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Fuzzy logic as a prerequisite for formulating inclusive public policies in Colombia

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Abstract

The research question that this article, as a result of the investigation, seeks to answer is: To what extent is it pertinent to apply the premises of fuzzy logic in the implementation of inclusive public policies in Colombia? In accordance with this question, the general objective is to analyze the feasibility of applying fuzzy logic in the implementation of inclusive public policies in Colombia. To achieve the stated objective and address the research question, it is necessary to initially examine three categories, namely: public policy, inclusion, and fuzzy logic. Subsequently, the categories of neuroscience, neurotechnology, and artificial intelligence will also be addressed, given that the principles and main structural elements for a public policy on neuroscience and artificial intelligence will be presented. The article will be developed in three main stages: first, an understanding of the concept of public policy will be addressed, followed by that of fuzzy logic; next, the concept of inclusion will be studied, as a development, consequence, and application of the principle of the included third; and finally, the principles and structural elements for a public policy on neuroscience and artificial intelligence will be described in an enumerative manner. The main conclusion is that, indeed, due to the real existence of risks and threats posed by the development of neuroscience, neurotechnology, and artificial intelligence, it is necessary to formulate and design comprehensive public policies that, through the application of the principle of the included third, establish mechanisms for the protection of rights.

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Introduction

Of the multiple definitions and elements that a public policy must or can contain, Gavilanes proposes the following definition:

Public policy is an integrating process of decisions, actions, inactions, agreements and instruments, carried out by public authorities with the eventual participation of individuals, and aimed at solving or preventing a situation defined as problematic. Public policy is part of a specific environment from which it feeds and which it intends to modify or maintain. (2009, p. 9)

Public policies in Colombia, historically and traditionally, have privileged the rights of some, leaving aside the rights of others; that is, applying the logical principle of the excluded third party, instead of applying that of the included third party; as has happened for example in the case of heterosexuals, marital children, city dwellers, those in the center, etc. the capable, etc., to the detriment or abandonment of the rights of children born out of wedlock, homosexuals, those from the periphery, the disabled, etc. And this is due to a binary thinking that excludes, hierarchizes and classifies (in application of the logical principle of the excluded third); instead of including, joining and integrating, applying the principle of the included third, proposed by *fuzzy logic*.

Fuzzy logic is understood as a coherent system of thought that, unlike traditional and bivalent (binary) logic, starts from the consideration that the difference between entities and concepts is not of essence, but of degree; giving way to conceptual vagueness and ontological and epistemological indeterminacy. The conceptual and functional origin of this polyvalent logical system (which goes beyond bivalent logic) is found in the proposal of *fuzzy sets* by Lotfi Azker Zahde (Giraldo, 2017); originally applied to engineering and transferred to the field of social and human sciences makes possible a more inclusive, dialogic, dialogic, open and flexible worldview, from which it is possible to build and implement inclusive, dialogic, flexible, alternative, decentralized, participatory, territorial and polydiverse public policies, from different approaches, such as the economic, social, the cultural and the environmental.

The object of logic is thought, its objective is the correctness and validity of what is thought (ideas); to the point that the way of thinking largely determines the way of acting. Therefore, inclusive thinking leads to inclusive actions, and vice versa; the exclusionary way of thinking corresponds to exclusionary actions; because ultimately in the human being, the way of thinking conditions the way of being and acting. It is not that thought depends on existence, but that existence depends on thought (Descartes, 2012). Hence, good practice requires a good theoretical foundation and a public policy is a praxis that involves actions.

The understanding of reality from a gradual perspective and inclusion are central contributions with regard to the construction and implementation of a public policy that, instead of categorizing and classifying people as capable and incapable, normal and abnormal; carry out an inclusive and inclusive categorization and classification; that starts from the premise that the difference between capacity and incapacity is not of essence, but of degree. The same is predicable of the living beings of nature. A categorization from traditional binary logic considers that the difference between plants, animals and human beings is one of essence; while, from fuzzy logic, it is considered that the difference between plants, animals and human beings is one of degree. Isn't this the idea that underpins Charles Darwin's evolutionary theory? (Ruse, 1975)

Would it not then be pertinent to apply these principles and assumptions in the construction of an environmental public policy, for example, that has as its premise the protection of all living beings from the biocentric conception, which has as its teleology the protection of health and life in all its manifestations: plant, animal and human, understanding these three types of life and health as interdependent on each other and under a horizontal relationship; instead of starting from an exclusive and vertical hierarchical conception, as has been applied by the anthropocentric conception, which has granted a privileged status to human life and health over plant and animal life and health?

