Chapter 2

Conceptual Development on the role of training in the generation and appropriation of a culture in Research Ethics, Bioethics and Scientific Integrity: transformation of cognitive biases, attitudes, and behaviors

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Abstract

Objective: A conceptual development is proposed which establishes the importance of training in the appropriation of a culture of Research Ethics, Bioethics and Scientific Integrity in the processes of science, technology, and innovation, as part of the roadmap adopted for the implementation of this policy by the Training Roundtable Discussion group that has been supporting this process.

Methodology: Based on the conceptual verification of cognitive biases, attitudes and behaviors, their interrelation and impact on the development of a culture, the role of training in the transformation of cognitive biases that have an impact on attitudes is identified, which at the same time influence ethical, bioethical and integrity behaviors

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in science, technology and innovation, evidencing the appropriation of a culture on the subject and resulting in the proposal of a conceptual model.

Results: Identification of the existence of a varied and flexible interaction between cognitive biases, attitudes and behaviors; the need to build conceptual and methodological tools to address in a concrete way the cognitive biases of science, technology and innovation processes; the importance of the social psychology approach in addressing attitudes as an adjuvant mechanism in the process; the various ways in which training influences patterns of behavioral change; and, most relevantly, the impact of training on the interaction "cognitive biases-attitudes-behaviors" and, therefore, on the appropriation of a culture in Research Ethics, Bioethics and Scientific Integrity.

Keywords: Cognitive biases, attitudes, behavior, culture, research ethics, bioethics, scientific integrity

Resumen

Objetivo: Se propone un desarrollo conceptual que establece la importancia de la formación en la apropiación de una cultura en Ética de la Investigación, Bioética e Integridad Científica en los procesos de ciencia, tecnología e innovación, como parte de la hoja de ruta adoptada para la implementación de esta política, desde el grupo de la Mesa de Formación que ha venido apoyando este proceso.

Metodología: A partir de la comprobación conceptual de sesgos cognitivos, actitudes y comportamientos, su interrelación e impacto en el desarrollo de una cultura, se identifica el rol de la formación en la transformación de los sesgos cognitivos que impactan en las actitudes, las cuales a su vez influyen en los comportamientos éticos, bioéticos y de integridad en ciencia, tecnología e innovación, que evidencian la apropiación de una cultura en el tema y dan como resultado la propuesta de un modelo conceptual.

Resultados: Se identificó la existencia de una interacción variada y flexible entre los sesgos cognitivos, las actitudes y los comportamientos; la necesidad de construir herramientas conceptuales y metodológicas que permitan abordar de forma concreta los sesgos cognitivos de los procesos de ciencia, tecnología e innovación; la importancia del enfoque de la psicología social en el abordaje de las actitudes como mecanismo coadyuvante en el proceso; las diversas formas en que la formación influye en los modelos de cambio comportamental, y, lo más relevante, el impacto que tiene la formación en la interacción «sesgos cognitivos-actitudes-comportamientos» y, por lo tanto, en la apropiación de una cultura en Ética de la Investigación, Bioética e Integridad Científica.

Palabras clave: Sesgos cognitivos, actitudes, comportamiento, cultura, ética de la investigación, bioética, integridad científica

Resumo

Objetivo: Foi construído um desenvolvimento conceitual que demonstra a importância da formação na apropriação de uma cultura em ética em pesquisa, bioética e integridade científica nos processos de Ciência Tecnologia e Inovação desenvolvidos pelas diversas áreas do conhecimento, sendo esta proposta um dos objetivos da Mesa de Capacitação, grupo de trabalho que apoia a implementação da política de ética em pesquisa, bioética e integridade científica na Colômbia.

Metodologia: propõe-se um modelo conceitual que consegue estabelecer o papel da formação na transformação de vieses cognitivos que impactam atitudes, que por sua vez influenciam comportamentos éticos, bioéticos e de integridade em Ciência, Tecnologia e Inovação, que mostram a apropriação de uma cultura em o sujeito.

Resultados: Identificou-se a existência de uma interação variada e flexível entre vieses cognitivos, atitudes e comportamentos; a necessidade de construir ferramentas conceituais e metodológicas que permitam uma abordagem concreta dos vieses cognitivos dos processos de Ciência, Tecnologia e Inovação; a importância da abordagem da psicologia social na abordagem das atitudes como mecanismo contribuinte no processo; as várias maneiras pelas quais o treinamento influencia os padrões de mudança comportamental; e, mais relevante, o impacto que a formação tem na interação «preconceitos cognitivos-atitudes-comportamentos» e, portanto, na apropriação de uma cultura em ética em pesquisa, bioética e integridade científica.

Palavras-chave: Preconceitos cognitivos, atitudes, comportamento, cultura, ética em pesquisa, bioética, integridade científica

2.1 Introduction

According to the American philosopher Charles Sanders Peirce (n. d., p. 5), “Few people care to study logic because everybody thinks himself to be proficient enough in the art of reasoning,” but -he adds- “I observe that this satisfaction is limited to one’s own ratiocination and does not extend to that of other men.” This observation sums up one of the reasons why it is so difficult to conduct one of the fundamental tasks posed by philosophy from its very beginnings: self-knowledge. The certainty that our own knowledge is true and well-structured prevents us from seeing our own errors, even though we do not have the same difficulty in pointing out the errors of others. We are invisible to ourselves, and only careful discussion can enable us to unveil our own presuppositions and identify in ourselves the logical errors that we can relatively easily attribute to others.

This difficulty in identifying our own flaws in reasoning can extend to the work we undertake together. In organizations such as governments, armies, companies and study groups, this self-concealment also occurs, the consequences of which extend beyond the individual and end up creating calculation problems of great magnitude: failed public policies, huge war defeats, large-scale economic losses, and unfeasible academic projects or those of little or no application. Although the institutions themselves are not precisely cognitive agents susceptible to self-knowledge errors, the agents that make decisions within these institutions are[7]. Hence the importance of having tools to identify these errors that, starting from projections with the best intentions of success, end up generating failures that impact not only those who plan, but also those who are harmed by these design errors. These analysis tools are known in psychology as *cognitive biases*.

Cognitive biases are tools that allow us to identify general structural factors such as the environment, the personal history of each agent or the limitations of human cognition. When these general factors are converted into dispositions for the action of each particular agent, we are talking about *attitudes*, specifically biased attitudes. Finally, once these attitudes are concreted into observable events, we refer to *behaviors*. Accordingly, when a systematic behavior is observed that has undesirable consequences, it is important to observe the attitude that underlies this behavior, and, ultimately, the bias that makes the agent think that his action strategy could have positive results, when reality shows the opposite.

