

Scenario as a tool for critical thinking : Climate change awareness and denial as a case study

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Abstract: Critical thinking and effective communication are indispensable skills in any professional setting in contemporary globalized and computerized society. The era of globalization and the Internet pose new challenges to education. On the one hand, people have immediate, global, and facilitated access to information. On the other hand, the increasing amount of information inevitably requires one to operate in a selective and analytical way, and to be able to critically evaluate the knowledge and information acquired. These abilities are instrumental in effective decision-making processes and complex problem-solving in the contemporary world. Moreover, critical thinking skills have a direct impact on fostering initiative, autonomy, and leadership. This paper argues for the relevance of scenario theory and practice for critical thinking. Scenario analysis has been used in complex planning domains, cybernetics, business organizations and in vocational education, but we suggest that this approach can also be used more widely in developing critical thinking. In this article, a scenario refers to a set or collection of projections of future events (Wall, 1983). By allowing the investigation of the 'what if' questions, scenarios make interpretations about the future and engage with the domains of the possible, probable and hypothetical. Indeed, scenarios allow us to envision possible futures and alternatives in a hypothetical course of events. Viewed through this perspective, scenarios could be included in the toolkit of critical thinking as self-reflective tools to assess the present. How, then, could imaginary scenarios enhance critical thinking? After an introduction about the concept of scenario, we will test the scenario-based approach to critical thinking in a two-level analysis. We will first analyze the scenarios employed in a corpus about climate change awareness (NASA Global Climate Change and Yale Climate Connections) and climate change denial websites (Watts Up With That and Climate Depot). Thus, we will build on the research by Oreskes & Conway (2010), Dunlap (2013) and others on the communication of contested

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science. The Internet plays a central role in shaping public perceptions today and hence needs to be discussed seriously as a source of misinformation. We will analyze how scenarios are used by the two competing interest groups. In the second phase of analysis, the results will be used to develop pedagogical advice for using scenarios in teaching critical thinking.

Keywords: scenario, critical thinking, climate change, future, science communication

Scénario comme outil pour développer son esprit critique: la sensibilisation au changement climatique et son déni comme étude de cas

Résumé : La pensée critique et la communication efficace sont des compétences indispensables dans tout contexte professionnel de la société contemporaine, mondialisée et informatisée. L'ère de la mondialisation et d'Internet pose de nouveaux défis à l'éducation. D'un côté, les gens ont un accès immédiat, global et facilité à l'information. D'un autre côté, la quantité croissante d'informations oblige inévitablement à opérer de manière sélective et analytique, et à pouvoir évaluer de manière critique les connaissances et informations acquises. Pour un processus de la prise de décisions efficace et pour la résolution de problèmes complexes, ces aptitudes sont essentielles dans le monde contemporain. Par ailleurs, la capacité de réflexion critique a un impact direct sur la promotion de l'initiative, de l'autonomie et du leadership. Cet article plaide pour la pertinence de la théorie des scénarios pour la pensée critique et montre son application dans les analyses. L'analyse de scénarios a été utilisée dans des domaines de planification complexes comme cybernétique, organisation d'entreprises et enseignement professionnel, mais nous suggérons que cette approche puisse également être utilisée plus largement dans le développement de la pensée critique. Dans cet article, *scénario* fait référence à un ensemble ou à une collection de projections d'événements futurs (Wall, 1983). En faisant considérer les éventualités au moyen des questions « Et si... », les scénarios font des interprétations sur le futur et s'engagent dans les domaines du possible, probable et hypothétique. Les scénarios nous permettent, en effet, d'envisager des futurs possibles et des alternatives dans un cours hypothétique des événements. Vu sous cet angle, les scénarios pourraient être inclus dans la boîte à outils de la pensée critique en tant qu'outils réfléchis pour évaluer le présent. Comment alors les scénarios imaginatifs pourraient-ils améliorer la pensée critique ? Nous testerons l'approche par scénarios pour la pensée critique dans une analyse à deux niveaux. Nous analyserons d'abord les scénarios utilisés dans un corpus de sensibilisation au changement climatique (NASA Global Climate Change et Yale Climate Connections), et les sites Web de déni de changement climatique (Watts Up With That et Climate Depot). Nous nous appuyerons ce faisant sur la recherche d'Oreskes & Conway (2010), Dunlap (2013) et d'autres sur la communication de la science contestée. L'Internet jouant aujourd'hui un rôle central dans la formation des perceptions publiques, son apport doit désormais être sérieusement discuté en tant que source de (més)information. Nous analy-

