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The Absence of Critical Thinking Skills and its Effects. Case Study: Vaccine Hesitation

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Abstract: The aim of this article is to estimate the relevance of developing a public policy aimed at increasing the importance of critical thinking skills among pupils, students and citizens in general, using the problem of vaccination as a reference. I thus aim to contribute to the possibility of identifying solutions designed to increase the impact of educational activities for the creation of critical thinking skills. Because perhaps the most important cognitive problem in this context is the decision to vaccinate against SARS-CoV-2, I use the report on the vaccination problem as a context for assessing the effectiveness of critical thinking, trying to test the hypothesis of reducing vaccine hesitation by using critical thinking. The case study on vaccine hesitation considers the use of the attitude towards vaccination as a potential revealer of critical thinking skills, contributing for the identification of both problems and solutions to remedy them. Critical reflection on critical thinking implies the possibility of being aware of its specific limits. I approach some of the problems of defining critical thinking by suggesting in this way some risks aimed at its use for ideological purposes. I indicate the specific limits of the deficit model, thus contributing to the shaking of common places in the field of causal explanation for vaccine hesitation. I systematize the cognitive errors according to some specific causes and types of solving the existing problems in the specialized literature, thus generating a relevant frame of reference for the debates regarding the public policies in the area.

Keywords: *Critical thinking; education; vaccine hesitation; thinking role; limited thinking.*

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1. Introduction

When we think about vaccine hesitation, we tend to keep in mind the image of people who think about the vaccine and, based on the acquired knowledge, make a decision, the behavior that follows it placing them in one or another of the two general categories that tries to summarize the attitude of people towards vaccination. I will "put in parentheses" (in the phenomenological sense of the word) the fact that this division into two categories is, in many cases, the result of a hasty generalization, crowding citizens into concepts that describe, to a small extent, their thinking, decision and behavior. I will also avoid the problem of the variable degree of thinking involved, in its strongest sense, in the attitude towards the vaccine. Instead, I will focus on the relationship between thinking and decision-making, exploring some aspects of the hypothesis of inadequate thought positioning in people with vaccine hesitation and its corollary that presupposes the possibility of reducing vaccine hesitation through critical thinking.

To the question "What does it mean to think?" one possible answer is "think critically"; meaning, to use critical thinking as a guide for thinking. To avoid a circular definition, we can note that critical thinking could mean knowing how to use information in order to reach reasonable and justified conclusions or thinking rationally (Mulnix, 2012). To the extent that critical thinking provides relevant cognitive support, it must do so in relation to ordinary contexts and, even more so, in relation to extraordinary contexts. In terms of ordinary contexts, everyday thinking seems to be largely focused (in the Western space) on the human economic outlook, indicated by the fact that employers expect employees have critical thinking skills (Bandyopadhyay & Szostek, 2019; Nakatani & Wynekoop, 2020). I won`t discuss here the justification of these expectations or the many necessary additions, considering relevant for the proposed topic the fact that the hazard offered us an extraordinary context: the COVID-19 pandemic. This context forces citizens to use cognitive resources to make appropriate decisions, with personal, loved ones and other members of the community "skin" in the game. As probably the most important cognitive issue in this context is the decision to vaccinate against SARS-CoV-2, I believe that reporting to the problem of vaccination provides a context for assessing the effectiveness of critical thinking, or testing the hypothesis of reducing vaccine hesitation by using critical thinking. I pay attention to the relevance of critical thinking skills in general, using vaccine hesitation as a case study.

I point out that the use of critical thinking skills as a solution to reduce vaccine hesitation is not new, being already suggested by some

studies or in broader proposals to increase the rationality of citizens on various topics (Halpern et al., 2019) or aimed at reducing vaccine hesitation, along with other solutions (Arede et al., 2019).