When designing research, technological development, or innovation projects, it is common to find that working groups focus exclusively on their object of study, ignoring the structures that determine their own analysis and that can lead to undesired results. Specifically, in matters related to research ethics, there is a risk that projects may be approached with the best of intentions but are fraught with bias or neglect with respect to unexpected consequences or expectations that are not fulfilled as they should be. The confidence that researchers usually have about the relevance and social commitment of their own studies may blind them to their own limitations, their biases, and the risks of applying methods that are successful in some contexts but may fail in others. Hence the importance for the agents involved in the CTeI processes to be aware of cognitive biases and how these are established through attitudes and end up materializing in behaviors. This analysis seeks to remedy the consequences of biases as far as possible and, thus, to improve the project formulation process by including ethical guidelines that will enable CTeI to contribute to building a better society.

[7] Although there is the concept of institutional bias or structural bias or systemic biases, what those express can be included in the category of availability biases, which will be included below: in brief, structural biases are conditions of the environment that negatively condition the agent's decision making and lead him to make systematic errors, particularly related to prejudices and exclusionary attitudes (Gassam Asare, 2019).

This chapter will begin by defining what cognitive biases are and how they originate in the very structure of human cognition, which allows us to understand them as something that is part of our nature and that we can try to mitigate as much as possible without pretending to have total control over them. Subsequently, a proposal for categorizing cognitive biases will be presented, according to their usefulness in the design of research, technological development, and innovation projects, in order to then establish criteria for identifying cognitive biases so that they can be used in the project design process. Subsequently, the impact of cognitive biases on attitudes and their coadjutant role in the generation of behaviors and, therefore, in the appropriation of culture in Research Ethics, Bioethics and Scientific Integrity will be presented. Finally, a proposal for behavioral transformation is presented from three models of behavioral change, based on the interaction between cognitive biases-attitudes-behaviors.

2.2 Cognitive Bias

2.2.1 Definition

The expression cognitive bias was popularized by psychologists Daniel Kahneman and Amos Tversky in the late 1970s and has one of its most recognized formulations in Kahneman's text Thinking, Fast and Slow (2011). According to this author, it is easy for people to identify errors of judgment in decision-making or in the behaviors of someone else in a given situation, but conceptual tools are needed to understand the general cognitive factors that underlie these errors. It is therefore important to identify the patterns that emerge from behaviors resulting from bad decisions, and from this arises the definition of bias as a systematic tendency to make mistakes when acting in certain circumstances. Thus, by identifying not only the particular errors in behavior, but also the biases that respond to a certain pattern of behavior, it is possible to better identify the causes and viable solutions to prevent these biases or, at least, to control their consequences on the processes as much as possible.

It is reasonable to think that no one seeks to make the same mistake repeatedly, unless their objective is to deceive an opponent or to achieve some end in an unscrupulous manner or, simply, to remain firm in their position regardless of whether or not it conforms to reality. For this reason, the origin of biases must be understood according to mechanisms different from those of rational decision making, which starts from an objective analysis of real data to take a course of action accordingly. To explain this, Daniel Kahneman (Kahneman, 2011) appeals to the figure of the "two systems" that constitute our cognition:

- First, there is system 1, which works almost automatically and whose purpose is to save the agent as much energy as possible in cognitive work. To achieve this "automation" of behavior, system 1 converts the cognitive processes that have been successfully internalized into habits. Thus, when the agent finds himself in a given situation, he is accustomed to responding in a certain way and does not have to spend much energy thinking about the best solution strategy.

- Then there is system 2, which works consciously and whose purpose is to analyze in detail the particular situations faced by the agent, in order to produce the most appropriate response. This system 2 demands a cognitive effort and, with it, a significant energy expenditure. For this reason, the agent tends to avoid resorting to this system and to unload the cognitive work on system 1, which works with less effort.

With this in mind, we can then understand that the automation of cognitive strategies that are successful in certain contexts can lead to extrapolating these same strategies in contexts that are not appropriate. This leads to systematic error, as far as agents tend to act automatically and avoid resorting to a conscious process. In other words, the automatic responses of system 1 persist because they are usually successful, and it is also for that reason that it is difficult to identify and accept when a strategy is not working.

In addition to automation, there is in agents, as mentioned above, an innate security in their own rationality that makes it difficult for them to identify their own mistakes. People are able to identify other people's mistakes and not see their own because they have difficulty seeing themselves objectively. Each person considers that he or she has the criterion of rationality in himself or herself and from his or her own perspective evaluates others, but hardly questions those same criteria that he or she believes to be true.

Adjusting the cognitive strategies that lead to a decision-making process puts the agent in the situation of having to resort to system 2 and expend cognitive resources, which, in addition, leads him to question the methods that he considers most appropriate and that are part of his practical rationality. The identification of biases is a tedious and challenging task, but it is often necessary to avoid the errors resulting from an unexamined decision-making process growing in such a way that they become increasingly difficult to solve. This is why identifying biases makes it possible to systematize errors in order to search for causes and solutions in a more general way and applicable to various contexts.

2.2. 2 Types of Cognitive Bias

This section will attempt to propose, based on a general analysis of the types of biases identified in the contemporary literature, a typology that fits the objectives related to

Research Ethics, Bioethics and Scientific Integrity[8]. This typology will have three main components: availability biases, egocentric biases, and intuition biases.

Availability Biases

Availability biases are those in which *decisions are conditioned by the information available to the agent or the way in which this information is presented*. The cognitive framework in which these types of biases occur is due to the fact that the transmission of information, either from an external agent or from the physical environment, is not a neutral process in which a message passes back and forth without any modifications other than those that may be introduced by external noise. Given that concrete situations present the agent with time pressures and perspective limitations, it is common to fall into this type of bias; but it is also possible to diminish the consequences when there is more awareness of the cognitive structure that underlies them and when habits of critical thinking are promoted to strengthen critical skills in interpretation.

According to the above, we would have two general types of bias: some more related to the immediate situation (anchoring, framing and availability heuristics) and others related to the particular history of the agent (prospect theory and perceptual salience), as discussed below:

- Anchoring effect
- Framing effect
- Availability heuristics
- Prospect theory
- Perceptual salience

Egocentric Biases

The second category includes those biases whereby the interpretation of information is mainly conditioned not only by the pressure of the concrete situation, but also by the *agent's general traits acquired through his personal history*. As an active interpreter of the situation, the agent does his part in reading the information from the environment and projects his own experiences or the strategies that may have brought him success in the past to achieve positive results in relation to the problem he must solve in the present,

[8] Some categorization proposals can be found in Caverni et al. (1990), Juárez Ramos (2019), Hilbert (2012) and Haselton et al. (2005). However, each categorization responds to the specific need for exposure and there is no stable consensus among the authors

or that may be presented to him in the future. As in the previous case, critical thinking and the strengthening of analytical habits can help reduce the negative consequences that can result from this type of bias.