serons comment les scénarios sont utilisés par les deux groupes d'intérêt concurrents. Les résultats serviront à élaborer des consignes pédagogiques pour l'utilisation de scénarios dans l'enseignement de la pensée critique.

Mots-clés : scénario, pensée critique, changement climatique, avenir, communication scientifique

Introduction : thinking critically and future-oriented thinking

Change is a pervasive phenomenon, but currently the world is changing at an ever-accelerating pace. Accommodating, adjusting to, and coping with fast and unexpected changes and uncertainty is probably the biggest challenge that humankind has to meet today. This process is further complicated by the information overload produced by the Internet and social media, which now compete with the more conventional sources of information and learning, thus making it increasingly difficult to make valid judgments about issues vital to individuals and societies. In this respect, critical thinking can be regarded as an indispensable aim for educational and professional training in contemporary globalized, computerized, and rapidly changing society. Trilling and Fadel (2009) list critical thinking and problem-solving among the “7C’s” necessary for the 21st century, alongside communication, collaboration, computing, career, cross-cultural and creativity skills.

The problem is thus social as well as educational. The era of globalization and the Internet culture pose new challenges to education at all levels. Unlike in the past, people have an immediate, global, and facilitated access to a wide range of information. The information now comes from a democratic array of sources, and few conventional gatekeepers of knowledge remain active in the Internet. The flood of unfiltered information requires one to operate in a selective, logical, and analytical way to be able to critically evaluate the massive amount of information available.¹ Such abilities are instrumental in effective decision-making processes and complex problem-solving in the professional domain as well as in everyday life. Moreover, critical thinking skills have direct and practical outcomes in one’s professional and personal life because such knowledge fosters individual initiative, autonomy, and leadership. Thus, learning how to reason critically is key to global citizens.

Critical thinking has been valued in education long before the advent of the Internet. John Dewey’s belief that reflective or critical thinking was to be an aim of education and critical thinking was adopted as an educational goal already in the 1930s. For Dewey, critical thinking required the “active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends” (Dewey, 1910, p. 6). Dewey believed that this would enhance both personal and social well-being.

¹ In this respect, Postman and Weingarten (1969) have introduced the concept of “media ecology” to teach students and media users how to filter the increasing amount of information.

Since the early days of critical thinking education, several methods and techniques have been developed to develop and foster critical thinking skills. For Dewey (1910), the starting point was personal observation or experience and the goal was the formation of a judgment. A good command of basic logic, a solid grasp of textual close reading techniques, the ability to ask the right questions, to hold a debate in a group discussion and, above all, to develop innate scepticism lay at the basis of critical thinking. One should be able to look at an issue from different perspectives and be able to make comparisons, correctly evaluate arguments, make inferences and apt conclusions.

This perspective can already be seen in Dewey's (1910, p. 9) model in which one is encouraged to weigh beliefs in the light of the grounds that support them, instead of taking things for granted. At a more basic level, critical thought entails the correct use of language in its written and oral forms. People should be able to operate confidently and decisively as well as to strive towards being conscious communicators – be able to convey their ideas in a concise, logical, and effective way. Thus, today, anyone, let alone a professional, must have extensive written and spoken language skills as well as the ability to read texts, not only in the mother tongue, but also in foreign languages. Critical thought presupposes not only the correct interpretation of texts, but also reasoning and analytical skills based on technical, scholarly or other specialized knowledge. Needless to say, written communication cannot be mechanical but must be critically evaluated to ensure the correctness of what is being transmitted to others, who, not infrequently, may be unconvinced of the information given.

