes the issue, because if there are thousands of things that are C ([2] and [3]), there must be billions of things that are not N ([1] and [2]), and as Rescher (2001) states: «Someone who gives us a verified black crow has made a modest but not trivial contribution to the whole verification project. But the contribution of a white tennis shoe is insignificant» (p. 226). In that sense, «it is simply false that the evidentially confirmatory contribution of black crows and white shoes is the same» (p. 226).

According to Clark (2009), the idea is that it is not true that the best way to verify that «all A is B» is only by looking for entities A that are B. If one wants to prove that «all vultures live outside Lima,» sightings of these birds outside Lima (for example, in areas with very similar climatic characteristics) actually tend to refute the same claim, because if there are so many vultures outside Lima and in areas with similar climates, it is likely that there are also vultures within Lima. Therefore, confirmation should not be reduced to a simple accumulation of favorable cases. It is important to consider the context, as it conditions our search. For example, if we know that vultures feed on carrion, then we can look for them in restaurant garbage dumps, but this would not yield a great find, and we might even believe that vultures also prefer dirt to hygiene. Therefore, it is more important to try to look for these birds in mountains, hills, beaches, etc., as this would indeed be an enriching find.

For López Astorga (2008), this puzzle can be addressed by resorting to Wason's selection task (1966, 1968). According to this cognitive psychologist, people tend to look for cases that reinforce or confirm rules rather than try to refute them. In this sense, if it is said that «behind the card with a vowel there is an even number and vice versa,» people tend to look for vowels or even numbers, but they do not start by searching for consonants or odd numbers. The latter is rare. Thus, Hempel's paradox can be dismantled because people do not usually think in negative concepts, but rather reason based on positive ideas.

Likewise, Sperber and Wilson (1986) have constructed a theoretical framework, the theory of relevance, from which it can be asserted that the human mind naturally prioritizes relevance. Information is irrelevant if it

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does not generate cognitive effects useful for analyzing novel beliefs. On the other hand, information is relevant when it serves as support for generating cognitive effects that lead to accepting or rejecting new beliefs. Furthermore, the less cognitive effort involved in this process, the more relevant the information is. Thus, naturally, we do not usually think about things that are not black or things that are not crows, as this requires too much effort and, moreover, does not help us to generate immediate cognitive effects. Therefore, Hempel's paradox fails in its attempt to present as equivalent the relevance of «all S is P» and «all non-P is non-S» as well as the cognitive effort involved in analyzing both the first generality and the second (the result of applying transposition), and this is what is questionable.

Quine argues something similar, but instead of relevance, he appeals to the idea of naturalness, according to Sorensen (2007):

> Quine [regarding Hempel's paradox] rejects Nicod's criterion. He restricts confirmation to hypotheses that use terms belonging to natural classes. Consequently, he denies that a white handkerchief confirms that «everything that is not black is not a crow» (p. 281).

Instead of stating whether it is relevant or not, Quine merely says that «not a raven» or «not black» is not a class that comes from nature. Similarly, Stemmer (1977) seeks to relate generalizations to the usefulness they provide to humans as a species for the purpose of survival. Thus, he proposes that generalizations are adequate insofar as they have allowed living beings to survive. In this sense, neither non-black nor non-crow can be considered important for ensuring the evolution of species. This implies questioning Nicod's criterion in order to justify it in another way.

About Goodman's paradox

Blasco and Grimaltos (2004), from the perspective of abduction, assert that if something is defined as *verdul* as long as «it is green if examined before the year 5000 AD or blue if examined after,» that is, x is *verdul* $\leftrightarrow$ $(p \vee q)$, this formulation makes it impossible to explain anything, because what is the point of asking about the cause of a disjunction? Thus, if we assume that «all emeralds are green,» we can explain the fact that this emerald is green, but the same is not true for «all emeralds are *verdul*,» because the property *verdul* cannot be considered an effect. A cause can produce p or it can produce q (sometimes p and sometimes q), but it cannot produce $p \vee q$. Thus, this paradox is rejected on grounds of the logical formulation of the concept *of verdul.* Since this concept hides a

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disjunction and no effect makes sense if expressed in this way, then the predicate *verdul* cannot be considered a legitimate effect.