Although there are several approaches about this problem in the literature, one might object that the issue of vaccine hesitation isn`t relevant to critical thinking. Why would philosophy address the problem of vaccine hesitation? Because this problem is in the realm of individual thinking, critical thinking being the discipline that seems best suited to intervene in solving problems considered to be caused by inappropriate cognitive/decision-making positions. In this regard, I consider that two useful directions of intervention are possible:

a) **Problem identification.** The discussion about the possible causes of the vaccination hesitation in Romania has chances to represent a form of highlighting some of the problems that critical thinking encounters in this mental space.

b) **Suggesting solutions**. To the extent that vaccine hesitation is related to the area of thinking, many of the solutions indicated to solve this problem may also belong to the category of interventions specific to critical thinking.

A second objection that can be raised is the relevance of critical thinking for interventions meant to reduce vaccine hesitation in Romanian society. Is critical thinking consistent with the characteristics of the Romanian mental space? The diversity of attitudes and interventions on vaccination tends to highlight either some mental traits that could play the role of specific boundaries or the effectiveness of some interventions, which would indicate areas where critical thinking skills can lead to expected changes. To the extent that vaccination is relevant to the critical thinking situation, resistance to specific critical thinking interventions can be identified in the area of limits against vaccination. Using the attitude towards vaccination as a potential revealer of critical thinking skills could help to identify both the problems and the solutions to remedy them.

Another category of objections is those raised generally to the effectiveness of critical thinking. Michael Huemer's argument for assessing the epistemic responsibility of using critical thinking in the formation of beliefs could be a sufficient example, showing that strategies that aren`t based on critical thinking (accepting conclusions and expert authority or giving up answers) are usually more effective in gaining true beliefs and avoiding false ones (Huemer, 2005). The context created by the COVID-19 pandemic tends to suggest the relevance of one of David Kary's counter-arguments: Huemer's argument doesn`t take into consideration the social

dimension of epistemic responsibility (Kary, 2013). It`s obvious that giving up finding answers (the third way that Huemer analyzed) has social consequences if we look at the problem of vaccination. Equally relevant is the possibility of interpreting Huemer's argument as a recommendation not to uncritically adopt critical thinking (Barua, 2021), trying to identify both the potential impact of interventions based on increasing critical thinking skills and their limitations; which is the main purpose of this article.

I conclude the arguments in favor of the relevance of critical thinking skills. Presented in the introduction, with a reminder of some of the current issues, which also announce future ones. Increasing the level of access to information, information processing tools and diversification of communication skills generate a form of (pseudo) democratization of knowledge, which is based on the confusion between the possibility of knowledge (generated by the feeling of easy access to relevant information) and possession of knowledge. From the fact that the information is only a few clicks away, some people deduce that they possess knowledge. The situation partly suggests the problems that the emergence of strong artificial intelligence or the increase in the magnitude of its weak variant can cause.

2. Methodological clarifications

The objective of this article is to estimate the relevance of developing a public policy aimed at increasing the importance of critical thinking skills among pupils, students and citizens in general. To increase the adequacy of the assessment to reality, I analyze the potential impact of critical thinking skills on vaccine hesitation, thus using the context provided by the COVID-19 pandemic. The competencies targeted are structuring the education area in the field of critical thinking for the defense against pseudoscience and the understanding of vaccination.

The case analysis on vaccine hesitation refers to data from a study on this topic (Rotilă, 2022), this being an approach based on the analysis of the literature on vaccine hesitation to identify possible causes and use them to assess the situation in Romania. From the whole problem of vaccine hesitation, we have learned from this study the aspects that are suitable for evaluating the efficiency of the use of critical thinking tools.

There is an implicit aspect of the analysis carried out in this article: the explanatory hypothesis of vaccine hesitation includes the deficit of critical thinking. From the fact that I frequently advocate for amplifying the efforts to build tools that support critical thinking (an example: Rotilă et al., 2021), there can be deduced the weight of this causal hypothesis in my explanatory attempts. However, I use a cautious approach to the problem,

highlighting the limits of this explanation. It should be noted that the main topic of this article isn`t the vaccination hesitation, but what this phenomenon could tell us about critical thinking. Using the problem of vaccine hesitation as a case study, I try to briefly identify the current situation of critical thinking in the Romanian mind.