In addition, one should be able to master tools to filter information and thus be able to judge the reliability or unreliability of a source, the credibility of a text, and the validity of an argument. Discerning reliable and truthful information from unreliable and deceptive accounts is one part of the process. These capabilities are vital for anyone who faces the need to manage decision-making in an analytical, conscious, and effective way. To this end, a person should be acquainted with the basic distinction between *facta* and *futura*, to use terms introduced by Bertrand de Jouvenel. Once this basic but fundamental division is understood, one is encouraged to think independently, instead of blindly following what one is told by others or by second-hand accounts.

In a study that became a classic in the domain of future studies, Bertrand de Jouvenel (1964) made an important distinction between past and future events. He formulated this idea on the basis of the etymology of the Latin terms *facta* and *futura*. *Facta* are events that have already occurred and have been fully realized in a specific moment in the past. *Futura* pertain to future events that have not yet become manifest and therefore could unfold in diverse ways. It is important to stress that *facta* and *futura* do not share the same epistemic status. Indeed, the domain of *facta* is the domain of the knowable (de Jouvenel, 1967, 5). Because the domain of *facta* encompasses events that have already occurred in the past, it follows that these events can become the object of factual knowledge. In other words, past events can

be reported, accounted for, and verified. Indeed, the truth and falsity of past events can be assessed, up to a certain extent. In contrast, the domain of future events cannot be tested on a factual scale and goes beyond any criterion of truth. Ultimately, future events cannot be known with certainty. While past events can be knowable, checked, corroborated, and verified future events pertain to the realm of the unknowable and the plausible (de Jouvenel, 1967, 5).

In what follows, we maintain that developing “the habit of future-oriented thinking” (Allain, 1979, p. 13) or “future-now thinking” (Kahn, 1962, p. 60) is crucial for managing change. However, as argued above, the future remains unknowable and its facticity cannot be assessed. For this reason, we contend that a conscious and systematic habit of envisioning and projecting alternative and plausible futures is instrumental to critical thinking and ought not to be overlooked alongside the more traditional skills outlined above. As David Passig (2004) has shown, this perspective can also be extended to the field of education.

The ways of thinking about alternative futures are manifold and many techniques could be employed, like simulation, modeling, gaming, and foresight, to mention just a few. We focus on a single technique, “scenarios”. Scenarios are “conjectures about what *might* happen in the future” (Cornish, 2004, p. 93, italics in original). A scenario “is a ‘future history’, a narrative that describes a possible series of events that might lead to some future states of affairs” (Allain, 1979, p. 23).

The present article argues for the promotion of critical thinking by using a scenario-based approach as a method and a practical tool for exploring future possibilities. It is our contention that scenarios, conceived as pragmatic tools for envisaging possible futures, may also be a key to critical thinking. We argue that scenarios could be included in the toolkit of the critical thinker as tools to reflexively assess the present (Grishakova, Gramigna, Sorokin 2019). Being “stories of what might be” scenarios “aim to stimulate creative ways of thinking” (Wollenberg, Edmunds & Buck at al., 2000, p. 2). Moreover, scenario-based thinking as mental modeling to engage with future possibilities capitalizes on creativity and creative thinking. As Anthony Weston pointed out, “by showing us the world, or some part of the world, as it *could* be creativity gives us a whole new view of the world as it *is*” (Weston, 2007, p.vii). Critical and creative thinking are widely mentioned in curricula and educational policy documents, but there does not seem to be much research as yet in this important domain (Brodin, 2016). We seek to contribute to filling this gap.

The purpose of the present study is fourfold: (1) to argue for the relevance of the study of possible alternative futures; (2) to introduce the concept of scenario in critical thinking; (3) to provide an application of this concept through a qualitative analysis of climate change scenarios in blogs; (4) to show the value of scenarios as tools for critical thinking and pedagogical practice.