On the other hand, Bunge (2007) wrote:

> This «paradox of confirmation» [...] was never taken into account by crystallographers, as they knew that emeralds cannot change color spontaneously and overnight, just as lions cannot metamorphose into gazelles. The reason is that the color of emeralds is determined by their chemical composition. If this changes, then the crystal ceases to be an emerald. The logical inference is as follows:
>
> For all x, x is an emerald if and only if x has composition C.
>
> For all x, if x has composition C, then x appears green in white light.
>
> ∴ For all x, if x is an emerald, then it appears green in white light.
>
> The conclusion, initially an empirical generalization, has been derived from higher (and deeper) level hypotheses. Therefore, it has more than just empirical support consisting of countless and often erroneous observations of emeralds. Moral 1: Empirical generalizations are not typical of science. Moral 2: Empirical evidence is not all that exists for science. Moral 3: The *Verdul* paradox is a pseudo-problem (p. 161).

It can be said that one should not generalize in such a simplistic way based on emeralds examined before time T without considering additional relevant information. In other words, it is not enough to know that such an emerald will behave in such a strange way by changing its color on a certain date. It is necessary to know more details about this type of behavior. The same is true when youth preferences are generalized to the entire population. For example, if it is said that because young people are fans of Taylor Swift's music, then the entire population is, this is a mistake because it is known that age or generational differences influence musical tastes. Therefore, the mere accumulation of cases that favor a certain generalization is irrelevant if the necessary contextual information is not considered. The important thing is to know whether or not the cases examined are representative (Clark, 2009).

Mosterín and Torreti (2010) have another opinion: «According to Goodman, the general preference for 'all emeralds are green' over 'all emeralds are verdul' is because the green/blue pair of concepts is much more deeply rooted [...] than verdul/azerde» (p. 452). For Ernst (2005), Salmon's (1953) solution, although questionable because it does not resolve the problem of the continuity of properties observed in the future, provides clues as to what happens with Goodman's paradox. According to

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Salmon, the reference of terms that allude to experience is determined by convention through the search for similarities between positive and negative cases. For example, the color «red» is established by convention by distinguishing between red and non-red things. The same does not apply to *green*, as it is difficult to distinguish between *green* things, i.e., green before T or blue after T (p ∨ q), and *non-green* things, i.e., neither green before T nor blue after T (~ p∨ ~q). Therefore, it is a misleading term with unclear reference.

According to San Bruno (2005) and Pietrini (2013), Goodman's paradox can be overcome by considering that an important feature of the predicates used by science is that they allow predictions to be made about future situations. This is known as «projectability.» For example, if it is stated that «all metals expand with heat,» it can be predicted that a metal will expand when it reaches that temperature; i.e., given regularity in nature, it is feasible to expect certain situations given certain initial conditions. This does not happen with *verdul* because when the date T to which the definition of *verdul* is tied arrives, it can be stated that the emerald seen at T will be green, as well as that it will be *verdul*. This imprecision does not occur with the predicates selected by science. It should be noted that this form of solution is linked to pragmatic and contextual considerations rather than definitive logical reasoning.

The use of language also explains why certain words are more suitable than others for classifying the world. Sorensen (2007) writes, considering Aristotle and Quine:

> In opposition to a purely conventional view of language, Aristotle thought that part of our vocabulary refers to these natural classes. Quine considers this particularly plausible in light of evolutionary theory. […] Part of scientific progress consists in creating a vocabulary that more closely matches natural divisions. We instinctively prefer «green» to *verdul* because «green» comes closer to sectioning nature according to articulations (2007, p. 280).

In relation to the above, it can be said that the world has natural divisions and that language must be based on these divisions in order to ensure the success of those who investigate the world. Thus, *verdul* would not be a good example of a natural division and, therefore, is doomed to disuse. The moral of this paradox lies in accepting that induction does not depend so much on the number of confirmed facts (observed evidence) but also on the predicates (or concepts) involved. According to Rescher (2001): «The thesis, with its problem that evidence depends only on the

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quantity (and not the quality!) of the available instances, is the most vulnerable argument in this case» (p. 230). There is a weakness in the thesis that states that the available observational evidence speaks equally in favor of all emeralds being green and all emeralds being *verdul* (considering that, in terms of observational evidence, each is confirmed—and confirmed equally—by exactly the same cases).

