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What Is An Ideal Critical Thinker Expected to Conclude about Anthropogenic Global Warming?

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Article abstract

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What Is an Ideal Critical Thinker Expected to Conclude About Anthropogenic Global Warming?

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Abstract: *Critical thinking involves the ability to properly assess statements and actions, and it also requires a permanent disposition to appropriately use cognitive skills in the evaluation of any claim. In the present paper, we discuss the characteristics of an ideal critical thinker, and apply them to a contemporary problem, namely anthropogenic global warming (AGW, a hypothesis that accounts for the increase of the average temperature of Earth as a consequence of human activities), in order to discuss what an ideal critical thinker is expected to conclude about the occurrence of this phenomenon. We assume that an ideal critical thinker is able to find out where the most reliable information regarding a certain issue is, is competent to reasonably evaluate it, and has an inclination to calibrate her beliefs according to the results of the inquiry. We thus conclude that an ideal critical thinker is expected to accept the current scientific consensus that AGW is occurring, albeit considering this issue, as well as virtually any other idea, open to revision. The fact that in many occasions people are selective in using critical thinking skills, such as when they reject the massive evidence of AGW, should be a cause of concern for educators, who should motivate their students to think critically about any problem and question they encounter; this, in turn, could help the students to develop a better understanding of the world, take more reasonable courses of action, and be protected against misinformation.*

Introduction

One of the authors of this paper was recently browsing through the books on critical thinking in an online store. While reading the users' reviews of a certain book, one comment grabbed his attention: A reviewer gave one out of five stars to the publication and explained that it was not because of the content of the material, but for personal reasons. The reader said he knew the author in question, a person who refused to accept the idea that human activities are contributing to global warming, and who also had doubts about biological evolution. So, the reader continued, he would think twice before buying a book on critical thinking written by a person who held these ideas, making it implicit that this is not the kind of person we may call a critical thinker.

We do not know if the reviewer was in fact an acquaintance of the author of the referred book—and

that does not matter for our purpose here—but his commentary raises an interesting question, which we address in the present paper: How should an ideal critical thinker approach a complex factual issue such as the occurrence of anthropogenic global warming (AGW, the increase of the average temperature of Earth influenced by human activities)?

The present paper aims to shed light on the question above. In the first section, we discuss what critical thinking is and what characteristics an ideal critical thinker is regarded to have. In the second part, we address AGW, an issue that has caused some public controversy in the last decade. We present a general view of the evidence of global warming and of the influence of human activities, and then discuss how an ideal critical thinker is expected to form her point of view about it. In the last part of the paper, we present our final considerations and discuss some educational implications of our views.

On Critical Thinking

"We humans have a talent to deceive ourselves" writes Sagan (1996, p. 71), summarizing the opinions of many social and cognitive psychologists (e.g., Chabris & Simons, 2010; Kahneman, 2013; Nisbett, 2015), neuroscientists (e.g., Buonomano, 2011; Levitin, 2014; Macknik, Martinez-Conde, & Blakeslee, 2010), and philosophers (e.g., Dennett, 2013; Law, 2011) about the fragility of our thinking and decision-making processes. The beliefs and ideas people hold about certain things may be influenced by some cognitive biases, such as confirmation bias, which happens when someone actively searches for information that is in accordance with her previous beliefs and discards contradictory evidence. Social influences are also very strong in shaping people's beliefs, not only in the ideas a certain individual has about how the world works, but also in her ethical views. Another problem with our decision-making system comes from human memory, which is not a perfect recording machine, as it is often regarded, but a potentially faulty device that reconstructs experiences. Our decision-making process also struggles against what Kahneman (2013) calls "System 1" mode of thinking: a fast, intuitive, emotional, and rather inflexible way to settle ideas about other people and the world.

To say that the aforementioned cognitive and social aspects naturally influence our thinking process is not to say that they definitely shape what, and how, we think. Our ideas and beliefs are not only consequences of a kind of psychological "default system," but rather the result of an intricate interaction between these forces and our capacity to reason (Bloom, 2013; Greene, 2013). It is possible to deliberate, to reason more carefully about things, to recognize and avoid biases, and to select courses of action according to the best evidence and arguments available. It is possible, in other words, to think critically about virtually any issue, including about how we think.