1. What might happen : glimpses of the future

If the future is by definition unknowable, this does not entail that it is unthinkable. As we shall show below, there are techniques that aim to conjure up the future, as it were, in order to render it less intangible. From an operational and pragmatic perspective, from time immemorial humans have made attempts to fathom and to envision the future. In this regard, we may think of the birth of astrology, the interpretation of dreams, various forms of divination, prophetic predictions, and so forth. As *homo prospectus* (Seligman et al. 2016), humankind is constantly caught in creating mental projections, forecasts, and visualizations in order to cope with uncertainty, make choices, project desires, and tease out possible alternative futures.

Indeed, one of the distinctive features that sets humans apart from other species is the ability to anticipate, to project, to foresee, and to invent (Mumford, 1956). Seligman (2016, p. ix) has pointed out that the “unrivalled human ability to be guided by imagining alternatives stretching into the future – “prospection” – uniquely describes *Homo sapiens*”. The French mathematician and philosopher Pierre-Louis Moreau de Maupertuis has identified “prevision” as an inherent faculty of the mind that pertains to the “anticipation of the future” (Maupertuis, 2014, pp. 5-6). It is worth noting that Maupertuis assigned such a cognitive faculty solely to human beings. Not dissimilarly, Bertrand de Jouvenel has argued that there exists an “action of the human mind”, namely, “an effort or *work* tending to make us know ‘what may happen’ rather than ‘what will happen’”. The result of this work is a *fan of possible futures*, or of futures which seem likely to us (de Jouvenel, 1967, p. 16, italics in original).

The systematic study of the future has gained momentum in more recent times. This has led to the establishment of specific fields of research such as futuristics and future studies.² In the domain of future studies and cognate disciplines, there have been numerous attempts to define the systematic activity of thinking about the possible futures and the outcome of such a process. There is a plethora of terms to describe an alternative set of imagined future events. To name just a few: “prophecy”, “forecast”, “prediction”, “projection”, “prognostics”, “trend spotting”, “scenario” (Gidley, 2017). To these, we may also add “futuribles” and “conjecture” (de Jouvenel, 1967), “anticipation” (Poli 2017), and “prospection” (Seligman et al. 2016). From the array of terms that have to do with thinking about – or imagining – possible alternative futures, our focus lies on the concept of “scenario”.

2. The concept of scenario and how we use it

Before venturing into the qualitative analysis of climate change scenarios, it is necessary to consider what this concept stands for, how we understand it, and how we intend to use it. Needless to say, there is no universal definition of or absolute

² For an overview and discussion about the terminology used to refer to the study of the future, such as “futuristics”, “futurology”, “futures”, “futures studies”, “foresight”, see Sardar (2010).

consensus on the concept of “scenario”. The original meaning of this term is rooted in the fields of theatre studies and the performing arts but it has gradually acquired a more operational and pragmatic meaning.³ Already in the 1950s, scenario analysis gained quite wide currency in the field of military intelligence owing to the security scholar Herman Kahn, who popularized this term while working as a defense analyst at Rand Corporation in Santa Monica. Not surprisingly, Kahn borrowed the concept of “scenario” from the field of cinema on the suggestion of Leo Rosten, American screenwriter working in Hollywood at that time (Cornish, 2004, p. 94).

Kahn was most probably the first one to use the term “scenario” explicitly as a technique for describing the future in strategic military settings. He used scenarios as a template to fathom nuclear war. For this reason, Kahn was referred to as a “thinker of the unthinkable”. In his famous book *Thinking about the Unthinkable* (1962) he defined scenarios as follows:

Scenarios are hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision-points. They answer two kinds of questions: (1) Precisely how might some hypothetical situation come about, step by step? And (2) What alternatives exist, for each actor, at each step, for preventing, diverting, or facilitating the process (Kahn & Wiener, 1967, p. 6).

The concept of scenario was further elaborated and refined in the fields of economics (Wack 1985), Artificial Intelligence, strategic planning, and scenario development came to be viewed as tools for analysis and a method for problem-solving. Wall has defined a scenario as follows:

A scenario is a collection of projections of future events, each of which is based on a set of assumptions about the behaviors, intentions and effects of the various processes involved. [...] Stated another way, the total set of possible future world states is in effect divided up into classes or categories on the basis of assumptions about the processes involved (Wall, 1983, p. 36).