Thus, it can be argued that the issue at stake here is that in science, not only the quantity of evidence is important, but also the quality of that evidence. For example, one could collect evidence in circumstances that are too favorable or too unfavorable without being aware of it. Perhaps the environment itself alters variables that are not taken into account in the research but that influence the work; perhaps the instruments used for observation are not sufficiently calibrated; perhaps the researcher's obsession with a certain theory is forcing him or her to ignore plausible evidence, etc. These biases are sometimes not detected by the researcher himself or herself.

Now that we have seen the different ways of approaching Hume's problem, as well as Hempel's and Goodman's paradoxes, it is time to specify precisely what types of thinking skills can be developed by analyzing these challenges.

Critical thinking skills reinforced after this research

For Lipman (2016), critical thinking means having the ability to express opinions, criticize, and make decisions. The important thing is for individuals to get used to looking for reasons, questioning what seems inconsistent, and understanding that each position in a debate also depends on a specific context that gives it meaning. It should be mentioned that, like Mora (2023), it is considered possible to reinforce critical thinking through discussion of paradoxes in general, although in this case, the work focuses on the problem of induction and confirmation paradoxes. The following numbering is based on Rosas *et al*. (2018), who have listed a series of skills that serve to develop critical thinking:

1. *Analyzing the value of statements*. The value of statements such as «everything that is not black is not a crow» and «every emerald is green» has been discussed, and in general, an attempt has been made to give the analysis of these confirmation paradoxes its rightful place.
2. *Classify and categorize*. Types of evidential support have been classified. Thus, it has been argued that finding a black crow

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supports our hypothesis in a different way than finding a white shoe does. Categories such as generality, evidence, confirmation, induction, projectability, etc. have been discussed.

3. *Constructing hypotheses*. Hypotheses have been proposed that the human mind tends to prioritize relevance and also that certain specific types of generalizations have enabled the survival of our species.
4. *Defining terms*. The problem of defining the term *verdul* or *azerde* has been studied.
5. *Developing concepts*. Concepts such as the idea of natural classes or projectability have been developed.
6. *Discover alternatives*. Various authors have been cited who propose different ways of addressing these paradoxes. For example, Salmon, Quine, Bunge, Rescher, Wason, etc.
7. *Deduce inferences from hypothetical syllogisms*. In the case of the *verdul* paradox, Bunge proposed an inference of this type by connecting the chemical composition of emeralds with their color.
8. *Find underlying assumptions*. The assumption that the same evidence can confirm law A and law B with equal importance, these being logically equivalent to each other, has been discussed.
9. *Formulate causal explanations*. It has been argued that the preference for «green» over *verdul* is because the former is more deeply rooted in human experience than the latter. The same is true of the divisions that exist in nature, which Quine calls «natural classes.»
10. *Formulate critical questions*. Questions have been asked such as: Why does not even a million pieces of evidence in favor definitively prove a generality? Why does the application of logic seem to fail in the case of Hempel's paradox? Is *verdul* a reliable predicate?
11. *Generalize*. The idea of "uniformity of nature" has been generalized to relate it to every situation where there is some regularity.
12. *Give reasons*. Reasons have been given to assert that science deals not only with generalizations but also with additional data on context or a theoretical framework that limits the application of certain laws.
13. *See the part-whole and whole-part connections*. Connections are explored between the chemical composition of emeralds and their apparent color with the law that supports the existence of *green* emeralds, as well as the link between generalization and particular confirmatory instances.