3. The definition of critical thinking

For greater clarity, an approach to what we mean by critical thinking is needed. In this regard, I will further indicate some issues of defining critical thinking, relevant to the objectives of this article, opening the presentation with two examples. The purpose is anti-reductionist, based on highlighting the relevant complexity.

Critical thinking marketing includes presenting it as a technique that guarantees individual success in competing with others. It`s a position that suggests taking advantage of one's "inappropriate thinking"; a process where success is largely achieved at the expense of others. This is a definition made in the halo of elitism, the context of the pandemic revealing its inadequacy.

Also, the social interest in solving problems by developing the critical thinking of each person may not be so wide or may register areas of discontinuity. Debates on agnotology, which involve the cultural production of ignorance (Proctor & Schiebinger, 2008) addresses this problem.

These examples draw our attention to the existence of aspects that bring into question the existence of several perspectives in defining critical thinking and suggesting that the definition is dependent on a specific horizon of definition. I will show below some relevant contexts for defining critical thinking along with some of their limitations.

Table 1. Relevant contexts for defining critical thinking

Defining context	Possible meanings	Hazards/risks
Others (community members) / others	To think: - the same with others	Groupishness (Haidt, 2012)
	- better than others	Interpreting the failures of others or risk as personal success. Attitudes such as "purpose excuses means" affect learning from experience.
And another entry	Reaching a maximum human level.	Ideological and affective influences in model selection. Situation far from reality.
All the humanity	The quality of thinking	A reductionist perspective

	realizes the quality of life.	that doesn`t take into consideration the emotional dimension, the importance of chance and the effect of personal choices (e.g.: religion).
The environmental	To think in order to survive. Ecological rationality	It brings up the problem of competition and, thus, the way others think. Difficulties in reconciling pragmatism with social interests.
Standards	To think in a certain way	The risk of arbitrary choices of the model or on a democratic basis (given that knowledge cannot be decided on a democratic basis). Standards can be the result of "social choices" whose rationality is questionable.
	Think to achieve certain goals/reach predetermined results.	Interested definitions, generated from ideological perspectives or other types of orientations.

Source: Authors' own conception

I will try to suggest some additional overtone in relation to the most common evidence of thinking: behavior.

3.1. The behavior

Critical thinking seems to be relevant for the relation to the decisions that underlie our behaviors, its specific interventions making possible to increase the adequacy of decisions and behaviors to the context and expectations.

From a behavioral perspective, critical thinking involves the following assumptions:

• *The ideal*: the existence of appropriate behaviors, based on rational decisions.

• *Personal choice*: our individual behaviors are decided by each of us, every time.

• *Consistency with values*: Our behaviors are appropriate to the axiological system to which we adhere.

• *Rationality*: our axiological systems are constituted on a purely rational basis.

Deviations from these conditions tend to be labeled as inappropriate behaviors, one of the causal explanations being that of a form of inadequate thinking, most often highlighted as the absence of its critical positioning. Obviously, the recommended standard solution is *critical thinking*, most often approached in the form of increasing specific skills.

Reflection on the above assumptions reveals that they aren`t confirmed in all cases and every time. This implies a limitation of the intervention's effectiveness specific to critical thinking, including the reduction of vaccine hesitation, thought of as a deviation from the expected behavior.

3.2. The values

Viewed as a set of rules that should govern thinking, communication, and cognitive behavior, critical thinking has a significant social importance in regulating these categories of relationships. Even if they don`t seem to have an independent existence, being included in other areas of reality, these rules make possible all the normative areas. Any normative system works on the basis of the rational access presumption to its justifications and conclusions at least from a majority, i.e.: on the assumption of an identifiable way of thinking. However, the interventions specific to critical thinking somehow reinforce this presumption, seeming to mediate the access to the "place of ideal (rational) meetings". In this context, all restrictions on individual freedoms (whether determined by general social interests or by favoring certain parties/parties came to power) come to be considered as part of the obligatory places of rationality. At this point, we can see an area of risk that involves the transformation of critical thinking into an ideological tool/justification of power decisions.