There are different definitions of critical thinking, and they have been proposed by scholars from distinct fields of inquiry such as psychology, philosophy, and education. Vaughn and MacDonald (2010, p. 3) argue that critical thinking is "the systematic evaluation or formulation of beliefs, or statements, by rational standards." Paul and Elder (2002, p.7) characterize critical thinking as "the disciplined art of ensuring that you use the best thinking you are capable of in any set of circumstances." Ennis (1993, p. 180) writes that critical thinking is "reasonable reflective thinking focused on deciding what to believe or do," a definition that is also embraced by Hunter (2014, p. 3). In turn, Bassham, Irwin, Nardone, and Wallace (2010) understand critical thinking in the following terms:

> a wide range of cognitive skills and intellectual dispositions needed to effectively identify, analyze, and evaluate arguments and truth claims; to discover and overcome personal preconceptions and biases; to formulate and present convincing reasons in support of conclusions; and to make reasonable, intelligent decisions about what to believe and what to do. (Bassham et al., 2010, p. 1)

The definitions presented above indicate that critical thinking is a kind of careful and disciplined thinking which is used by someone in order to decide what to reasonably believe—or do—about a certain issue. Two elements pervade most definitions of critical thinking, and they are identified by Siegel (1988; 1997): a critical thinker is someone who (a) possesses cognitive skills to properly assess statements and actions ("the reason assessment component" of critical thinking), and (b) is constantly inclined to incorporate the "critical spirit," a permanent disposition to evaluate arguments and to believe and act according to the best reasons and evidence available.

The reason assessment component of critical thinking involves cognitive abilities that are relevant for the evaluation of reasons, claims and arguments (Siegel, 1997). A critical thinker must have the skills to assess how a certain argument is justified, that is, what its warrants are, and if there is strong support for the presented conclusion. Siegel understands that an ideal critical thinker is not worried about truth in first place, but rather about the quality of reasons and evidence that warrant certain statements and actions. Nonetheless, a rational justification for a given claim is an indicator, albeit fallible, of its truth. A critical thinker, in ideal terms, regards ideas that are better justified as more reliable and closer to the truth than other claims that lack the same epistemic status, and this is the reason why she must be concerned about evaluating reasons and evidence fairly and competently.

Lipman (1988; 2003) adds an important element for the reason assessment component of critical thinking: its sensitivity to context. Among other things, being sensible to the context means understanding that a type of reason or evidence that may be considered a good justification in a given situation might be not in others. Personal experience, for example, may be a good source of evidence when someone is dealing with friends and acquaintances. Questions such as "Should I allow my neighbor to drive my car?" or "Should I lend a great amount of money to my brother?" are reasonably well answered based on past experiences we have had with these people. However, personal experience may provide unreliable evidence in a wide range of situations. Alternative health treatments indicated by people without medical training constitute a good example of this: Someone who supposedly benefited from a certain procedure may influence other people to undergo it when they are feeling similar symptoms. In many cases, these practices may do more harm than good by keeping people away from regular medical treatments and by offering products or procedures that do not help to improve the conditions of the patient at all (Singh & Ernst, 2009).

The second component of critical thinking presented by Siegel (1988; 1997) is the critical spirit. The critical spirit is the behavioral aspect of critical thinking, that is, it is a disposition, an inclination, to use the skills to evaluate any statements and actions that are presented to the thinker, and her own. Siegel (1988) also calls this disposition the critical attitude. It is regarded as essential for a critical thinker because it is what makes the thinker prone to evaluate ideas. It is not sufficient for someone to be able to assess information properly; she needs to be inclined to use her cognitive skills frequently.

The critical spirit, according to Siegel (1988), is related to intellectual honesty because it implies that a person who possesses it has the habit of thinking critically about virtually any issue, even about things she holds dear. As a consequence, the critical spirit demands evaluating reasons as impartially as possible, weighing the evidence fairly, acknowledging that our beliefs are subject to be shown false, and following

an argument where it leads, which means eventually changing one's mind if there are strong and convincing reasons for it.