From the economic sphere, for example, fuzzy logic is an epistemological scenario conducive to the implementation of economic public policies of alternatives to development and sustainable development, with a territorial approach; thinking about the inclusion of community and solidarity economies, different from the traditional, hegemonic and centralized economic system that has prevailed until now in Colombia. It should be noted that the Constitution itself leaves open the possibility of recognizing and protecting other economic models, other than the hegemonic one, when in the third paragraph of Article 333 it literally states: *"The company, as the basis of development, has a social function that entails obligations. The State will strengthen solidarity organizations and stimulate business development."*

From the social sphere, the fuzzy logic can allow the implementation of inclusive and inclusive social public policies

with regard to the defense of the rights of homosexual people, the disabled, blacks, indigenous people, the poor, women, children, workers, among others. Well, not only in Colombia, but in the world, the law has applied normative policies of protection designed from heterosexuality, capacity, patriarchy, anthropocentrism and even Eurocentrism; although it is also necessary to recognize that this has been changing (gradually) in recent decades.
From the cultural point of view, the fuzzy logic allows the creation and application of public policies that integrate diverse cultures on a level of equality and coordination and not on a plane of inequality and subordination. There are no cultures more perfect than others. All cultural manifestations are valid and have the same value; just as there are no better ways of thinking and beliefs (worldviews) than others. All religious and cosmogonic manifestations must have the same value in a society that claims to be democratic.

From the environmental field, fuzzy logic provides an opportune epistemological scenario for the construction of environmental public policies under a biocentric approach through which it is considered that the difference between beings (plants, animals and humans) is not one of essence, but of degree; which is why the only subjects of law are not human beings, but also plants and animals, and even life-generating ecosystems, such as moorlands, rivers and oceans, have also been considered subjects of law, (and not only subjects of special protection).

As can be seen, public policies presented and developed from the fuzzy logic broaden the spectrum in the recognition of rights to communities and beings that have historically been denied such dignity and recognition; because under the classical legal conception, the only subjects of law are persons (legal and natural), insofar as they can acquire rights and contract obligations (Article 1502 of the Colombian Civil Code); but in current law the criterion for being a subject of law is not the capacity that an individual has to contract obligations, but the need for protection.

Hence, the question is not whether plants and animals can enter into contracts and contract obligations; The question is, whether animals, plants, rivers and moors deserve and should be protected and have the right to enjoy their natural ecosystem.

Article 53 of Law 1564 of 2012 and sufficient jurisprudence of the High Courts in Colombia, have already recognized the condition of rivers as subjects of rights (Sentence T-622 of 2016). With respect to animals, their ontological status as subjects of law has not yet been recognized; they are barely recognized as sentient beings (Law 1774 of 2016); but from logic, ontology and diffuse epistemology (Giraldo, 2023) they should be considered subjects of law; for the difference between human beings, plants, and animals is not of essence, but of degree, and consequently, both plants and animals participate in the condition of subjects, but not of objects; although their degree of belonging to the set of subjects is precisely gradual; the measures should be gradual, the recognition of rights and the measures of protection.

It is not a question of recognizing exactly the same rights of human beings to plants and animals; it is about recognizing their dignity as subjects (not objects) who deserve to live, because they are living beings, and they deserve to live in the natural conditions that their respective ecosystems demand. The tree has the right to be a tree and to live as a tree; The animal has the right to be an animal and to live as an animal, in the same way that man has the right to be a man and to live as a man.