Egocentric biases can be divided into two groups: those that have to do with adjusting the world to one's own beliefs (confirmation bias and cognitive dissonance) and those that focus on the agent's reference to himself (*egocentric bias, effort justification*).

Intuition Biases

Finally, we have a group of biases that are more general and have to do with the difficulties that human beings have, given their limited cognitive capacities, to *interpret information from the environment in a reliable way* all the time without falling into errors.

There are two general types of fallacy in this category: biases that have to do with the confusion between certainty and truth (*mere exposure effect and superficial truth*), while there are others that have to do with introducing extra information to make sense of the scarcity of data (*intuitionism, apophenia*).

Table 2. Types of cognitive biases

Type of bias	Description	Division	Bias (specific)
Availability	Biases that condition the decision according to the way information is available in the environment.	Immediate situation	Anchoring Framing Availability Heuristics
		Agent-environment relationship	Prospect theory Perceptual salience
Egocentric	Biases that condition the decision according to the agent's personal history.	Adjustment of the world to one's own beliefs	Confirmation bias Cognitive dissonance
		Self-reference	Egocentric bias Effort justification
Intuition	Biases that condition the decision according to the limitations of human cognition.	Confusion between certainty and truth	Mere exposure effect Superficial truth
		To make sense of or complete the limited data	Intuitionism Apophenia

Source: Author's preparation

2.2.3 Criteria to identify cognitive biases

The requirement to be clear about when reference is made to a cognitive bias defines the search for characteristics that indicate whether or not a bias of this type is being addressed. For the purposes of this identification of biases, two possible indicators are initially proposed: on the one hand, the requirement that it be repetitive, and, on the other hand, that its initial intentionality be positive; both aspects were addressed previously. However, since it is possible to speak of cognitive bias only if there is clarity about what is "right" and what is "wrong", it is important to have some criterion that allows us to identify this difference, so in our case the principles and conducts established in Research Ethics, Bioethics and Scientific Integrity (Minciencias, 2022), aspects validated as part of the implementation of the Policy on Research Ethics, Bioethics and Scientific Integrity, which specifically orients desirable conducts in the CTeI processes, and in this way it is possible to identify if the biases are associated with possible conducts against the EIBIC.

Based on the above, the criteria that help to define whether a cognitive bias is being addressed are the following:

Table 3. Criteria to define cognitive biases

No.	PROPOSED INDICATOR
1	Identify whether the bias corresponds to a pattern (repetitive)
2	Analyze whether bias generates problems or erroneous results in EIBIC (this can be determined by relating bias to established conducts and principles).
3	Identify whether the target was intentionally positive (initially)

Source: Author's preparation

Once the specific cognitive bias has been defined according to the typology described above, it is identified how these biases interact through attitudes to subsequently manifest themselves in conducts, always taking attitudes as mediating agents and interaction with the environment and peers as factors that drive this conversion into conducts. Hereafter, a definition of attitudes will be made, making distinctions between the approaches that have addressed this definition, and then we will move on to the definition of the functions of attitudes before addressing behaviors.

2.3 Attitudes

By addressing cognitive biases, attitudes and behaviors and their interrelation as the basis for the appropriation of a culture, it is reasonable to propose that it is the cog-

nitive biases that impact the attitudes that people have towards the defined object or situation (in this case, towards Research Ethics, Bioethics and Scientific Integrity) in the development of science, technology and innovation processes. These attitudes have a direct influence on the behavior of the actors involved; these conducts are, finally, the action that evidences the appropriation of the culture, as far as they demonstrate the following of standards, norms and guidelines on the subject.

Although variants of the interaction between these constructs (biases, attitudes, behaviors) are presented, this document attempts to show the path that is structured when moving from cognitive biases to attitudes and how these become a mediating factor that influences behaviors. Therefore, a concrete model applicable to the processes of science, technology and innovation is offered. Thus, this section focuses on the approach to attitudes as one of the links that help in the realization of the process of appropriation of a culture.

2.3.1 Definition

Although the study of attitudes began in the 1930s, it can be said that there is still no agreement on their definition, characteristics, and scope. According to Guerra de los Santos and Cantillo Galindo (2012), they have been defined as hypothetical constructs or as real elements, of a conscious or unconscious type, covering the cognitive, emotional, and behavioral sphere. However, according to Escobar-Melo and Díaz Amado (2008), especially in the 21st century, the focus of study has been strongly oriented to social cognition: the framework of social psychology from which it has generally been approached, although this area of psychology began to use the technical term attitude since the early 20th century (Guerra de los Santos and Cantillo Galindo, 2012).

In the chapter "Attitudes in interpersonal relationships" (Guerra de los Santos and Cantillo Galindo, 2012), the models for approaching the study of attitudes are presented, which can offer a reference in relation to the appropriation of the approach addressed by this document.

For Guerra de los Santos and Cantillo Galindo (2012), there are two main functions of attitudes:

- Motivational functions: They are represented as a response to the needs of the individual or the group.
- Cognitive functions: oriented to the selective choice of information. Each of these functions presents an internal classification that allows understanding its application to the motivational or cognitive field.

Table 4. Models for approaching attitudes

Model	Description of attitude approach
Unitary Models Fazio (1990) Pratkanis and Greenwald (1989)	Attitudes associated in memory with an affection for a given object. A positive or negative affect has been considered in this sense. Model represented by the MODE proposal (Fazio, 1990): objects with which one has direct experience generate more accessible attitudes, i.e., more stable attitudes, more resistant to criticism, while offering more confidence; attitudes guide conducts through automatic activation of the attitude in the presence of the object, or through careful analysis of the information.
Dual models Wilson, Lindsay, and Schooler (2000)	Considers that one can have both an explicit (conscious) and an implicit (unconscious) attitude towards an object; it is possible to show different affects towards the same object. These dual attitudes have different mental representations, are formed by different cognitive processes, and are activated in different contexts.
Process models Schwarz and Bohner (2001) Gawronski and Bodenhausen (2006)	Constructivist perspective of attitudes, whereby attitudes are formed for each specific situation, according to feelings, beliefs, and most salient conducts. This generates a "selective access to information", thus influencing the evaluation of information. The APE model - of associative-propositional evaluation (Gawronski and Bodenhausen (2006) - defines that one acts positively or negatively towards the object, according to the affection associated with it or the thoughts it generates. Likewise, affect can be transformed by beliefs. They emphasize that attitudes are not found in memory.
Metacognitive model Pretty, Briñol and DeMarree (2007)	Attitudes remain in our memory, thus generating positive or negative evaluations. Characteristics: The activation of attitudes depends on the context; having antagonistic attitudes (good/bad) towards an object, the activation will depend on the closest experience or contexts where they are related, on the valuation that the subject makes of the attitude towards the object.