An elementary component of the critical spirit is what Hare (1979) calls open-mindedness. An open-minded person is someone who is willing to revise her views on a certain issue in the light of counter-evidence, and when this person does not have an opinion about it she will make up her mind according to the best evidence available. We assume that open-mindedness should be an inseparable aspect of the critical spirit because it is possible for someone to conduct an inquiry critically but then refuse to change her mind if the results contradict some of her deeply held convictions.

What Is the Ideal Critical Thinker?

We have argued that critical thinking has two core elements: a reason assessment component and the critical spirit. Based on them, it is possible to say that the ideal critical thinker is someone who embodies these elements to the greatest extent: an individual who considers reasons and evidence adequately, and who presents an attitude of desiring to know about and understand a given subject the best she can. The final result of such an inquiry, assuming that open-mindedness is also a vital element of the critical spirit, is that the person will calibrate her ideas according to the most reliable evidence and/or the strongest reasons available to her.

The ideal critical thinker is not primarily characterized by what she believes, but by how she approaches a certain issue, that is, by her abilities and disposition to evaluate ideas appropriately. Nevertheless, what a person thinks is generally linked to how this person has researched the subject and how she has deliberated about it. Lynch (2012) assumes that people do not have direct control over all their beliefs, but it is possible to control, at least to some extent, other aspects that affect the construction of these beliefs, such as adopting reliable means when conducting an inquiry, consulting sources, and handling the data in order to find more trustworthy answers, for example.

The ideal critical thinker is someone who is able to understand the nature of the problem she is approaching, and, thus, comprehends the kind of evidence or reasoning that is necessary to address it appropriately. On some occasions, empirical evidence is what a critical thinker needs to answer a given question (e.g., "Have animals evolved?"). On other occasions, an evaluation of philosophical reasons is demanded (e.g., "What kind of life should I live?"). Some circumstances may require empirical evidence coupled with philosophical reflection (e.g., "If there is good evidence that fish do not feel pain, should I, a utilitarian vegetarian, take that information into account and then consider changing my dietary habits?").

In issues that demand empirical evidence, a key question that an ideal critical thinker is expected to ask herself is, "Where can I find the most reliable information about the topic I'm interested in?" Sometimes, she can rely on her memory of a past event, and apply the same reasoning to a similar situation in the present. Relying on the experience of other people may help a critical thinker in dealing with other situations. Seeing, reading, and hearing (that is, experiencing) things for oneself is a common way to gather relevant data to address some questions. And, for the many issues that demand empirical evidence beyond the scope of personal experience and the senses of the critical thinker, one reasonable way to find out about them is to turn to what experts say.

In the case of a question that requires empirical evidence to be answered, it is not sufficient for an ideal critical thinker to only possess information in order to make up her mind about it. She must be able, and inclined, to evaluate the information critically in order to make sense of it, adjusting the strength of

her belief according to the quality of evidence available in its support. In this regard, it is important to stress that a critical thinker does not possess a God's-eye view of the world. Being human, she is subject to biases and has personal preferences and interests. Acknowledging and overcoming biases that may distort one's own reasoning is, according to DiCarlo (2011, p. 75), "the most difficult part of becoming a critical thinker."

Karl Popper once wrote that we should not "exaggerate a difficulty into an impossibility" (as cited in Siegel, 1997, p. 20), and the same reasoning may be applied to the impact of biases in critical thinking. There are occasions on which ideological, political, or religious biases—to mention a few of them—may have a decisive effect on the thinking processes of people, who will accommodate new beliefs according to the preexisting ideas or worldviews they hold. This may happen with a person who adheres to Young Earth Creationism and, because of that, thinks our planet is about ten thousand years old, despite the overwhelming scientific evidence to the contrary. But the fact that some people—like Pope John Paul II, who publicly recognized the strength and quality of the evidence in favor of the theory of biological evolution (Gould, 2003)—accept ideas that appear to contradict their biases or system of beliefs is an indicator that appreciating reasons with fairness is a possible task.