Under the binary logic approach, plants and animals are located in the set of objects (things-goods); From the fuzzy logic, on the other hand, plants and animals are located in the same group of human beings, as subjects (of law) and not as mere objects. And this categorization is transcendental and fundamental for the recognition of rights to plants and animals and marks a milestone in the relationship between man and nature. From the binary logic, this relationship is vertical (of subordination) and domination: man is the master and lord of nature (anthropocentrism). On the other hand, from the fuzzy logic, the relationship is more horizontal and coordinated: man is protector and caretaker of nature; not only because their life and health depend on plant and animal life and health; but because nature, in and of itself, deserves to be protected.

If we were to pose the question about who needs more of whom, man from nature or man's nature. From binary logic, perhaps the answer would be that nature needs man more because he is its master and lord. But from the fuzzy logic it is man who needs nature the most. Can man exist without animals and plants? Can plants and animals exist without man? The answer to these two questions marks the difference between anthropocentrism and biocentrism; between classical (binary) logic and fuzzy logic; between the logical principle of the excluded third party and that of the included third party.

Contributions of fuzzy logic to public policies:

Despite the fact that, in recent years, Colombia has made progress in the recognition of the rights of historically excluded populations and communities (discriminated against, vulnerable), through, for example, norms, especially of a jurisprudential nature, which have declared property and personal rights to same-sex couples, the disabled, indigenous and raizal communities, among others; discrimination and lack of protection still existed. As evidence, it is sufficient to cite the fact that the equality recognized for same-sex couples, with regard to marriage and adoption, has been achieved thanks to the jurisprudence of the High Courts, especially that of the Constitutional Court, and

not to legal norms.

This denotes that the Colombian legislator, a manifestation of representative democracy; it continues to apply the principle of the excluded third, insofar as it has not recognized a third possibility of living sexuality, different from male and female; traditionally defined as male or female; leaving outside its scope of protection other (third) possibilities of living sexuality, which do not necessarily fit under the binary dilemma of male or female.

This urgently requires the Colombian State to implement inclusive and inclusive public policies at all levels, sectors and areas, and therefore it is presented to fuzzy logic as the logical, ontological and epistemological paradigm that can be the foundation of such policies. About the characteristics of fuzzy logic, Morales-Luna expresses:

Fuzzy logics, since in fact they must be spoken of in the plural, are essentially multivalued logics that extend to classical logics. The latter impose on their statements 'only false or true values. While they have satisfactorily shaped a large part of "natural" reasoning, it is true that human reasoning uses truth values that are not necessarily "so deterministic." For example, when qualifying that "the sky is blue" one is tempted to graduate how "blue", in fact, the sky is, and likewise, if "a vehicle is moving fast", one is also obliged to consider how fast the vehicle is, although the latter does not necessarily imply quantifying the speed of the vehicle with complete precision. (2002, p. 8)

This way of thinking about the graduated, polyvalent and open reality presented by fuzzy logic, is considered a pertinent epistemological paradigm, and even necessary for the construction and implementation of more inclusive and contextualized public policies; because traditionally in Colombia, public policies have been built and implemented from a traditional binary classical logical paradigm, instead of applying the principle of the included third party. This exclusionary worldview has been reflected, for example, in classism, racism and machismo, or in other terms colonialism, capitalism and patriarchy, in concepts of Boaventura de Sousa Santos (2013), which has predominated in our society; even from the normative regulation and recognition of rights.

Suffice it to cite by way of example the original article 1527 of the Colombian Civil Code, which in this regard literally stated:

Obligations are civil or merely natural. Civil are those that give the right to demand their compliance. Natural are those that do not confer the right to demand their compliance, but that when fulfilled authorize the retention of what has been given or paid, by reason of them. These are:

1a.) Those contracted by persons who, having sufficient judgment and discernment, are nevertheless incapable of binding themselves according to the laws, **such as married women in cases where the authorization of their husbands is necessary**, and adult minors who are not of legal age. (Underlining and highlighting outside the original text)

Fortunately, this was repealed by Law 28 of 1932 and Decree 2820 of 1974; norms that began to recognize the equality and capacity of women in Colombia.