Another problem is the dispute on the source of values: in relation to the individual, is adherence to one or the other of the values rational or emotional? Even if the question is an inadequate simplification of reality, and other explanations are possible, it`s sufficient to highlight the fact that critical thinking brings with it the need to understand the limits of the rationality`s intervention. Critical reflection on critical thinking implies the possibility of being aware of its specific limits.

4. The adequacy of critical thinking

An attempt to avoid some of the problems mentioned in the previous sections is the use of the appropriate form of thinking, somehow leaving in suspense the reference of adequacy. Although this formula has the advantage of avoiding a rigid reference, it has its own limitations, which can be highlighted by a few examples.

4.1. Adaptation to context

Contextual appropriateness can take many forms, for the sake of reasoning, keeping in mind the appropriateness of the environment, groups and communities. The separation of the three levels has a degree of artificiality because the environment can be understood simultaneously in both its natural and social dimensions. In a simplified form, adaptation to the environment can be thought through ecological rationality (Gigerenzer et al., 1999). Ecological rationality involves legitimizing the use of simple and fast heuristics, while assuming limited rationality (Herbert, 1955), i.e.: the limits of reason. In this horizon, critical thinking also means assuming the specific limits of thinking, thus moving away from the burden of the unlimited rationality ideal and moving more towards the option of optimizing thinking.

4.2. Adequacy of expectations

Social expectations may sometimes differ from decisions called by the need to adapt to the environment. When such differences arise, the ideal of unlimited rationality conflicts with the ones of ecological rationality. The influence of values on social expectations brings into question the rationality of social selection of values.

In this section we have suggested some arguments for a prudent approach to critical thinking, indicating some of the risks involved in missing its contextual understanding. I will continue to explore some of the problems involved in resorting to unlimited rationality in explaining vaccine hesitation.

5. The deficit model

Assessing the possibility of using critical thinking as a useful tool for interventions to reduce vaccine hesitation involves using the deficit model as an explanation for what is happening in Romania (and other countries) regarding vaccination. Synthetically, the deficit model explains the vaccination hesitation through a deficit of knowledge (general and/ or

scientific) from the part of the population, i.e.: deficiencies aimed at rationality. Its basic assumption is that people who don`t get vaccinated make this decision because they don`t understand the effectiveness of vaccination due to poor cognitive reporting. Although I agree with Goldenberg (2021) that, as the only explanation, the deficit model is an inadequate assessment of the current situation, I limit myself to its total rejection in the case of Romania, maintaining that the working hypothesis the possibility of partial relevance. In other words, I consider that, in terms of the vaccine hesitation share in Romania, the deficit model is one of the relevant causal explanations. Which in fact means that the relevance or irrelevance of the *deficit model* is dependent on the analyzed cultural context.

Apparently paradoxically, one of the existing arguments in support of this option is the approach that is a critique of the deficit model, respectively contextual approach (Miller, 2001). I believe that this indicates the need for a dialogue between scientists and the population, which must include both an adaptation of the communication carried out by scientists to social reality (adaptation to the specific context of the mentality of the citizens of this country) as well as an increase in the critical thinking skills of the population. I specify that the assessment of the deficit model`s partial relevance doesn`t focus on its essential part, namely the deficit of scientific knowledge, but on a reinterpretation of it from the perspective of critical thinking deficit, which can have the effect of missing appropriate decisions. Consequently, I believe that the limitations of the cognitive deficit model don`t negate the relevance of critical thinking in combating vaccine hesitation, but tend to provide better guidance in using this tool to increase the level of general rationality.