The definition of an ideal critical thinker we have presented departs from a commonsensical understanding of what critical thinking is. "Being critical" is an expression that frequently carries a negative connotation: it often indicates an avid inclination to constantly seek faulty reasoning and mistaken ideas in the interlocutor's discourse. Another commonsensical approach to "being critical" associates this expression to a kind of skepticism whereby a person embraces unlimited doubt about everything, no matter how well a certain claim is justified. Vaughn and MacDonald (2010) address this misunderstanding:

> The *critical* in critical thinking is used in the sense of "exercising or involving careful judgment or judicious evaluation." Critical thinking is about determining what we are justified in believing, and that involves an openness to other points of view, a tolerance for opposing perspectives, a focus on the issue at hand, and fair assessment of arguments and evidence. (p. 7)

A critical thinker is not someone who is always questioning herself about what to believe regarding the shape of planet Earth, nor is it someone who thinks it impossible to rationally decide if the assertion "the Earth is spherical" is closer to the truth or better justified than "the Earth is flat." By assuming that an ideal critical thinker is someone who is determined to figure out what she is justified in believing, and that in order to achieve it she has the capability and the inclination to appropriately evaluate reasons and evidence, we can then expect that she will eventually embrace ideas that are more reliable than their alternatives, while keeping her mind open to revising her beliefs.

AGW: Thinking Critically About the Evidence

The discussion about anthropogenic global warming has raised a lot of questions, ranging from those that need empirical evidence to be answered to those that demand philosophical reflection on the possible courses of action that would be reasonable to take if human activities are impacting the climate of Earth. We focus here on two issues: "Is the planet warming?" and, if so, "Have human activities contributed to

it?" These questions are better approached with an evaluation of the evidence of the possible change in the climate on Earth throughout millennia, and also of the impact that certain human activities may have had on the temperature of the planet.

There are converging lines of evidence that point to the conclusion that (a) the average temperature of our planet is increasing and (b) it is extremely likely that human activities are significantly contributing to this increase (Oreskes, 2004; Prothero, 2012). In general terms, it is assumed that the burning of fossil fuels, deforestation in tropical areas, and the expansion of livestock production are responsible for the emission of a large amount of gases such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) into the atmosphere. These gases are components of the greenhouse effect, a natural process in which the sun's heat that is radiated back from the surface of Earth is absorbed in the atmosphere. The greenhouse effect is responsible for the maintenance of a temperature that is adequate to sustain life on our planet. Without the greenhouse effect, the Earth would be a much colder place, and would not have the conditions required for life as we know it to exist. The problem is that there has been a rapid increase in the levels of CO_2 and CH_4 in the atmosphere since the Industrial Revolution due to anthropogenic influence, and this has enhanced the greenhouse effect. The enhancement of the greenhouse effect is claimed to be responsible for the augment of the average surface temperature of the planet.

Currently, there is a robust consensus in the scientific community that the planet is getting warmer, and that human activities, especially those based on the emission of fossil fuels and methane, are decisively contributing to it. Several meta-analyses of climate studies have been conducted recently, and all of them indicate a high percentage of papers that conclude that anthropogenic global warming is going on (Oreskes, 2004; Prothero, 2012). Anderegg, Prall, Harold, and Schneider (2010), for instance, evaluated papers related to global warming published by 1372 climate scientists, and concluded that 97 to 98 percent of the most active researchers in this area endorse the conclusions of the Intergovernmental Panel on Climate Change (IPCC) about the occurrence of AGW. Cook et al. (2013) obtained similar results in their meta-analysis of 11,944 papers related to climate change published from 1991 to 2011. Considering only the papers that presented conclusions regarding AGW, they found that 97.1 percent had evidence in support of the idea that human activities are causing global warming. It is important to highlight that the meta-analyses conducted by Anderegg et al. (2010) and Cook et al. (2013) used data provided by thousands of scientific studies carried out by climate experts who worked mostly independently from one another, in different places, and in different time periods. Cook et al. (2016) have recently reviewed and synthetized the consensus on AGW based on six meta-analyses, and they found that 90 to 100 percent of publishing climate scientists agree that human influence is a major cause of global warming.