Another example of exclusionary regulations is found in Article 1504 of the Civil Code when it stated: "The insane**, the prepubescent and the deaf-mute, who cannot make themselves understood** in writing, **are absolutely incapable**." Underlined and highlighted outside the original text to indicate how the Colombian State has been exclusive of persons and has applied the binary principle of the excluded third, classifying persons as capable and incapable; even using pejorative and offensive language, for example, with regard to the term insane. In addition, it also considered deaf-mutes who could not make themselves understood in writing incapable, as if they were then required to have the power to write, under penalty of not being recognized as full subjects of law with legal capacity.

Gradually, the legal system has been changing and advancing in the recognition of rights to people who suffer from psychological and medical pathologies, until reaching Law 1996 of 2019 that recognizes full legal capacity and also presumes that capacity. But there are still remnants of these discriminatory historical vices. For this reason, it is pertinent in this paper to analyze, in particular, the contribution of neuroscience and neurotechnology to the development of the physical and psychological capacity of people with certain medical pathologies and the way in which these contributions imply the configuration of a public policy of neuroscience, as will be explained later.

As can be seen in the previous examples, the norms hierarchize and classify to grant rights to some and deny them to others, as happened with marriage and marital union, marital and extramarital children, those from the center and those from the periphery, the city and the countryside, heterosexuality and homosexuality. fully capable people and the incapable, among others. Hence the demand for a paradigm shift or worldview that serves as the foundation for inclusive, inclusive, integrative, effective and efficient public policies in terms of the protection of rights, since, as Espinoza states:

Public policies are a set of interdependent collective options that are associated with decisions taken by governments

and their representatives and that are formulated in areas such as: defense, health, education, welfare, social welfare, among others. In any of the areas mentioned above, there are different possibilities for policy actions that are linked to ongoing or potentially implementable government initiatives and that involve conflicts between the different actors in the community. (2009, p. 4)

In recent years in Colombia, public policies have been implemented for environmental protection, animal protection, health, education, housing, gender equality, protection of the disabled, freedom of religion, worship and conscience, etc. All of them with the purpose of solving problems and/or protecting rights, satisfying needs and providing services to the community in a more efficient and effective way; because in short, these are the main purposes that justify the existence and formulation of a public policy.
However, there are two ways of formulating public policies: with the participation of citizens or without the participation of citizens. The duty of any public policy that is intended to be formulated and implemented must be the product of a need felt by and by the community and not of a need imposed or intuited by the ruler of the day to legitimize a given government plan. Unfortunately, public policies are sometimes formulated unilaterally that do not reflect the real and felt needs of the population and are not even the result of a democratic exercise of citizen participation as it should be.

By the way, Alzate asks: Have public policies been an effective instrument for the resolution of anomalies and problems of communities, unions and other interest groups? Or, on the contrary, have they been an element of electoral legitimization of the administration, with a low impact on the political system? (2011, p.95) In response to his question, the aforementioned author states:
Public policies are understood as a set of instruments through which the State, after identifying a need (economic, political, environmental, social, cultural, among others), implements a set of reparative measures, built with the participation of the groups affected by the various problems. This type of inclusion can be done in two ways: on the one hand, a traditional and technocratic scheme based on the formulation and implementation of policies from the State; vertical and exclusionary processes such as administrative acts,1 where the groups affected by the policy are understood as the center of analysis and legitimization of the process, but these actors other than the Government are not taken into account in the formulation, implementation and evaluation of policies. This approach of *inputs* and *ouputs*, where society demands and the State responds without taking into account the considerations of the community, has been incapable of effectively deciphering the problems that it is responsible for solving, this largely determined by:

• The failure of affected communities to identify and develop policy.

• The absence of a population that gives life to public policy and takes it beyond paper. (Alzati, 2011, p.95)

Note in the quote that the author responds to the question that he himself asks, considering that public policies, unfortunately in Colombia, obey more to instruments of political legitimation of the administration, than to effective means of solving problems and satisfying the needs of the community, and considers that this problem is due to the little or no participation of the communities in the identification and elaboration of the policy and the absence of of that population that gives life to that policy. This unfortunately means that these remain on paper and, consequently, are ineffective and their impact is zero, scarce or very low.