Source: Prepared by the authors based on the Classification of Attitude Approach Models in "*Las actitudes en las relaciones interpersonales*" (Guerra de los Santos and Cantillo Galindo, 2012).

Table 5. Attitude functions

Functions	Type	Description
Motivational	Adaptive or instrumental	Related to the attempt to obtain the greatest gratification from experiences and relationships, and to diminish unpleasant aspects. In this case, the function of attitudes is to allow rapprochement with what we consider pleasant and to avoid what we consider unpleasant, therefore closeness and consistency with rewards and punishments is fundamental in this function.
	Self-defense	In this case, attitudes protect the individual from negative feelings towards himself, towards others or towards a group. In general, from this perspective, all people have defensive attitudes that they will use to a greater or lesser extent, according to the context.
	Value expressive	It is oriented to make known the individual's core values and the type of person he/she believes him/herself to be. This approach considers that attitudes serve the individual to obtain social approval.
	Cognitive with respect to the environment	This function refers to the contextual framework that attitudes provide for the search for information about their surroundings. In this way, attitudes help to understand the environment that surrounds them.
Cognitive	Information processing	They provide a frame of reference for organizing and understanding information coming from the outside world.

Functions	Type	Description
Cognitive	Active research of attitude-relevant information	Selectivity in the search for information, oriented towards information with which they feel more identified or closer (in accordance with their attitudes).
	Perception of attitude-relevant information.	This function is intended to serve as a filter for the evaluation of incoming information.
	Recall of attitude-relevant information	Attitudes allow for greater recall of issues where they were more intense (for or against) than where they were neutral.

Source: Own preparation based on the Classification of Attitude Approach Models in "*Las actitudes en las relaciones interpersonales*" (Guerra de los Santos and Cantillo Galindo, 2012).

For the purpose of this paper, i.e., how training can have an impact on the transformation of cognitive biases -then, attitudes and behaviors-, in this case, for the generation and adoption of a culture in Research Ethics, Bioethics and Scientific Integrity, within the framework of the science, technology and innovation processes developed in the country, the approach from social psychology is considered the most relevant for the study of attitudes, since it allows exploring them from the perspective of the mediating agent; in this case, between cognitive biases and conducts.

From this approach and according to Escobar-Melo and Díaz Amado (Escobar-Melo and Díaz Amado, 2008), attitudes are a subjective construct that belongs to social psychology, referred to "a comprehensive way of approaching socially mediated conduct" (p.75). For these authors, attitudes have three dimensions:

- **Cognitive:** It refers to "beliefs regarding the attitude object in terms of assumptions about what it is like and relative objectivity in relation to it" (p.75).
- **Affective:** It relates to "evaluative feelings of favorability or unfavourability, feelings that refer to particular emotions" (p.75).
- **Behavioral:** It is oriented to the "tendencies to action, in terms of how a subject responds or acts before that object, person or group of people, which constitute the objective or target of the attitude" (Morris and Maisto, 2001; cited by Escobar-Melo and Díaz Amado, 2009, p. 75).

Escobar-Melo and Díaz Amado (2008) consider that attitudes can be understood as true dimensions that influence the conduct of a given subject, also as mediators and guides of conduct or as complex responses of the organism resulting from the influence of the groups in which it lives or the social situations it experiences (p. 75).

We understand attitudes as a mediating construct between cognitive biases and behavior, to the extent that they contribute to the process through which cognitive biases are consolidated in beliefs, affections and evaluations of the environment, conditions that in turn guide or condition the behavior of people in the face of certain objects or situations, in this case, in the face of research ethics, bioethics and scientific integrity. Based on this approach, the following section will specifically address the behavioral aspect and the conceptual approaches that contribute to the transformation of behaviors, always bearing in mind that behavior is in constant interrelation with cognitive biases and attitudes.

2.4 Behavior

2.4.1 Definition

Behavior, understood as the construct referring to the conducts that an individual evidences in a given situation, allows, within the framework of Research Ethics, Bioethics and Scientific Integrity, to account for compliance with guidelines, norms, standards, among others, aligned with the "must be" of the development of the processes of science, technology and innovation dictated by the scientific community to which one belongs.

This section will address the most representative models of behavior change that can be applied to the case of interest, in such a way that they are the conceptual basis for developing a proposal regarding the roles that can be played by the training processes in the acquisition and transformation of behavior, therefore, in the appropriation of culture in Research Ethics, Bioethics and Scientific Integrity.

2.4.2 Models of behavioral change

Although there are several models for behavioral change, this paper will focus on three: *individual-centered models*; *integrative individual-environment models*; and *contemporary models*, specifically, *behavioral design*.

The characteristics and elements that make up each of these models allow us to propose the role that training plays in the acquisition and transformation of behaviors within the framework of each of the models, always considering the premise of the existence of an interrelation between cognitive biases, attitudes, and behaviors.

Individual-centered models

According to Alvarez (2010), individual-centered behavioral change models are oriented to attitude change and cognitive restructuring, and to a stepwise or "motivational" change. The following table provides a synthesis of the individual-centered behavioral change models proposed by Alvarez (2010).

Table 6. Individual-centered models of behavior change

Model/Authors	Characteristics
Festinger (1954) Cognitive dissonance	Cognition is a determinant of behavior. Behavior and cognition may not be aligned (dissonant), so the individual would be in charge of making the changes in cognition to achieve the desired behavior.
Fischbein and Azjen (1975) Self-regulation and rationality Perceived behavioral control	• 1975-Cognitions are changed by experiences or by deliberation about them. • In self-regulation it is the individual who predicts, manages, and controls his or her behavioral change. • 1985-"Perceived behavioral control": internal reinforcers aid attitudinal and behavioral change and maintenance.
Weisten (1988) Adoption of precautions	• Staged model focused on motivation: • Information about the situation. • Calculation of risk. • Recognition of one's own susceptibility. • Decision for action. • Desirable conduct.
Eagly and Chaiken (1993) Persuasion and cognitive response approach.	Behavioral change depends on the validity and credibility that the individual gives to the message and the source of the message (external persuasion) or the individual's own argumentation to do so (self-persuasion).
Prochaska, Norcross, and Diclemente (1994)	Behavior change: "any activity that a person undertakes to help him modify his thoughts, feelings or behaviors" (Prochaska, Norcross and Diclemente, 1994, cited by Álvarez, 2010).