Studies such as those carried out by Anderegg et al. (2010) and Cook et al. (2013; 2016) corroborate and give support to the position of the most prominent academies of science throughout the world concerning the occurrence of AGW. According to Cook et al. (2016), the National Academies of Science from eighty countries have issued statements endorsing the consensus position. The American Association for the Advancement of Science, for example, affirms in a document released in 2006 that "the scientific evidence is clear: global climate change caused by human activities is occurring now, and it is a growing threat to society" (AAAS, 2006). More recently, a joint statement signed by twenty-four professional and scientific societies of the United Kingdom concludes that "the scientific evidence is now overwhelming that the climate is warming and that human activity is largely responsible for this change through emissions of greenhouse gases" (The Royal Society, 2015).

The IPCC is an organization established by the World Meteorological Organization (WMO) and the

United Nations Environment Programme (UNEP) to evaluate the evidence regarding the occurrence of anthropogenic global warming and, if it is occurring, discuss ways to mitigate it. It is responsible for the development of what is arguably the most detailed and updated assessment reports on climate change. These reports have been produced by working groups composed of experts from different countries who evaluate peer-reviewed papers that represent the latest climate science. The first report was available to the public in 1990, and the latest version—the fifth assessment—was finished in 2014. According to the Synthesis Report, in which the findings are summarized,

> human influence on the climate system is clear and growing, with impacts observed across all continents and oceans. Many of the observed changes since the 1950s are unprecedented over decades to millennia. The IPCC is now 95 percent certain that humans are the main cause of current global warming. (IPCC, 2014, p. V)

Do we have reliable evidence that anthropogenic global warming is occurring? According to studies carried out and evaluated by the relevant community of experts on the issue, it is possible to say that there is solid evidence that AGW is very likely occurring. Even acknowledging that ideas held by scientists for a long time may turn out to be mistaken, the more tested an idea is, the more people work on it independently, and the more agreement there is among the researchers, the more reliable a given claim is (Lynch, 2012; Pigliucci, 2010). That is the case for AGW.

What Is an Ideal Critical Thinker Expected to Conclude About AGW?

The massive evidence in favor of the idea of anthropogenic global warming endorsed by the consensus of the experts in the area is expected to be sufficient to rationally convince an ideal critical thinker that human activities are likely influencing the climate of Earth. This position, however, should be adopted in a non-dogmatic way, which means that the critical thinker comes to this conclusion after evaluating the best evidence currently available on global warming as it is presented by those who are knowledgeable about the issue, but she is willing to revise her point of view if strong evidence appears in the future pointing to a different scenario.

"Open-mindedness means that one does not accept a certain conclusion as dogma, but only tentatively and in the proportion to the available evidence," writes Pigliucci (2010, p. 170), and this rationale also relates to critical thinking. Applying the concept of open-mindedness to the theory of evolution, Pigliucci continues: "By that standard, the scientific theory of evolution is what an open mind should accept, since it is overwhelmingly supported by the available empirical evidence" (p. 170). We acknowledge science is a fallible enterprise in which all ideas are subject to revision, and some of them are eventually rejected. Even so, it is necessary to admit the preponderance of solid evidence supporting the idea of AGW. Gould (1983) writes that evolution could be regarded as a fact because the evidence in its favor is so massive that it would be perverse to withhold provisional assent. The same may be thought of AGW. Based on what is known about it to this day, it seems difficult to reject the strength of evidence that maintains that the average temperature of Earth is rising because of human influence.