Principles and Assumptions for the Implementation of a Public Policy on Neuroscience and Artificial Intelligence

Neuroscience emerged with the laudable idea of proposing solutions to pathologies of the human mind that materialize in diseases such as schizophrenia, Alzheimer's, Down syndrome, autistic disorder syndrome, bipolar disorder, among others. By scanning the brain through procedures such as electroencephalogram or functional magnetic resonance imaging, neuroscience can know the structure and functioning of the brain and even modify it. This modification is initially aimed at the solution of the different pathologies, as already warned; but there is also the possibility of invading the most intimate thoughts of our brain and then this leads to the risk of violation of such expensive rights as personal identity, mental intimacy and free will, among others, as has already been warned; because, in short, "Everything we are is simply a product of the brain" (Yuste, 2019, p. 10)

Neuroscience, which can be defined as the scientific study of the nervous system, aims to facilitate a better understanding of the functioning of our brain and the neurological mechanisms underlying our mental functions and behavior, as well as their relationship with neurological diseases and ailments. This knowledge serves as the basis for the development of technologies ("neurotechnologies") that mainly pursue preventive, diagnostic and therapeutic purposes. Apart from its applications in the clinical and research fields, new knowledge contributes to the development of new tools for communication, marketing, emotional well-being, self-assessment of cognitive abilities and even the enhancement of these abilities. (Adorno, 2023, p. 10)

The exponential development of artificial intelligence with the application of natural language, through fuzzy logic, in overcoming binary logic; It has been possible thanks to the understanding of the structure and functioning of the human brain that has been carried out by neuroscience and neurotechnology. The question that arises then is whether

the consequences of these advances are positive or negative and the answer to this question cannot be posed in terms of binary logic, but of fuzzy logic (Jiménez, 2023); because science and technology is, in a certain sense, neutral and it is the uses and abuses of these that can be positive or negative.

Artificial Intelligence (AI), despite the multiple and diverse definitions that can be proposed, can be understood as the ability of computing machines to relate data to generate information, solve problems, learn and make decisions through algorithms (Merjury et al, 2024).

As a general rule, the application of neurotechnology and artificial intelligence is good and allows human development and growth in fundamental fields such as medicine, education, work, industry and commerce, among others. But it must also be recognized that these new technologies bring with them not so positive consequences, risks or threats in the same fields in which they allow positive advances. Neuroscientific interventions threaten personal identity, mental privacy and free will, equitable access, and ideological biases (Yuste, 2019) among other characteristics intrinsic to the human being.

Artificial Intelligence applications represent threats and risks from many points of view. For example, from the programming of these tools with discriminatory algorithms that can reproduce human biases such as classism, racism and machismo; or since its application, there may be massive loss of jobs, without a programmatic plan of adaptation and replacement; as well as manipulation of information, loss of human control, alteration and distortion of reality, etc.

These risks and threats therefore require the design and implementation of a set of actions and the definition of plans, programs, projects, institutions and responsibilities, in order to limit these risks and threats, which ultimately have to do with the identity of people, privacy, work, education, health, among others. And a public policy is the ideal scenario from which the use and abuse of neurotechnologies and artificial intelligence can be limited, in such a way that the probability of violation of rights is reduced to the maximum possible level; but not from partial, fragmented and isolated visions, but in a systematic, comprehensive and integrating way.

But what should be the principles, assumptions and structural elements of a comprehensive public policy on neuroscience and artificial intelligence? To answer the previous question, it is necessary to take into account that there is a close relationship between neuroscience and artificial intelligence; to the point that the so-called deep thinking (*deep learning*) has been developed thanks to advances in neuroscience and neurotechnology, and the application of one and the other, represent risks to the violation of human rights as expensive as the right to identity, mental privacy, free will, protection against bias and equitable access, which Rafel Yuste (2019) calls neuro rights.

At the international level, some countries have already presented proposals for the regulation of artificial intelligence, such as the Law of the European Parliament, the UNESCO recommendation on the ethics of artificial intelligence, the principles of the Organization for Economic Cooperation and Development (OECD) on Artificial Intelligence. In addition, from the regulation of neuroscience and neurotechnology, cases of integration of the so-called neurorights are already being presented, as happened in Chile and the discussion of bills has also been proposed in Spain, Colombia, Brazil and Argentina.