6. Can critical thinking education change the share of vaccine hesitation?

Intuition (understood as *educated guess*; the only resource in the absence of evidence) suggests that yes, but only to a certain extent. It`s supported by the heads of evidence suggested in the previous sections. An impact level can be estimated broadly based on the identification of variables that are likely to be influenced by the increase in critical thinking skills, risk analysis and decision-making in uncertainty being some of the examples. As we have shown elsewhere (Rotilă, 2021), the interventions in the COVID-19 pandemic are taking place against a background of a high level of uncertainty. Critical thinking can facilitate the cognitive accessibility of problems, especially useful in the context of a high level of objective uncertainty. Obviously, I am describing an ideal reference here, in fact it

being important to establish some directions of action that could generate a level of change.

Realizing that the burden of proof belongs to the one proposing an action, I try to complete the "evidence" by indicating in its support the common belief of the impact of education on changing citizens' attitudes (causal explanation based on education). Although, overall, we can see the effects of the education impact, we can also see that it doesn`t act uniformly and every time, the multitude of educated people (sometimes even nations) whose behaviors deviate from the ideals of rationality indicating a relevant limit.

Methodologically, the verification of hypothesis seems to benefit from the advantage of the context (which actually contributed to its birth): the existence of a significant difference between the share of Romanian citizens affected by vaccination hesitation and that specific to Western states. I am sure that the difference isn`t only generated by the level of critical thinking skills. Strictly speaking, we didn`t identify certain data, results from studies, which clearly indicate the existence of differences in critical thinking, but only indications of its possibility. The results of the Pissa Test (OECD, 2019) and the data provided by the Eurobarometer (European Union, 2021) can be kept as evidence.

The limitations of the deficit model and the multitude of additional variants (Rotilă, 2022), with different explanatory probabilities, leave room for the possibility that in some cases the vaccination hesitation is determined by "too much critical thinking", which leads to the suspension of the simple and fast heuristics use. Like mistrust in experts, inadequate expectations based on critical thinking force individuals to analyze problems with too high level of specialization to support solutions to profane thinking, given that the volume and complexity of information exceeds the possibilities of an average level of critical thinking proficiency. It`s worth noting the special nature of the problem posed by the solution (vaccination) and the context in which it arises (pandemic), they generate certain limits of average critical thinking skills, respectively the need to change their reference level due to increasing environmental complexity. To the extent that interventions to reduce the share of people who hesitate or refuse to be vaccinated (PERV) must take into account models other than those based on the deficit generated by too little critical thinking, we can see an objective limit to the interventions effectiveness to increase critical thinking skills.

Assuming that the indication of potential limits has generated a reasonable level of caution, I continue to try to identify some possible interventions based on increasing critical thinking skills. Simplifying, I will

focus the approach on the area of cognitive errors, trying a short causal identification followed by the selection of possible remedial strategies.

6.1. The importance of the community specificity

To what extent can we talk about the existence of specific limits, generated for example by mentality, which could reduce the impact of education for critical thinking? Is critical thinking consistent with the specific mentalities of each community? I will try two illustrations of specific mentalities in an attempt to argue the need for a contextual approach.

Many of the critical thinking topics are related to the behavioral economics discoveries, being based on research. After almost half a century of scientific socialism, it would be expected that the Romanian society would already be familiar with the scientific approaches of the social. However, because scientific socialism was rather a formula meant to cover the axiological system specific to communist-type ideology, the sensitivity of Romanian society for the data provided by research tends to be low. Mental formations produced by ideology and continued (sometimes even amplified) in new directions by a form of rebirth of religion have generated little space for data provided by science.

We are still dominated by the model of the ideal man, proposed on the horizon of different niche ideologies or practices. Our specialists in the problem of educating the mind haven`t yet come out of the logic`s domination, there being a relatively low grip on scientific knowledge in the area.