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14. *Make connections and distinctions*. Hume's problem has been connected to the paradoxes of confirmation, and a distinction has been made between the quantity and quality of available instances.
15. *Anticipating consequences*. Emphasis has been placed on anticipating consequences with regard to the acceptance of different generalities based on the same empirical evidence, as in the *verdul* paradox.
16. *Working with analogies*. The divisions present in nature have been compared with those that the butcher knows how to identify when preparing his merchandise.
17. *Working on consistency and contradictions*. In studying all these problems and paradoxes, the need to combat the appearance of contradiction that exists in all cases in order to maintain a certain theoretical consistency has been observed.
18. *Detect and eliminate fallacies*. In relation to Mill's proposal to justify induction based on the principle of uniformity of nature, the fallacy of begging the question was detected.
19. *Recognize contextual aspects of truth and falsehood*. In the case of the *verdul* paradox, the idea of projectability is considered a contextual and pragmatic solution. In relation to the same paradox, it is assumed that the truth of a generalization depends not only on the quantity of evidence supporting it but also on its quality. Likewise, in the case of the problem of induction, Russell recommended believing in the truth of induction for pragmatic reasons.
20. *Recognize the independence of means and ends*. A distinction has been made between Hume's problem of induction, which consists of starting from particular instances (means) to conclude universal generalizations (ends), and the paradoxes of confirmation, which start from generalizations (means) to find favorable evidence in this or that particular instance (ends).
21. *Make series*. Regarding Hume's problem, an attempt was made to justify induction based on the principle of uniformity of nature, but instead of stopping the investigation, the evaluation continued to determine whether this principle had another foundation. The series sought to determine some ultimate foundation. However, it was later noted that this principle was justified by another induction.
22. *Take all considerations into account*. In the case of the paradoxes studied in this work, the factors (such as Nicod's criterion,

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equivalence condition, rule, and prediction) that influence their development have been problematized.

Conclusions

Induction, so useful to science, leads to a conclusion of a probable nature. Inductive logic seeks to design criteria of correctness for inductive inferences, although almost all types of induction have flaws. However, if inductive logic were to succeed in establishing these criteria, the generation of scientific knowledge would be well-founded. Induction by simple enumeration, which consists of observing many particular cases to formulate probable general conclusions, is questioned by Hume's problem. Hume's problem of induction calls into question the justification of valuable inductive inferences, both for science and for everyday life. Probabilistic inference, although it also has its risks, is the constant that characterizes all inductive reasoning.

Hempel's paradox questions the idea of confirming general hypotheses through particular instances, as well as the application of logic to scientific inferences. The discussion regarding the rational principles E1 (if it can be known a priori that two hypotheses are equivalent, then any data that confirms one confirms the other) and G1 (a generalization is confirmed by any of its instances) highlights the complexity of the idea of confirmation, which invites us to rethink the relationship between evidence and general hypotheses. Goodman's paradox questions the link between verified evidence and the justification of universal generalizations. This paradox highlights the complexity of proposing definitive criteria for confirming particular inductive hypotheses. For this reason, ideas such as «projectability» have been proposed, and it has been suggested that the relationship between the internal coherence of theories and their predictive capacity should be strengthened.

The aim of this paper was to highlight how the different solutions (or dissolutions) proposed develop certain critical thinking skills. Reflecting on the problem of induction and the paradoxes of confirmation makes this possible. For example, one must avoid falling into false generalizations, it is important to be open to rectifying the theory when necessary, and one must know how to solve problems creatively in order to overcome all the limitations and contradictions present. Critical thinking (and scientific reasoning) becomes important when, as a result of studying the problem and the paradoxes mentioned above, statements

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are analyzed, evidence is classified and categorized, and hypotheses are constructed and terms are defined in a rigorous manner. The quality of evidence is as relevant as the quantity, since factors such as context, the care taken with measuring instruments, and the debatable objectivity of the scientist can influence the results achieved. We need to learn to anticipate the consequences of accepting certain ideas, as well as to detect fallacies. Likewise, we must recognize the complex relationship between means and ends and seek solid foundations for the principles that underpin our accepted inferences.

It is suggested that for future research, these paradoxes be discussed with philosophy students or within epistemology courses. It would be important to know how students respond to such challenges and to measure these results quantitatively. The idea is for students to recognize which critical thinking skills can be applied to solve these problems. In this regard, at the beginning of the educational process, a table would be provided asking students to identify the critical thinking skills that motivate the development of such paradoxes. Then, each week, with the help of some expert texts related to the subject, the critical thinking skills that have been developed in this regard would be discussed. And in the last week, a test would be given in which students would be asked to weigh the different solutions and, if possible, propose their own original position. Finally, the table would be presented again so that students could identify the thinking skills. If they are able to recognize these skills, learning has taken place. If not, the experience could be improved and repeated.