To say that an ideal critical thinker is expected to form her point of view about AGW after evaluating the position of scientific experts on the issue is not to affirm that critical thinking is simply a matter of following the conclusions of scientists regarding any given subject. As we discussed in a previous section,

critical thinking means being able to evaluate reasons and evidence appropriately and having a constant disposition to do so. On some occasions, as in the debate about the occurrence of AGW, the critical thinker must rely on reasons and evidence that are provided by scientists and other experts in a certain area. Ideal critical thinkers defer to scientific evidence when it provides the best guarantee regarding a certain topic, but they are not susceptible to scientism, which is defined by Haack (2007) as follows:

> an exaggerate deference towards science, an excessive readiness to accept as authoritative any claim made by the sciences, and to dismiss every kind of criticism of science or its practitioners as anti-scientific prejudice. (pp. 17–18)

Critical thinkers do not assume scientific inquiry is the only way for people to know or learn about a certain matter. We learn many (reliable) things through personal experience, the experiences of other people, practices of traditional cultures, religious rituals, philosophical studies, and so on. But it is necessary to stress that, in order to answer very complex questions such as those related to the occurrence of AGW—questions that demand empirical evidence—, scientific inquiry is the method that potentially produces the most reliable answers. That does not mean an "exaggerate deference towards science," but a recognition that understanding the results of empirical studies and the position of the consensus of the experts in climate science is the most reasonable way to find the best information possible regarding the existence of anthropogenic global warming.

Not all issues related to global warming may be addressed through scientific inquiry. For example, "If AGW is going on, what should individuals and governments do?" is a question that demands a reflection about ethical presuppositions, and the answer to that question will inevitably include knowledge of different areas such as economy and politics. So science can provide reliable information about the occurrence of global warming and the influence of human activities on it, but the scope of the problem goes much beyond—and thus cannot be confined to—scientific studies.

An ideal critical thinker is expected to ponder different points of view on a given issue before making up her mind about it. But that does not mean she will eventually give the same weight to all concurrent claims. We may think of evolution as a clear example of this situation: There is a strong religious pressure to include so-called "intelligent design" (ID) as a legitimate scientific alternative to biological evolution in the educational systems of some countries, a proposition that is opposed by scientists and science educators (Pigliucci, 2010; Scott, 2013). The objective of showing the alternatives and letting people decide which one they want to embrace may sound noble. But the alternatives are not equally plausible, considering that one idea (evolution) is adopted by virtually all experts in biological sciences, while ID is a typical example of pseudoscience (Pigliucci and Boudry, 2013).

It is obviously desirable that an ideal critical thinker reflects upon the dissenting view on AGW, but she will probably recognize that the controversy involving AGW is, at least at this moment, an example of pseudo-symmetry, that is, "the false impression that scientists' opinions are about equally divided" on certain claims (Park, 2000, p. 12). Fewer than one out of ten experts on climate science currently subscribe to the alternative view on AGW, and this position is discredited by all relevant academies of science throughout the world because the preponderance of evidence suggests a different scenario. It is unlikely that a book on critical thinking would present, as an example of the application of critical thinking skills, the conclusion that it is not possible to make up one's mind on AGW, or that we have good evidence that this phenomenon is not happening. Given what is known about AGW, a critical thinker might ask herself: "What reasons do I have to reject this idea at this moment?"

Russell (1928) says he is ready to take any well-established result of science not as absolute truth, but with a reasonable degree of probability that permits him to accept the evidence and use it to base his ideas and courses of action. This attitude, which Russell refers to as moderate skepticism, is also useful for laypeople when they approach complicated questions about which they do not have a deep understanding. Russell suggests consulting the consensus of experts before deciding on what to believe. If the experts agree on an idea, the opposite opinion cannot be regarded as likely. If the experts are not in agreement, no idea can be regarded as the most reasonable. And when the experts consider there are no grounds to form a belief, the layperson should suspend judgment about the issue.

The moderate skepticism advocated by Russell presupposes the application of the core components of critical thinking that we have defended here: the skills to detect where the relevant arguments on a certain subject may be found and to evaluate them fairly, and an inclination to do so and to calibrate beliefs according to the result of the inquiry. The acceptance of the position of the scientific consensus regarding AGW thus cannot be regarded as an instance of blind obedience to authority or to science, but a recognition that some questions are better answered if the critical thinker relies on the epistemic authority of legitimate experts, while recognizing that these authorities may not be the most qualified to give proper responses to other issues regarding the ethical, political, and economical aspects of AGW.