Viewed from this perspective, scenarios have a distinct planning overlay and generally entail a reference to the future as a temporal horizon. This, however, does not preclude that a scenario could be used to interpret past or present events. Scenarios play quite a strategic role in various domains because they are used as an aid for planning and improving the decision-making process by providing information about the future. The objective of scenarios is “creating and/or strengthening awareness about the future by offering alternative future images and choices of action based on those images. They are used to generate, present, manipulate, and evaluate

³ For a discussion of the history of the concept of scenario and its multifaceted meanings, see Marina Grishakova, Remo Gramigna, Siim Sorokin (2019), “Imaginary scenarios: on the use and misuse of fiction”. An overview of some of the main definitions of scenario within the field of strategic planning can be found in Duinker and Greig (2007) as well as in van Notten (2005).

information about the future” (Duinker, Greig 2007, p. 207). In a nutshell, from the planner’s perspective scenarios are a tool for analysis.

For J. Ogilvy and T. Mandel (1986, p. 11) “scenarios are devices for ordering one’s perceptions about alternative environments in which one’s decisions might be played out”. Ramirez suggests that “scenarios accept structural uncertainty with multiple interpretations and multiple futures” (Ramirez et al, 2015, p. 73). Scenarios have also been considered as narratives or “descriptions of system change” (Vervoort et al 2015, p. 61). Violet Anselmini Allain (1979, p. 23) sketched out a succinct and effective definition of a scenario: “A scenario is a “future history”, a narrative that describes a possible series of events that might lead to some future state of affairs.”

Despite the variety of definitions, there is a general consensus that scenarios are not to be confused with predictions. This is an important point to stress. Scenarios are not forecasts or visions because they are not meant to predict what is likely to happen. Instead, scenarios answer the question of what might happen. Indeed, Duinker and Greig have argued that a common feature of the different definitions of the term is that “scenario-building does not focus on making predictions or forecasts, but rather on describing images of the future that challenge current assumptions and broaden perspectives” (Duinker & Greig 2007, p. 209). The majority of scholars agree on this point.

Moreover, the theoretical foundation underlying the concept of scenario stresses that the idea of one single future is ill-thought-through. On the contrary, the concept of the scenario is predicated upon the idea that what has not yet happened is a “fan of possible futures” (de Jouvenel, 1967, p.16) or “alternative futures” (Anselmini Allain 1979, p. 21). In a nutshell, from this perspective, the future is always plural.

We can lay out some of the key features of scenarios, in the way that we understand the concept in the present study, as follows:

- Scenarios engage with a dynamic conception of the future. There is not one single future but a fan of alternative, possible courses of future events;
- Scenarios are a kind of fiction. They are fictions in the sense that they are “imagined and literally shaped”;⁴
- Scenarios can be laid out as narratives as well as in other forms or modalities (for example, in visual form);
- Scenarios heighten creativity and creative thinking by sketching out possible futures.

⁴ It is worth noting that de Jouvenel (1967, p. 25) described the idea of a “fan of possible futures” as “fictions”. He pointed out that the word *fiction* “seems appropriate, as the past participle of *figo* designates what is imagined and, literally, shaped. It is significant that the potter, *figulus*, molds they clay into a shape that he first sees in his mind” (de Jouvenel 1967, p. 25). However, this does not mean that scenarios are solely imagined constructions because they are expressed in a written, oral, or visual form.