7. Cognitive errors and their correction

A relevant direction to address the problem of errors is to identify their source. Following the suggestion made by Elton (2000) regarding the existence of a sub-personal domain, considers that cognitive biases intervene at this level, proposing an explanatory scheme of errors, based on the following explanatory levels (Cassam, 2017):

a. *Personal level* - is a generator of epistemic vices. Represents the category of errors for which we are fully responsible.

b. *The sub-personal level* - the level where unconscious operations are performed determined by evolutionarily formatted cognitive mechanisms, they generating cognitive biases. In a general formulation, cognitive biases can be understood as adaptive cognitive strategies that environmental changes turn into inadequacies.

c. *The situational level* - includes the following relevant variables: time, pressure, distraction, workload or fatigue.

d. *The systemic level* - contains the errors determined by the organization of the system: lack of resources, poor training, professional culture.

If we refer to this classification, we can consider that the interventions specific to critical thinking have a high degree of relevance at the personal level and medium to low for the rest of the levels. It can be considered a useful general framework for analyzing the limits of our rationality and for developing relevant critical thinking strategies.

The use of vaccine hesitation as a case study to estimate the effectiveness of the critical thinking use brings with it the need to relate specific public policy interventions to limited rationality. Katsikopoulos (2014) indicates the existence of two different approaches for solving the problem of limited rationality: the idealistic version, which considers that people behave irrationally systematically, and the pragmatic culture, focused on corrective solutions to this lack of rationality. The analysis of the two variants can take the form of comparisons between boost interventions and stimulation/impulse approaches (nudgets). In this respect, I consider relevant the analysis framework opened by Ralph Hertwig and Till Grüne-Yanoff (Grüne-Yanoff & Hertwig, 2016) on this topic, later summarized (Hertwig & Grüne-Yanoff, 2017) in a tabular form (Table no. 1), meant to show the differences between boost and nudget strategies. For clarity, I propose a few personal additions to that table, intended to highlight the places where the increase in critical thinking skills becomes relevant.

Table 2. Additions to the table proposed by Ralph Hertwig and Till Grüne-Yanoff (2017)

Intervention	Idealistic version: the boosts	Pragmatic variant: stimulation/impulses (nudgets)
The level of intervention	The behavior	Competences
Authors and reference concepts	*Daniel Kahneman (2011) - the two systems / fast thinking-slow thinking.*	*Gerd Gigerenzer (Gigerenzer et al, 1999) - Simple and fast ecological rationality/ heuristic.*
Timely reporting	*They can be used in a short time.*	*They involve long periods of prior intervention.*
Category of targeted interventions	*Marketing/awareness campaigns (manipulation)*	*Education (especially for heuristic decisions)*

Source: Authors' own conception

The table proposed by Hertwig & Grüne-Yanoff (2017) improved with these proposals is a good start for identifying the analysis framework; it`s necessary but insufficient to explain the differences indicated by the level of vaccination. We hold it in mind, completing it with an analysis of possible explanatory hypotheses.

Behavioral economics demonstrates the existence of a behavioral inadequacies set related to rational consumer theory, bringing into question the need for approaches based on limited rationality. The analysis must focus on two different categories of problems: the causal explanation and the establishment of appropriate intervention solutions. A contribution to the clarification of the situation could be made by the summary presentation in the table below:

Table 3. A summary of the causes and solutions

Explanatory models (causal explanation)	The main authors	Intervention solutions	Authors who support intervention solutions	Effectiveness of critical thinking interventions
The two systems	D. Kahneman	Boosts strategies	(Grüne-Yanoff & Hertwig, 2016)	Low
Ecological rationality (together with simple and fast heuristics in the context of limited rationality)	Gigerenzer, G., Todd, P. M., & The ABC Research Group	Nudgets strategies	Katsikopoulos, (2011). Richard Thaler & Cass Sunstein (2009)	High
The two different realms of the real - mid-Christian and extremist	Nassim Taleb (2007)	Ergodicity and strategy of dumbbells	Nassim Taleb (2012)	High
Epistemic vices	Cassam, Q. (2021); Meyer, M., Alfano, M., & De Bruin,	Intervention solutions against epistemic vices.	Self-Improvement Cassam, Q. (2019).	High