An ideal critical thinker is justified in endorsing the current consensus on AGW for basically two reasons. The first is the fact that the vast majority of thousands of scientific papers point to the same conclusion about the topic. Most of the studies were carried out by different people, from different institutions, in diverse places, and in distinct periods of time, and their results are nonetheless similar. Perhaps their conclusions cannot be regarded as completely independent from each other, but the same may be said of the conclusions made in the studies that reject the occurrence of AGW. The second reason for justifying the acceptance of a scientific consensus is that, even if the vast majority of experts (more than nine out of ten, for instance) agreed with a certain position simply because of the existence of a couple of good studies indicating AGW is real, and accepted these studies as very reliable—because they were performed by leading researchers, using appropriate methods, with a good sample, and they were extensively reviewed by peers—, that would be a good enough reason to take that position into account when deciding what to believe about AGW (Coady, 2012). In this second scenario, a critical thinker would assume that experts are the most competent people to judge the expertise of their peers, and the stronger their agreement on a given topic is, the more reliable a non-expert should take this position to be.

It is important to highlight that an ideal critical thinker is not committed to hold any belief forever. An indispensable component of critical thinking is the recognition that any idea may turn out to be mistaken or regarded as less reliable in the light of new evidence; that is, an ideal critical thinker must be comfortable with fallibilism. According to Leite (2010, p. 370), fallibilism is "an anti-dogmatic intellectual stance or attitude: an openness to the possibility that one has made an error and an accompanying willingness to give a fair hearing to arguments that one's belief is incorrect." Nonetheless, accepting fallibilism is not the same as endorsing extreme versions of relativism or skepticism: A critical thinker may form a reasonable opinion about a given issue, and hold this belief provisionally, that is, until better evidence or reasons appear. As Leite (2010, p. 370) puts it, "it is possible to remain open to new evidence and arguments while also reasonably treating an issue as settled for the purposes of current inquiry and action." In the case of AGW, it is reasonable for a critical thinker to provisionally accept its occurrence and, at the same time, be aware of and open to the possibility of having to evaluate fairly new evidence

and reasons that may come, and then recalibrate her point of view on the topic.

So far, we have focused on the application of critical thinking to a question about how a certain aspect of the world likely is, a task that demands a scrutiny of the most reliable factual information available. Nonetheless, critical thinkers must not be regarded as cold-blooded calculators who are just concerned about facts, and who do not worry about the impact their ideas and actions have on the lives of other people. On the contrary: Lipman (2003), for example, argues that an essential feature of critical thinking is that it must be encouraged and applied within a humanist framework in which a critical thinker takes into account the interests of other people (and other living things) whose lives are somehow linked to the consequences of her ideas and courses of action. It is not in the scope of this paper to discuss how a critical thinker should act after reviewing the evidence regarding AGW, but we endorse Lipman's humanistic application of critical thinking and argue that an ideal critical thinker is expected to seriously consider changing some of the features of her personal life that might impact the climate of the planet, such as her diet, habits of consumption, and/or the means of transportation she normally uses.

Thinking Critically in the Weak Sense

We have defended the idea that a critical thinker, at least in ideal terms, is expected to accept the occurrence of AGW, but should be open to re-examine her position on the issue if new evidence demands so. Let us suppose, for a moment, that a person who declares herself a critical thinker (or even wrote a book on critical thinking) rejects this conclusion, denying the influence of human activities on the climate of Earth. Is this critical thinking?

A person who rejects the overwhelming evidence about AGW (or evolution, or the relationship between HIV and AIDS, for that matter) may have the critical thinking skills to assess claims, spot fallacies, detect incongruences and bad arguments. Nonetheless, this person may use these skills selectively, applying them to some claims but not to others. This selective use of thinking skills is similar to what Trumble (2013) calls an *à la carte* attitude towards ideas, a disposition to "pick and choose what to believe based solely on personal preference" (p. 144). According to Paul and Elder (2002, p. 342), this kind of attitude is a component of what they name "weak sense critical thinking," which happens when individuals "use the intellectual skills of critical thinking selectively and self-deceptively to foster and serve their selfish interests (at the expense of truth)." Even if these thinkers do not choose when to use their intellectual skills for selfish purposes, as Paul and Elder argue, this behavior is the antithesis of the critical spirit, and it is the reason why a person who holds this *à la carte* attitude is unlikely to be regarded as an ideal critical thinker, albeit she can think critically in many circumstances.