The current assessment of science and technology means that States are therefore faced with a problematic situation that they have to resolve: the tension between the benefits of progress and the scientific and technological development that allows the massive management of data and the possibilities of digital governance that AI allows. versus the risks and threats that the use of these tools implies. A State that absolutely prohibits or exercises high control over artificial intelligence tools will be at a competitive disadvantage with other States that use AI for the development of educational, labor, economic, industrial, scientific, medical, judicial, etc. projects and processes.

But also, to the extreme, a State that does not regulate the application of artificial intelligence tools, setting limits, will be exposed to a growth in the standards of violation of rights and even to an increase in crime, with regard, for example, to cybercrime or cybercrime. Hence, an intermediate term is required that defines the field of application of AI, prohibiting, ordering and allowing its application, according to the degree of convenience and according to the levels of risk that its use represents in the different scenarios.

Colombia is no stranger to this need for regulation; because as in other latitudes, in Colombia neuroscientific and artificial intelligence practices are growing, and their regulation is still scarce. By regulation, we understand not necessarily prohibition, since the deontic character of the norm is to allow, prohibit and order. The general rule is that the rule allows. Only in an exceptional way does the norm order and prohibit. A public policy for the regulation of neuroscience, neurotechnology and artificial intelligence must precisely define what actions, actions and practices should be allowed, ordered and prohibited; as well as the corresponding sanctions when what the regulation prohibits or orders is not complied with.

But what is the field of application of neuroscience? What relationship does it have with neurotechnology and

artificial intelligence? And why is a public policy of neurotechnology and artificial intelligence important? To resolve these questions, it is necessary to delve into the conceptualization of neuroscience, neurotechnology and other concepts that are closely related to each other, such as, for example, neurodata, neurostimulation and neurorights.

Neuroscience provides us with new knowledge about the functioning of the brain and cognitive processes, as well as the neurological mechanisms that underlie human behavior, producing important advances, especially in the medical field. Neurostimulation, for example, could allow people with spinal cord injuries to walk again. Brain stimulation, in which electrodes are inserted into the brain, could support the treatment of diseases such as Parkinson's and dystonia. Likewise, in combination with computers, the potential of neurotechnology in the workplace to transcribe our thoughts directly on screens without the need for keyboards is being explored. (Adorno, 2023, p.6)

Regarding neurotechnology and neurorights, Rafel Yuste himself, one of the co-founders of the *Brain* project, explains them as follows in an interview, the most outstanding sections of which are collected below. Regarding the potential of neurotechnology, Yuste said:

Neurotechnologies are methods that can be optical, electrical, nanoscience, chemical, or magnetic to do two things: to record brain activity and to alter brain activity. Neurotechnologies are currently being developed in the United States and in many other places around the world, and they are important because the brain is not just any organ of the body, but it is the organ that generates the human mind, brain activity generates all the cognitive and mental properties of human beings. So neurotechnologies can access mental activity and change it, and this is not science fiction, but something that we do routinely in animals, in the lab, and you can start to glimpse how this can be used in humans as well. (Iriarte Rivas & Oliviera Muñoz, 2021, p. 205)
Yuste then adds in the same interview:

Because of the potential that neurotechnologies have to be able to access brain information and change it, they have the possibility of changing mental activity, and mental activity is the essence of the human being. I'm talking about everything we are mentally, our perceptions, our ideas, our imagination, our memories, our emotions, our plans, our decisions, all of this arises from brain activity. We think it is necessary to protect brain activity from potential abuses with neurotechnology. And since brain activity generates the human mind, we think that it is a human rights problem; that we have to protect brain activity as a basic human right, because otherwise the mind can be subject to improper manipulations and decipherments. (Iriarte Rivas & Oliviera Muñoz, 2021, p. 206)
The first neuro right proposed by Rafael Yuste is:

Personal identity:
We are proposing the right, for example, to personal identity. This is something that we do not believe is included in the Universal Declaration of Human Rights, because no one would have imagined in 1948 that they can change your identity, your self, that who is the person you are can be changed. This is one thing that can happen with neurotechnology, and in fact is happening, with patients receiving deep brain stimulation. (Iriarte Rivas & Oliviera Muñoz, 2021, p. 207)

What is left of the person who acts through a computational interface or with synthetic, virtual or digital prostheses? What is the boundary between the natural-organic (human) and the mechanical (computational)? What is left of the person when his thinking and acting are determined by the modification of his brain through neurotransmitters? These are the questions that Yuste raises.