	B. (2021b)	Inoculation Interventions based on logical education, statistics, orientation (part of education) towards pragmatic aspects	Katsikopoulos, (2014).	Theoretically maximum. But depending on the limits of the deficit model.
The deficit model				

Source: Authors' own conception

8. Some features

8.1. Intervention boost-type

Because boost interventions are presented as different from those specific to schooling, they are aimed at "domains that are not typically addressed in school curricula, such as good financial decision making, accurate risk assessment, healthy food choices, informed medical decisions, and effective self-regulation" (Hertwig & Grüne-Yanoff, 2017), their approach can be done either by modifying the school curriculum or by resorting to other training solutions. Even if the indicated areas belong to the area of interest specific to critical thinking, boost interventions aren`t in the same situation, they being very sensitive to uses in the interest of marketing or manipulation. I could even say that there is a need to develop specific cognitive tools that will prepare citizens to critically analyze *boost* interventions. Viewed from the perspective of respect for the individual's freedom of decision, they are part of the category of paternalistic interventions, raising the issue of limits of interventions based on critical thinking. Although I tend to believe that a level of paternalism is needed in actions on vaccine hesitation, I don`t share attempts to show that paternalism doesn`t affect individual freedom (Sunstein & Thaler, 2003). Rather, I believe that the freedom of the individual is limited by social interests, these limits having a dynamic of their own, dictated by the need to adapt to new environments.

8.2 Epistemic vices

The creation of an Epistemic Vice Scale (EVS) (Meyer et al., 2021a) and its use in the context of the COVID-19 pandemic indicated an increased

sensitivity to misinformation in people with a high EVS score. A first assessment made by us (Rotilă et all., 2021), using the Epistemic Defects Test (TVE) in a dedicated platform (COGNITEST.RO) regarding vaccination, has so far not shown a correlation between vaccine status and TVE result, it being only noticed in the case of the Conspiracy Theories Sensitivity Test (TSTC).

9. Conclusions

I believe that critical thinking education can change the share of vaccine hesitation to some extent, its ideal impact varying depending on the specific mentalities of different communities. But this belief is based only on an *educated guess*. Against it can be invoked the absence of experimental evidence meant to support it, and in its favor the lack of evidence to deny it. An essential aspect must also be kept in mind: the special nature of the problem posed by the solution (vaccination) and the context in which it arises (pandemic), generates certain limits of average critical thinking skills, respectively the need to change their reference level due to environmental complexity. As the increasing complexity of the environment has led to an increase in people's cognitive burden, this must also be reflected in the necessary critical thinking skills.

Reporting to the classification based on the levels of intervention of cognitive errors proposed by Cassam (2017) allowed me a first identification of the intervention's relevance specific to critical thinking: high degree at the *personal level* and medium to low for the rest of the levels. It provides one of the general guidelines for developing critical thinking strategies.

The draft of the critical thinking maximum reference, seen from the perspective of the expected behaviors, revealed some possible areas of inadequacy. The finding is consistent with the theory of limited thinking, developed in behavioral economics, which is a mandatory reference framework for public policies aimed at actions based on increasing the level of critical thinking skills. The shaping of appropriate interventions starts from the admission of the limits of rationality, the renunciation of unlimited rationality offering a relevant direction of analysis.

Critical reflection on critical thinking implies the possibility of being aware of its specific limits. Even if they share the belief that the use of the deficit model as the sole explanation for vaccine hesitation is wrong, its non-discriminatory denial is in a similar situation. I believe that the (partial) relevance or irrelevance of the deficit model is dependent on the cultural context analyzed, the contextual approach leaving room for the analysis of the relevance of interventions based on increasing critical thinking skills. I

believe that the limitations of the cognitive deficit model don`t negate the relevance of critical thinking in combating vaccine hesitation, but tend to provide better guidance in using this tool to increase the level of general rationality.

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