Model/Authors	Characteristics
Flórez (2003) Heuristic Scheme DPPP (psychological dimension promotion-prevention)	Complex stage model: each stage brings the individual closer to the desired behavior, and each stage has limits, facilitating variables and barriers. It combines group influence with the subject's gradual decisions.

Source: Author's preparation based on "Psychological models of change: from individual-centered models to psychosocial models in health psychology" (Álvarez, 2010).

Taking into account that in all models of behavior modification centered on the individual, cognitions are fundamental, either because they are on a par with behavior change, because they regulate the emotions that affect behaviors or because they are precursors of behavior change itself, it could be said that knowledge of the situation or knowledge related to the desired behavior fulfills various objectives at the cognitive level, such as the discussion and generation of awareness about the distorted knowledge or perceptions regarding the behavior, the identification of advantages and disadvantages of the behavior and the validity of the arguments against it, the emotional aspects that impact on the beliefs or attitudes and the possibility of concretizing the behavior and maintaining it.

Despite the importance of knowledge, the development of capacities or the acquisition of skills on behavioral modification in models centered on the individual, it is important to take up again what De la Cruz Tomé (2003) defined when he emphasizes that "the problem is that information alone does not guarantee behavioral change" (p. 208); for behavioral change, a prolonged period of time and constant accompaniment are necessary.

Integrative individual-environment models

Some authors approach behavioral change as a process where individual aspects related to beliefs, cognitions, emotions, among others, converge with aspects of the environment that positively or negatively affect behavior change. In this paper, these will be referred to as *integrative individual-environment models.*

According to Batlle (Batlle, n.d., p.2), among the models that have analyzed at some point the environment-behavior relationship are the following: interconductism, inter-conductual psychology, functional contextualism, neuroscience models that work on the brain-environment interrelationship, cognitive-behavioral models based on learning theories, information processing models.

According to Fuentes (2009), these models are based on understanding changes in behavior based on the interaction of the individual with his *social environment*, while Batlle (n.d.) associates them with behavior as a product of the "association of external

stimuli and internal cognitive processes" (p.5). Bandura (1980) manages to consolidate the postulates of this approach as "social learning theory", defining that behavior patterns can be acquired by one's own experience or by observing the behavior of others and including the cognitive process as fundamental for the acquisition and maintenance of behavior.

For Bandura (1980), the social learning theory identifies three regulatory systems of behavior, which in some respects are aligned with aspects defined by other theories:

Table 7. Regulatory systems of social learning

System	Description
First system	Antecedent stimulus that triggers the behavior, making it possible to predict to some extent the consequences of the behavior and getting the behavior into action. These antecedents that drive the behavior are various contextual factors.
Second system	Influence of behavioral feedback, defining that behavior is largely controlled by its consequences. Punished or poorly reinforced behavior is discarded, while behaviors that are reinforced are maintained and strengthened.
Third system	Cognitive control: influence that the individual's cognition has on the change of behavior; cognitive mechanisms can lead to different response options in response to the antecedents and consequences of the behavior.

Source: Own preparation based on *The Social Learning Theory of Aggression* (Bandura, 1980)

Based on these behavioral models, the role of training is broad and varied, from basic knowledge about the possible consequences of the desired behavior, which influences decisions to carry it out or not; the acquisition of response patterns associated with the desired behavior; the symbolic management of situations where behaviors must be put into practice; to the acquisition of behaviors by observing them in other people, and the consequences derived from their adoption.

It is important to mention that there are some aspects considered necessary to achieve behavioral change (Schwarzer and Gutiérrez-Doña, 2009, p.11), referring to perceived self-efficacy related to the belief that the person has about their own abilities to develop the action (behavior) or to maintain it, and strategic planning, focused on the

preparation of the individual to respond to the difficulties that may arise when applying the behavior, for example, how, where and when to adopt the behaviors (Schwarzer and Gutiérrez-Doña, 2009).

In this model, the knowledge one has about the behavior and the "training" to perform the behavior successfully will have an impact on the acquisition of the desired behaviors and their maintenance over time.

Contemporary models of behavioral change: behavioral design

Contemporary models of behavioral change have kept pace with technological development and neuroscience research. Because of this, they have made it possible to combine constructs from different areas to achieve the goal of large-scale behavior transformation in public policy; behavioral design is one of these models with evidence of positive results. Sánchez-Navarro (2018) considers behavioral design as "an emerging field that combines theories and methods to understand design as a tool to influence people's behavior" (Sánchez-Navarro, 2018, p.1), having as a premise that people's decisions are influenced by both rational factors and "impulses and emotions" (p.1) that are "linked to cognitive biases and mental shortcuts that affect the way we act" (Sánchez-Navarro, 2018, p.1). In this regard, Arellano and Barreto (2020) frame this type of models in what they call behavioral governance, which they consider a combination of "neurosciences, evolutionary psychology and behavioral economics" (Arellano Gault and Barreto Pérez, 2016, p.927), so it is understood that behavior change does not occur only from rationality, but that other less conscious factors intervene in people's decision making.

One of the postulates of the behavioral design perspective is that "the best way to modify behavior is to modify behavior" (García Arteagoitia, 2020). Thus, these initiatives focus on establishing guidelines that influence the adoption of behaviors so that, from the generation of habits, attitude change is achieved, contrary to what behavioral sciences generally propose to start with attitudinal or cognitive change interventions (2020). According to Olivera (2020), with behavioral design, "action-oriented results are sought... changing a given behavior rather than modifying a way of thinking" (p.1).