Bibliography

BEZANILLA ALBISUA, María José, POBLETE RUIZ, Manuel, FERNÁNDEZ NOGUEIRA, Donna, ARRANZ TURNES, Sonia & CAMPO CARRASCO, Lucía
2018 El pensamiento crítico desde la perspectiva de los docentes universitarios. *Estudios Pedagógicos*, *44*(1), 89-113. https://dx.doi.org/10.4067/S0718-07052018000100089

BLASCO, Juan & GRIMALTOS, Tobies
2004 *Teoría del conocimiento*. Valencia: Universidad de Valencia.

BORGHI, Luigi
2018 *Breve historia de la medicina*. Madrid: RIALP.

BORJA, Milton, VÁSQUEZ, Rodrigo & ZEBALLOS, Jorge
2017 La filosofía analítica: su enfoque hacia el proceso de enseñanza-aprendizaje. *Sophia, Colección de Filosofía de la Educación*, (22), 149-169. https://doi.org/10.17163/soph.n22.2017.06

BUNGE, Mario
2001 *Diccionario de filosofía*. México DF: Siglo XXI.

Print ISSN:1390-3861 / Electronic ISSN: 1390-8626, pp. 203-229.

CANGALAYA, Luis
2020 Habilidades del pensamiento crítico en estudiantes universitarios a través de la investigación. *Desde el Sur*, *12*(1), 141-153. https://bit.ly/4iMq1zw
CHALMERS, Alan
1990 *¿Qué es esa cosa llamada ciencia?* México DF: Siglo XXI.
CLARK, Michael
2009 *El gran libro de las paradojas. De la A a la Z*. Barcelona: Gredos.
DA COSTA, Newton
2000 *Lógica inductiva y probabilidad*. México DF: UL; FCE.
ERNST, Gerhard
2005 Justificando la justificación de la inducción de Salmon. *Enrahonar*, (37), 77-84. https://bit.ly/49OxJ8e
GARCÍA, Óscar
2012a *Ciencia, verdad y filosofía.* Lima: CEPREDIM.
2012b *Elementos de lógica*. Lima: Visual Press.
GAZMURI, Rosario
2022 Afectividad y vulnerabilidad: límites de la razón científica y posibilidades de verdad. *Sophia, Colección de Filosofía de la Educación*, (32), 197-223. https://doi.org/10.17163/soph.n32.2022.06
GOODMAN, Nelson
1955 *Fact, Fiction, and Forecast*. Cambridge, MA: Harvard University Press.
HEMPEL, Carl
1945 Studies in the Logic of Confirmation I. *Mind*, *54*(13), 1-26. https://doi.org/10.1093/mind/LIV.213.1
HERNÁNDEZ, Héctor & PARRA, Rodrigo
2013 Problemas sobre la distinción entre razonamientos deductivos e inductivos y su enseñanza. *Innovación Educativa*, *13*(63) 61-74. https://bit.ly/49REc2j
HUME, David
1945 *Investigación sobre el conocimiento humano*. Madrid: Alianza.
1984 *Tratado de la naturaleza humana*. Madrid: Orbis.
LIPMAN, Matthew
2016 *El lugar del pensamiento en la educación*. Barcelona: Octaedro.
LÓPEZ ASTORGA, Miguel
2008 La paradoja de Hempel. *Ciencia Cognitiva*, 7 de diciembre. https://bit.ly/4pmglya
ŁUKOWSKI, Piotr
2011 *Paradoxes*. Londres: Springer.
MILL, John Stuart
1917 *Sistema de lógica inductiva y deductiva*. Biblioteca Científico Filosófica.
MORA, Rafael
2023 Uso de las paradojas como recursos didácticos que desarrollan el pensamiento crítico en los estudiantes. *Sophia, Colección de Filosofía de la Educación*, (35), 249-279. https://doi.org/10.17163/soph.n35.2023.08
MORA, Rafael, LLACCHUA, Carlos, SÁNCHEZ, Pedro & NAVARRO, Byron
2023 *El problema de la esencia de la lógica jurídica: recomendaciones didácticas*. Lima: Red Holos XXI.
MOSTERÍN, Jesús & TORRETI, Roberto
2010 *Diccionario de lógica y filosofía de la ciencia*. Madrid: Alianza.