An individual who is capable of evaluating reasons, and has enough information available to form a reasonable opinion about a given subject, but refuses to acknowledge the strength of the arguments related to it, fails to recognize the power of reasons and evidence in shaping beliefs. In other words, this person may not believe critical thinking is of any use other than reinforcing her convictions. Siegel (1997) argues that a critical thinker must be someone who is appropriately moved by reasons, which means a person who understands that compelling reasons are stronger than preconceived ideas and personal biases, and so is disposed to adjust her beliefs accordingly. As Carroll (2011, p. 28) explains, "the goal of a critical thinker is not to defend beliefs against all attacks, but to believe whatever a preponderance of evidence supports."

Final Considerations

People experience an ambiguous situation regarding access to information in the contemporary world. On one hand, it is easy to search for answers to almost any question in a matter of minutes on the internet. On the other hand, one must be very careful about what she reads because untrustworthy sources abound. Considering the spread of misinformation in our societies, and the lack of moderate skepticism and critical thinking for people to deal with it, Helfand (2016) writes that we live in the "age of misinformation." At the core of this definition lies our incapacity to use both critical thinking abilities and the critical spirit.

We have stressed that critical thinking cannot be reduced to a process of cognitive skills training. Siegel (1997) writes that a critical thinker must possess certain character traits and habits of mind that make her prone to using thinking skills to evaluate any ideas, be they presented by other people or her own. A critical thinker is someone who has a genuine desire to know and to understand things better, not just to conform to her previous beliefs, and has the intellectual tools and the attitude in order to achieve it.

The problem we posed in the introduction of this paper is how a critical thinker is expected to form her beliefs regarding the occurrence of anthropogenic global warming. Considering that this is fundamentally a matter of fact, we have argued that an ideal critical thinker is likely to base her opinions on AGW according to the best evidence and reasons available to the present date, both because she is able to find out where reliable information is and to evaluate it, and because she has a disposition to do so. Thus, a critical thinker is expected to endorse the strong consensus of the experts that indicates that AGW is an ongoing phenomenon.

Critical thinking has been regarded as one of the main objectives of education, and authors such as Lipman (2003) and Siegel (1988) argue that schools should be concerned with encouraging and improving critical thinking abilities and dispositions in students. How to foster critical thinking is a complicated issue: While the abilities required to analyze arguments can feasibly be taught (and learned) at school (Lipman, 2003; Siegel, 1988), the same may not apply to the critical spirit. Humans have several cognitive biases and are under the pressure of social forces that make it very difficult (but not impossible) for them to be permanently imbued with the critical spirit. So, when we think about the development of individuals who are inclined to appropriately apply their cognitive skills to the greatest extent—ideal critical thinkers—at schools and universities, we understand that this is a very complex task, and something that frequently cannot be accomplished completely.

Nonetheless, educators should encourage students to develop an evidential style of belief, "a disposition to seek reasons and evidence, and to believe on that basis" (Siegel, 1988, p. 88), a feature that is contrary to an *à la carte* attitude towards ideas (Trumble, 2013). Encouraging students to ponder the importance of good reasons and evidence in order to improve the reliability of their ideas and actions is a significant feature against the selective use of critical thinking skills—and an attitude any educator concerned about critical thinking should consider.

Pigliucci (2010, p. 171) understands that the role of education is to "provide students with both the best available understanding of a given problem to date and the reasoning tools to think independently about the problem itself." We add that educators should encourage students to extend the application of those reasoning tools to other questions, in and outside school, not only in order to improve their

understanding of the world but also to make them better decision-makers and to protect them against misinformation, deception, and manipulation.

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