According to Eslava and Silva (2021), although behavioral sciences have been essential for the achievement of public policy objectives, approaches to behavioral change have had to be reoriented from classical behavioral paradigms - according to which behavior is modified "based on coercion and material incentive" - to implement contemporary approaches based on "nudge, boost, think, among others" (Instituto Mexicano de

Economía del Comportamiento [IMEC], n. d.; Hertwig and Gradwig (2020); Hertwig and Gradwig (2020)). f.; Hertwig and Grune-Yanoff, 2017; John et al., 2009; cited by Eslava and Silva, 2021). These new "behavioral design" tools are defined in the following table:

Table 8. Behavioral design tools

Tool	Concept
Nudge	It refers to "small nudges"; more specifically, to "interventions that modify the architecture of the decision seeking a change in behavior that is light, inexpensive and respects people's autonomy" (Eslava and Silva, 2021). Social norms largely regulate individual behavior, so the perception of "what others do" or "what others think we should do" influences behavior (Bicchieri, 2008; cited by Eslava and Silva, 2021). Cognitive processes are a source of people's error, since they inadequately guide individuals "who do not know", i.e., those who do not have the knowledge or have distorted knowledge (IMEC, 2020).
Boost	They are "light educational interventions that use the expansion of people's capabilities to enable them to make better decisions" (Eslava and Silva, 2021). Focused on the capabilities or lack thereof of individuals, they aim to provide knowledge and skills required by the individual, to achieve behavior change (IMEC, 2020).
Think	They are "spaces for deliberation and argumentation techniques for people to make collective decisions" (Eslava and Silva, 2021). It seeks "change in behavior through the conscious processes of the individual and places its efforts on people's reason and discussion" (Arellano and Barreto, 2020, p. 927)"; in this way, it builds 'strong institutional frameworks' where people collectively reflect and make decisions, thanks to the possibility of public and free dialogues with others.

Source: Author's preparation based on (Eslava and Silva, 2021; Bicchieri, 2008, cited by Eslava and Silva, 2021; IMEC, 2020; Arellano and Barreto, 2020).

Based on the above, due to the structural changes that the world is facing due to globalization, within the framework of the behavioral design model, it is necessary to reorient the efforts of the training and knowledge acquisition processes to develop in individuals the capacities and skills that allow them to "put their knowledge into action" and thus respond adequately to the demands of rapid adaptation of the environment (Calderón Jemio, 2000).

2.5 Role of training in the appropriation of culture in Research Ethics, Bioethics and Scientific Integrity

2.5.1 Overcoming biases and attitudinal changes through training

Based on José Ortega y Gasset's maxim, according to which "I am me and my circumstances, and if I do not save them, I do not save myself" (1914, p. 322), Tomás Moratalla (1997) proposes a change in attitudes that involves recognizing the context in which the agent finds himself and also recognizing the interdependent relationship

between the agent and his circumstances. There is no change in attitude that does not imply a change in the way one relates to one's surrounding world, and it is training that enables this transformation. Therefore, the role of training is associated with the following factors that help build the path that drives change:

Indignation: Every change of attitude and every awareness prior to a work of ethical transformation implies an affectation with respect to the surrounding world that moves the agent to change his situation. When I am indignant about the situation I live in, I move to improve it. If I do not start by becoming indignant, the world will be indifferent to me, and my biases and attitudes will remain intact.

Culture: Culture must be conceived not as the ready-made result of great products of knowledge and action, but as a process in which a type of configuration of social life is gradually being built. The agent is the protagonist of this gradual change, despite the fact that at first sight the results on a large scale are not so remarkable. It is in the constancy of continuous action that a type of culture is consolidated and, therefore, the change of attitude requires the perseverance of the agent.

Ethics: Ethics is not conceived as a set of rules to be followed, but as a conscious attitude towards the way we act and the consequences of our actions. It is also conceived as a projection that drives us to make our actions better and better.

Responsibility: It is the axis through which ethics acquires its real manifestation and has three basic elements:

Awareness: The agent perceives himself as the protagonist of his actions, as well as the one who assumes their consequences, to the extent that it is within his reach.

Autonomy: From the moment of awareness, the agent is not guided in his actions by external impositions or automatic responses, but by a sense of being the one who can take control of his actions.

Exemplary: Through his actions, the agent serves as a model in his community, while taking other models as a reference point for his own improvement.

Imagination: It is the element that allows us to transcend the current situation and its criteria to look for creative ways to act and to overcome the limits imposed by the biases that make us act unconsciously.

Regarding the possibility of modifying or transforming attitudes, Guerra de los Santos and Cantillo Galindo (2012) consider that a person changes his or her attitude when it is no longer useful to achieve his or her objectives, when it is no longer useful to adapt to the situation in which he or she finds him or herself, either because it is a new situation or because the socio-environmental circumstances have changed in a habitual one and he or she must display other conducts in order to remain in the desired environment. (Guerra de los Santos and Cantillo Galindo, 2012).

According to Escobar-Melo and Díaz Amado (2008), in social science research, "attitudes continue to be considered as the underlying conceptual framework that supports research, be it opinion, favorability or intentionality in relation to future actions or beliefs and values that accompany human actions" (Escobar-Melo and Díaz Amado, 2008).

Considering that attitudes are based on the way the environment appears to the agent, how the agent uses his own history to justify his relationship with the environment or how the same limitations of cognition distort the agent's attitudes, it is also important to go to the bottom of the attitude and find the cognitive bias that sustains it and where the roots of the behavior to be modified lie. From the behavior, which is what the analyst has available for observation, it is possible to identify patterns that constitute attitudes, and, from the attitudes, it is possible to identify the biases that justify those attitudes and make the agent think that he is behaving rationally and that he does not need to question his motives.

Table 9. Representation of the problem path in the appropriation of culture in the EIBIC.

Problem identification path		
Behavior	Attitude	Bias
(directly observable)	(disposition)	(Cognitive structure)

Source: Author's preparation.

Table 10. Representation of the path of transformation and appropriation of culture in EIBIC

Transformation path		
Identifying the wrong behavior (Indignation)	Taking responsibility (From the wrong agent to the agent of change)	Ethical and cultural changes (Identification of biases, attitudes, and creation of strategies for change)

Source: Author's preparation.

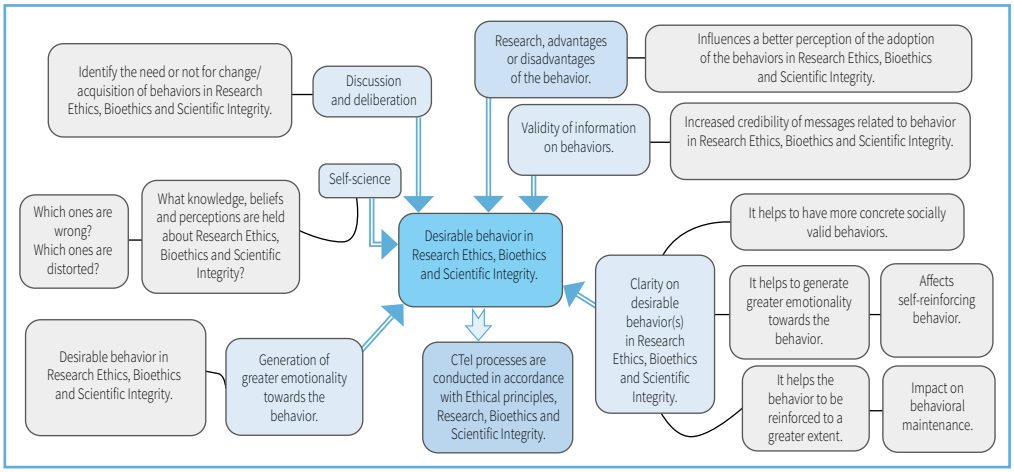
2.5.2 Role of training in changing behaviors

Previously, the interrelation between cognitive biases, attitudes and behaviors was identified, emphasizing that it is the behaviors that can evidence the appropriation of a culture in ethics, bioethics and integrity in the development of science, technology and innovation processes, and that, depending on the model of behavior change that is addressed, the impact of training in the generation, change and maintenance of behaviors and, therefore, the appropriation of culture will follow a different path, by impacting in different ways the constituent elements of each model.