The second neuro right is **free will**, which has to do with the impossibility that, through neuroscience and neurotechnology, the decisions made by people are manipulated and that these decisions are not free and autonomous; because if after a patient has undergone a neuroscientific and neurotechnological treatment, that modified his way of thinking and acting, said subject makes a certain decision, it is then worth asking whether the decision has been made by the subject or by the algorithm. Once again, the key question appears: what is going to be the limit between the human and the machine?

Mental **privacy** is the third neuro right proposed by Rafael Yuste, and in this regard he indicates:
Then, we also have the third neuro right that we propose, which is the right to mental privacy. This goes much further in our view than the data privacy rights that currently exist in the world, which in some parts are stronger than others, because these refer to personal data that you may have stored on your mobile phone, on your computer, or data about how you move around town. and it is important that this is protected, but we believe that it falls short when it comes to protecting brain data (Iriarte Rivas & Oliviera Muñoz, 2021 p. 207)
To what extent are scientists and states entitled to penetrate the most intimate part of human beings, which are their thoughts, even unconscious?

The fourth neuro right proposed by Yuste is equitable access to neurotechnological treatments when they do not

violate other neurorights. By the way, he says:

That is why we want to make sure that before these technologies are spread by the population, they are regulated under the universal principle of justice, so as not to break equitable access to these technologies that can change the essence of the human being. That also gives you an idea of why we think it's a human rights issue, because we're talking about the essence of what it means to be a person. (Iriarte Rivas & Oliviera Muñoz, 2021, p. 208)

Surely some families will have the possibility of covering the medical expenses required by the neuroscientific treatments of one of their members; but there will also be other families that do not have enough resources for it, and then a discriminatory gap will be generated between people who have access to these neurotechnologies and those who do not. And in Colombia, we would even have to think about a public health problem that may arise, and that is that the families of those who have no way to cover the expenses of this type of treatment will come to the State's aid and ultimately to the tutela action. Which will ultimately result in greater saturation of the justice system.

The fifth neuro right is **protection against bias,** which above all aims to protect people from the eventual discrimination generated by artificial intelligence tools, driven by advances in neuroscience and neurotechnology.

Finally, the last human right we are proposing is the right to be protected from the biases of the algorithms that are used and will be used in neurology. These algorithms, unfortunately, often have a bias that, with neurotechnology implanted directly in our brain, would be incorporated into our mind as something of our own, as something we think, not as something that comes from outside. (Iriarte Rivas & Oliviera Muñoz, 2021, p. 208)

However, there are also what could be called the critics of neuro rights, those who consider that the already existing Declarations of recognition of rights are enough and sufficient and that it is not necessary to add more rights to the long list that already exists. Thus, for example, Assisi asserts:

Well, some of the criticisms are directed on the very foundations of the proposal. Thus, it is affirmed, as we have seen, that it is based on a false hypothesis (defending that the current human rights system is not capable of facing the challenges of neurotechnological applications) (2022, p. 67)

However, there are also other voices that join Yuste's proposal for neurorights; such as that of Adorno, who recognizes the risk of violation of rights by neurotechnology and then states:

However, by allowing direct access to mental data and facilitating unprecedented forms of intervention in the brain, these same neurotechnological advances, combined with artificial intelligence devices, raise serious ethical and legal questions. The possibility that neurotechnology opens up to "hack" the brain, while at the same time it can contribute to overcoming traumas, can also involve manipulating individual preferences in directions opposite to the conveniences or desires of the individual in question. (2023, p. 7)

Regarding the ethical and legal need to somehow curb the threats of neurotechnology and artificial intelligence (integrated), the author indicates:

These unprecedented possibilities of access to people's mental data and alteration of neural activity generate important ethical and legal dilemmas, since they could be used in a way that is contrary to respect for human dignity and human rights. It is therefore crucial that these challenges be duly addressed by public authorities and by the competent regional and international bodies. In this sense, the formal recognition of new rights – or at least the expansion of existing rights – has been proposed in order to protect cognitive freedom, as well as the right to mental privacy, mental integrity and personal identity. (Adorno, 2023, p. 10)

For this reason, he cites as an example the process of regulatory adaptation carried out by Chile, as the first State in the world to add neurorights to its Political Constitution. It would be another thing to inquire about the effectiveness of said constitutional consecration; that is, does the consecration and constitutional recognition of neurorights contribute to the protection of citizens from the risks and threats posed by neuroscience, neurotechnology and artificial intelligence or is it simply a symbolic and rhetorical efficacy that does not represent significant and real changes in practice? In any case, the aforementioned author describes the Chilean experience as follows:
On October 25, 2021, the Chilean Congress approved through Law 21,383 an amendment to Article 19, paragraph 1 of the Constitution that was drafted as follows: "Scientific and technological development will be at the service of people and will be carried out with respect for life and physical and mental integrity. The law will regulate the requirements, conditions and restrictions for its use in people, and must especially protect brain activity, as well as the information coming from it" Also in Chile, on October 7, 2020, a bill "on the protection of neuro rights and mental integrity, and the development of research and neurotechnologies". The project proposes the recognition of five "neuro rights": 1. Personal identity: not altering the sense of self under any circumstances; 2. Free will: people will make decisions freely, without neurotechnological manipulation. 3. Mental privacy: Brain activity data may not be used without the consent of individuals. 4. Protection against algorithmic bias: People may not be discriminated

against based on data obtained by neurotechnologies. 5. Equitable access: improvements in brain capacities must be accessible to all (Adorno, 2023, p. 27)

In other states, bills have also begun to be proposed that seek to protect citizens from what has been called neurodata; because it is no longer just a matter of protecting the individual's external data, which can be private, semi-private or public, among others; but also to protect the most internal data that rest in the human brain and that have to do, even with unconscious thought. In this regard, in 2022, bills were presented in Brazil and Argentina; as well as in Colombia, in 2025 a draft Law on the regulation of neurorights was presented.

Conclusions

Fuzzy logic, as one of the so-called polyvalent logics, allows the formulation and implementation of inclusive and inclusive public policies, in application of its logical principle of the included third, as opposed to the traditional principle of the binary logic of the excluded third. This paradigm even facilitates an open, flexible, dialoguing and inclusive worldview that, in the end, promotes the development of democracy by closing the gaps between traditional dichotomies that put in a scenario of conflict topical concepts and realities such as rich-poor, black-white, man-woman, capable and incapable, among others.

The indeterminacy, uncertainty and openness of reality itself requires the application of more inclusive, flexible and integrating ways of thinking, which, instead of dividing, combine and instead of dividing, bring together, and, instead of hierarchizing, allow dialogue and interaction. Hence, the understanding of the gradualness of fuzzy logic and its application leads in turn to the understanding that beings are not substantially different, but that their differences are only quantitative and not qualitative. Thus, for example, a comprehensive environmental public policy will have as its premise; not the separation of humans, as subjects; with respect to animals and plants as objects; rather, it will understand this relationship in a horizontal and biocentric way and not in a vertical and anthropocentric way.

In the same way, fuzzy logic can also make it possible to formulate a comprehensive public policy on neuroscience, neurotechnology and artificial intelligence that has as its premise the understanding of capacity and disability in their difference of degree and not of essence and allows for gradual, differentiated implementation; but also systematic, of mechanisms of protection against risks and threats; through the recognition and normative consecration of neurorights, for example, as some States are already doing.

In short, fuzzy logic is configured as the most appropriate and pertinent logical and epistemological system for formulating inclusive public policies in Colombia; not only by the application of the principle of the included third party, instead of the principle of the excluded third; but also because fuzzy logic allows a greater understanding of social problems, from their indeterminacy, vagueness and blurriness; as well as because the fuzzy logic allows the gradual implementation of plans, programs and actions aimed at satisfying the respective needs that a given public policy seeks to satisfy.

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