Sophia 40: 2026.

Print ISSN:1390-3861 / Electronic ISSN: 1390-8626, pp. 203-229.

OKASHA, Samir
2007 *Una brevísima introducción a la ciencia*. México DF: Océano.
PEÑA, Lorenzo & AUSÍN, Txetxu
2012 Paradoja. En L. Vega Reñón & P. Olmos (eds.), *Compendio de lógica, argumentación y retórica* (pp. 442-444). Madrid: Trotta.
PIETRINI, María
2013 La teoría del equilibrio reflexivo en Nelson Goodman. *Revista Internacional de Filosofía Mutatis Mutandis*, (1), 11-22. https://bit.ly/49Sf62Z
PISCOYA, Luis
2007 *Lógica general*. Lima: UNMSM.
2009 La inducción clásica. En Autor, *Tópicos en Epistemología* (pp. 63-77). Lima: UIGV.
POPPER, Karl
1962 *La lógica de la investigación científica*. Madrid: Tecnos.
RESCHER, Nicholas
2001 *Paradoxes: Their Roots, Range and Resolution*. Chicago: Open Court.
ROSAS, Pablo, ACOSTA, Roberto & AGUILAR, Javier
2018 *Diálogo abierto*. Guadalajara: Universidad de Guadalajara.
RUSSELL, Bertrand
1983 *La perspectiva científica*. Madrid: Sarpe.
RUIZ MATUK, Carlos
2023 Falacias estadísticas en investigación psicológica y cómo enseñar la sabiduría podría ayudar. *Ciencia y Educación*, *7*(2), 89-102. https://doi.org/10.22206/cyed.2023.v7i2.pp89-102
SAINSBURY, Richard
1988 *Paradoxes*. Cambridge, RU: Cambridge University Press.
SALMON, Wesley
1953 The Uniformity of Nature. *Philosophy and Phenomenological Research*, *14*(1), 39-48. https://doi.org/10.2307/2104014
SAN BRUNO, Lisardo
2005 *La evolución del pensamiento de Hilary Putnam* (Tesis doctoral). Universidad Complutense de Madrid, Facultad de Filosofía Departamento de Filosofía. https://bit.ly/49RMZ45
SOLÍS, Carlos & SELLÉS, María
2008 *Historia de la ciencia*. Barcelona: ESPASA.
SORENSEN, Roy
2007 *Breve historia de la paradoja: la filosofía y los laberintos de la mente*. Madrid: Tusquets.
SPERBER, Dan & WILSON, Deirdre
1986 *Relevance: Communication and Cognition*. Hoboken, NJ: Blackwell.
STEMMER, Nathan
1977 Una solución a la paradoja de Hempel. *Teorema: International Journal of Philosophy*, *7*(2), 119-128. https://bit.ly/3DuCt6T
STRAWSON, Peter
1952 *Introduction to Logical Theory*. Londres: Methuen.
WASON, Peter Cathcart
1966 Reasoning. En B. Foss (comp.), *New Horizons in Psychology* (pp. 135-151). Penguin.

Sophia 40: 2026.

Print ISSN:1390-3861 / Electronic ISSN: 1390-8626, pp. 203-229.

1968 Reasoning about a Rule. *Quarterly Journal of Experimental Psychology*, *20*(3), 273-281. https://doi.org/10.1080/14640746808400161

WESTON, Anthony
2006 *Las claves de la argumentación*. Barcelona: Ariel.

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Declaration of Authorship - CRediT Taxonomy	
Author(s)	**Contributions**
Rafael Félix Mora Ramirez	The entire article is the work of a single author, and as such, the content presented in the document is the sole responsibility of the author.

Declaration of use of artificial intelligence
The author, Rafael Félix Mora Ramirez, **DECLARES** that the article entitled “Critical thinking skills motivated by the study of Hume’s problem and confirmation paradoxes” was not created with the support of artificial intelligence (AI).

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