- Scenarios are “self-reflective tools because they loop back into the present decision-making process” (Grishakova, Gramigna, Sorokin 2019).⁵

3. Scenarios used in climate change blogs: a qualitative case study

Although scenarios are employed in numerous domains, from future planning to marketing, we limit our inquiry to scenarios of climate change, as employed on a small corpus of websites that attempt to create climate change awareness or to deny anthropogenic climate change. First, climate change is an issue that is hard to deal with precisely because the results of today’s actions or inaction will become visible only decades later when it may be too late to take action. That is, scenarios have to be – and have been – deployed to make the public understand the risks related to our environmental behavior. Second, anthropogenic climate change is a deeply politically charged topic. Van der Linden, Leiserowitz, Feinberg & Maibach (2015) demonstrate that at least 97% of climate scientists agree on anthropogenic climate change but powerful interest groups have invested heavily in creating a sense of a continued controversy in the news media, as the burning of fossil fuels continues to be profitable for many industries. This has created a “denial machine” that seeks to manufacture uncertainty (Dunlap, 2013). The public, therefore, has a skewed understanding of the extent of certainty among climate scientists. This has produced a noticeable consensus gap (Lewandovsky, Gignac & Vaughan, 2013) which makes adequate public decision-making challenging. The situation is aggravated by the social media filter bubble that exposes people to opinions that are in harmony with their previous choices. Climate change is one of the issues in which being presented only the kind of information that agrees with your previous opinions would prevent you from getting the information necessary for critical thinking. The blogs and other source speaking for and against anthropogenic climate change may be using the same evidence, but place it in a different context, including narrative scenario context (Harvey et al 2017, p. 2).

Harvey et al (2017, p. 3) studied 90 climate change blogs, evenly divided between the two opposing viewpoints, and discovered a radical difference in the positions presented. “Science-based blogs overwhelmingly used the frame of established scientific certainties and supported arguments with the published literature”, while 80% of the denier blogs studied based their arguments on sources without any peer-reviewed academic research in the field. What is relevant for the present study is the finding by Harvey et al (2017, p. 3) that one of the key approaches used in the denial blogs “is to frame uncertainty by focusing on the present and to question the accuracy of future predictions”. That is, the denialist argument explicitly tackles the future orientation of the climate scenarios. These points are also relevant for our discussion as we try to establish how well scenarios as a tool can be adapted to teaching critical thinking on issues like climate change.

⁵ These characteristics of scenarios as well as other features of the concept were conceptualized and laid out in a previous co-authored work on “imaginary scenarios” (Grishakova, Gramigna, Sorokin 2019).

In the context of the present article, we single out two fronts – climate change awareness and denialism – that envisage contesting scenarios in regard to environmental issues. The first front seeks to draw attention to climate change, in particular, anthropogenic climate change, while the second argues that climate change is not human-induced and as extensive as climate change awareness side suggests. Instead, the climate change denial camp sees danger in excessive government regulation. These two groups employ different narratives to frame climate-related discourse.

As was stated above, the discussion of climate change makes the use of scenarios almost inevitable because the effects of human actions become visible in the lived environment decades, even centuries after the act, at a point in which change may be irreversible. Thus, the future has to be made imaginable to the public and policy-makers to allow them to decide on appropriate courses of action today. The imagined futures have to be multiple, from more to less probable ones, to allow for nuanced decision-making concerning the future. Scenarios are almost a natural choice because they combine rigorous analysis with the imagination necessary for exploring the possible outcomes of the present processes, in view of the data available. This is why climate scientists have come to believe that “scenarios are one of the main tools for assessment of future developments in complex systems that often are inherently unpredictable, are insufficiently understood, and have high scientific uncertainties” (Carter 2001). It needs to be noted that climate science proceeds from the knowledge that certainty is impossible when it comes to the future and that some level of uncertainty needs to be accepted.

Climate science has relied on scenarios to understand and communicate climate change or, in other words, “to better understand uncertainties in order to reach decisions that are robust under a wide range of possible futures” (Moss et al 2010, p. 747). Scholars have tried to outline different scenarios to cover the complexity of the field (emission, climate, vulnerability, and other scenarios) and linked climate scenarios with socio-economic scenarios that influence the future of climate. The most authoritative climate change projections are reported by the Intergovernmental Panel on Climate Change and also use scenarios (for example, see Rogelj, Meinshausen & Knutti, 2012). As scenario thinking is well-established in the context of climate scholarship and the communication of science, it is a fitting tool for our analysis of climate change information and denial websites, to see how scenarios are represented and understood as what the two sides are arguing about is the link between the present and the unknowable future. Climate change scenarios combine narrative storylines with quantification, unlike the definition of scenario we employ in the present article, but there is sufficient similarity in the terms to make our analysis feasible.