This section will present three proposals of the role of training in the appropriation of culture in Research Ethics, Bioethics and Scientific Integrity, as it is identified as an inciting or mediating factor in the process of acquisition and transformation of behaviors, and by assuming that training as a process of knowledge acquisition, development of capabilities, training of skills, as well as an integral process of transformation of the individual at personal and social level. The role of training in the appropriation of culture will be proposed for each of the behavior change models addressed: individual-centered models, integrative environment-individual models, contemporary models: behavioral design.

The first proposal proposes the role of training in the individual-centered behavioral change models, as shown in the following figure:

Figure 4. Role of training for behavior change in Research Ethics, Bioethics and Scientific Integrity: individual-centered models.



Source: Prepared by Magda Liliana Rincón Meléndez (2021) for the Ministry of Science, Technology, and Innovation (contract No. 241-2021) and Fundación Tecnalia Colombia (No. 221-2022).

In the so-called individual-centered models, training plays several roles in behavior change, named in this exercise according to their function.

Discussion and deliberation role: They allow the individual to recognize through reflective and deliberative processes the need to change or assume behaviors related to Research Ethics, Bioethics and Scientific Integrity; a change in thinking is evident.

Self-awareness role: It guides the individual in a first phase to identify what knowledge, beliefs and perceptions are held regarding the behaviors related to Research Ethics, Bioethics and Scientific Integrity, in order to subsequently establish whether this knowledge is real, wrong or distorted, and make the corresponding adjustments, which leads him/her to become aware of the need or importance of the behavior.

Emotion generation role: It cooperates in the establishment of emotionality in the behaviors in Research Ethics, Bioethics and Scientific Integrity; in this way, it influences beliefs and attitudes towards the behavior.

Advantages and disadvantages identification role: It clarifies to the individual the advantages and disadvantages of assuming the behaviors related to Research Ethics,

Bioethics and Scientific Integrity, thus improving their perception and adoption by relating them to greater advantages.

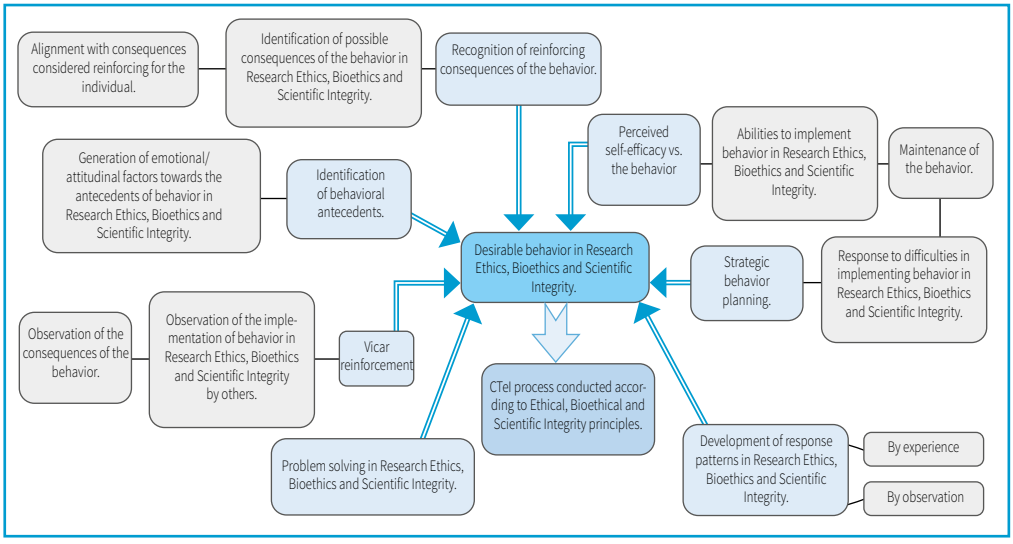
Information validity role: It helps the individual to recognize as valid in his or her particular context the messages that reach him or her about behaviors in Research Ethics, Bioethics and Scientific Integrity, thus influencing the decision to carry them out.

Clarity role over behavior: It gives clarity on desired behaviors, which allows:

- implementation of them in a concrete way in their context,
- to be considered valid by the social group,
- generate associated emotional processes that become "self-enforcing factors" of the behavior,
- promote further reinforcement of the behavior (internal and external) that helps to maintain it over time.

The second proposal on the role of training for the appropriation of a culture of research ethics, bioethics and integrity is approached from the models that in this document have been called integrative -individual-environment- and is graphically synthesized below:

Figure 5. Role of training for behavior change in Research Ethics, Bioethics and Scientific Integrity: integrative individual-environment models.



Source: Prepared by Magda Liliana Rincón Meléndez (2021) for the Ministry of Science, Technology, and Innovation (contract No. 241-2021) and Fundación Tecnalia Colombia (contract No. 221-2022).

According to integrative models of behavior change, the role of training includes seven fundamental functions.

Identification of behavioral antecedents: It generates positive emotional and attitudinal aspects that precede and drive the implementation of behaviors in Research Ethics, Bioethics and Scientific Integrity; it is related to the requirement, from integrative models, of having sufficiently strong antecedent factors to drive or trigger the behavior.

Role of recognition of reinforcing consequences: It allows both the identification of possible consequences for the execution or absence of behaviors related to Research Ethics, Bioethics and Scientific Integrity, as well as the personal recognition of those consequences perceived as more reinforcing for the individual.

Vicar reinforcement role: Specific type of training considered highly effective for the acquisition and maintenance of the behavior, which enables the learning of behaviors in Research Ethics, Bioethics and Scientific Integrity through the observation of "others" in their context that perform the same behaviors, while allowing to observe the positive or negative consequences for these "others" of the implementation of the behaviors.

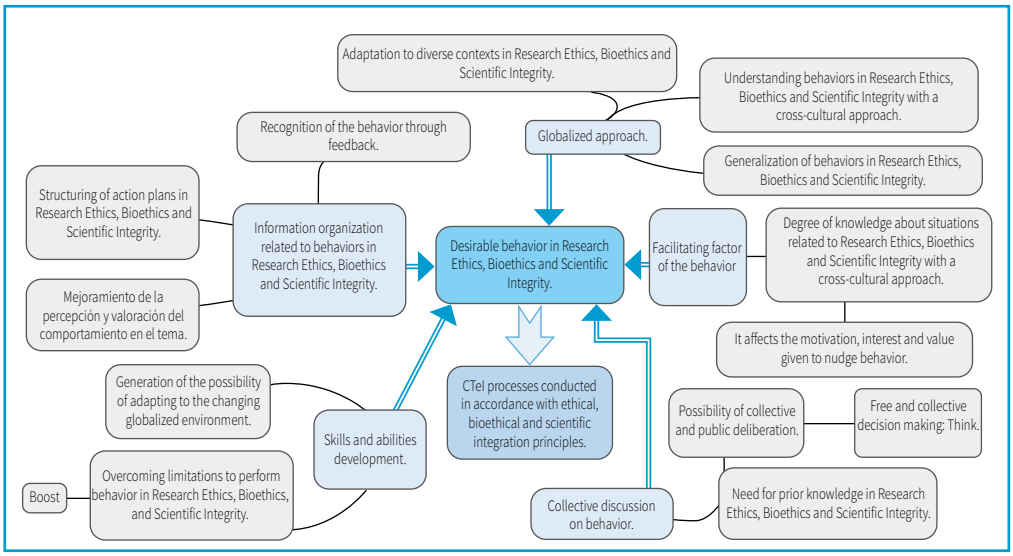
"Response Pattern Development Role": Develops concrete responses to situations that require behaviors in Research Ethics, Bioethics and Scientific Integrity, and guides the individual to make these responses flexible and adaptable to various situations.

Problem solving role: Increases the individual's capabilities and skills at a behavioral level to provide solutions to problems in Research Ethics, Bioethics and Scientific Integrity.

Perceived self-efficacy and strategic planning: They are related to the possibility of maintaining acquired or modified behaviors over time, that is, of their being constant. In the role of perceived self-efficacy, the training increases the individual's perception of his or her ability to perform the desired or required behaviors in Research Ethics, Bioethics and Scientific Integrity. While, in the strategic planning role, capabilities are developed to cope with the contextual difficulties evidenced when implementing behaviors in Research Ethics, Bioethics and Scientific Integrity, expecting the individual to project both the difficulties and the behavioral solutions.

The last approach proposes the role of training for the appropriation of a culture in Research Ethics, Bioethics and Scientific Integrity in contemporary models of behavior change.

Figure 6. Role of training for behavior change in Research Ethics, Bioethics and Scientific Integrity: contemporary models of behavioral change



Source: Prepared by Magda Liliana Rincón Meléndez (2021) for the Ministry of Science, Technology, and Innovation (contract No. 241-2021) and Fundación Tecnalia Colombia (contract No. 221-2022).

In contemporary models of behavioral change, five roles of training can be identified.

Facilitating role of the behavior: Associated with what contemporary theorists call *nudge*, according to which the degree of knowledge about Research Ethics, Bioethics and Scientific Integrity situations allows "nudging" the behavior to be established. The formative processes influence the motivation, interests, and value that the person gives to the behavior in Research Ethics, Bioethics and Scientific Integrity; this pushes the individual to acquire or change the behavior.

Skills and capabilities development role: Associated with boost, it considers that training should be used to increase the technical or more operational skills required by the individual to conduct the behavior. In this case, contemporary models start from a person's limitations in action skills.

Collective discussion role: Training is the basis for arriving at thinking, referred to collective decision-making regarding behaviors, in this case, in Research Ethics, Bioethics and Scientific Integrity, since, without the minimum knowledge on the subject, collective discussion is oriented towards making erroneous decisions or influences the impossibility of freely participating in decisions on behaviors.

Information organization role: Impacts on the development of individual and collective action schemes when faced with situations related to Research Ethics, Bioethics and Scientific Integrity. It also helps to improve the individual's perception and assessment of the behaviors on the subject and leads to their adoption and implementation. Finally, the formative processes become feedback mechanisms for the behavior, thanks to which they improve their implementation and obtain greater reinforcement for their execution.

Globalized approach role: The transcultural vision of the formative processes develops in the individual the ability to apply the behavior in Research Ethics, Bioethics and Scientific Integrity in diverse contexts, and skills for the generalization of behaviors and their adaptation to structural changes, as a result of current global changes.

From the above, it is evident that, regardless of the behavior change model addressed, training plays fundamental roles in the acquisition and transformation of behaviors that impact on the appropriation of a culture in Research Ethics, Bioethics and Scientific Integrity. Thus, they fulfill various functions in each model, both in the cognitive and emotional spheres required to drive the behavior and in the practical field aimed at the application of these behaviors for problem solving and in the mechanisms of reinforcement of these behaviors.

Conclusions

The model proposed is *cognitive biases-attitudes-behaviors*. It allows to stablish a methodological route where training can operate as a transforming factor of cognitive biases that impact attitudes and behaviors in Research Ethics, Bioethics and Scientific Integrity, and that are present in the development of science, technology, and innovation processes. Therefore, the role of formative actions is fundamental to achieve substantial changes at the cognitive level, which, through attitudes as a mediating link, are evidenced in behaviors; in this way, they allow to account for the appropriation of a culture in Research Ethics, Bioethics and Scientific Integrity.

Although the model proposed in this document establishes a defined path in the interaction between cognitive biases, attitudes, and behaviors, it is assumed that the interaction between these three constructs is varied and flexible, so it is relevant how the formative processes impact this interaction; this results in cultural appropriation in the subject.

It became evident, in the methodological route developed, the need for the groups of actors involved in the processes of science, technology and innovation to start with

the identification and acceptance of their own cognitive biases, both individual and of the group to which they belong, to guide in this way the formative actions to these processes of discussion, in pursuit of the search for transformations that really impact on the ethical, bioethical and integrity attitudes and behaviors of the processes of science, technology and innovation.

It is possible, from the conceptual development conducted, to conclude that training plays a basic and fundamental role in the appropriation of a culture of Research Ethics, Bioethics and Scientific Integrity in all areas of knowledge.

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