We will first analyze how scenarios are referred to on two climate change awareness (NASA Global Climate Change and Yale Climate Connections) and two cli-

mate change denial (Watts Up With That and Climate Depot) websites.⁶ Two websites have been chosen for each side, to yield an understanding of the strategies used. An attempt was made to choose representative examples for both discourse communities. NASA is a leading research institution in the field of climate change, originally raised concerns about climate change, and has played a central role in climate education. Yale University's Program on Climate Change Communication is a recognized institution in researching public climate change knowledge and has received awards for its science education efforts. These two sites, thus, can be seen as representative sources of climate change awareness information. Watts Up With That and Climate Depot are among the most widely read climate change denial websites and have also been referenced in previous research (e.g., Dunlap & McCright 2011, Harvey et al., 2017). Neither is run by academics but both have conservative political links.⁷ Thus, they can be considered representative of the climate change denial discourse. The websites all come from the USA, the country where the climate change debate has been most intense and politically driven (see, e.g., Dunlap, 2013; Oreskes & Conway, 2010). As English language information dominates the Internet, these localized websites have global audiences and thus affect the understanding of climate change across the world. There is also evidence of concerted spreading of climate change denial from the USA across the world (Dunlap & McCright, 2011, pp. 155–156). This justifies our focus on American material.

We will analyze how scenarios are referred to by the two competing interest groups and how effectively the potential of scenarios, in the sense that we have established above, is exploited for the clarification of the competing positions. This is very important because, as Cook et al (2018, p. 1) have argued, "When people lack the expertise and skill to evaluate the science behind a claim, they typically rely on heuristics such as substituting judgment about something complex (i.e. climate science) with judgment about something simple (i.e. the character of people who speak about climate science) and are therefore vulnerable to misleading information." We hypothesize that climate change scenarios might also be targets of such misinterpretation, thus creating "false scenarios" or limiting the creation of a wide range of viable scenarios that are necessary for the imagination of multiple futures.

The analysis employs the qualitative case study method, that is, a small number of texts are scrutinized in order to understand a broader picture. The findings of such a study suggest that similar instances may be found in other texts, but no generalizations are made (see e.g., Gerring, 2004). In the first step, the sites were scanned for the overall usage of the word "scenario". All four sites have an inbuilt search function that was used to elicit all results for the term "scenario" to get a broad sense of how the notion was being used. In view of the length of the present article, the discussion will look at the entries for 2018. The relative frequency of the term over this

⁶ The information was last retrieved on July 21, 2018 from <https://climate.nasa.gov>, <https://www.yaleclimateconnections.org>, <https://wattsupwiththat.com> and <http://www.climatedepot.com>.

⁷ Anthony Watts who runs Watts Up With That is a retired TV meteorologist, Marc Morano who runs Climate Depot a former Republican political aide.

one year is representative of the frequency with which scenario thinking is being discussed on the four sites in general. Copies of reports were excluded from analysis. Neither of the climate awareness sites employed emotional images with dramatic captions, as may have been expected (although the front page of the NASA site provides the core numerical indicators for climate change). The predominant visuals are satellite images and heat maps. In other words, the climate change awareness websites were not seeking to appeal to emotions with the visuals chosen.

The climate change awareness sites are run by academic institutions (NASA and Yale University) and their presentation therefore also seeks to focus on scholarship, albeit in the register of popular science. These two sites first and foremost present information about studies that report new research findings on different aspects of climate change. The dominant linguistic tools are descriptive (i.e. the experiment or study, its procedures and results are described, as one of the means of establishing the validity of the findings). As is common in scholarly literature, results are presented with appropriate reservations (e.g. hedging devices like modal verbs “can”, “may”, etc.), as few research results have absolute certainty (for more detail on the narrative style of research articles, see, e.g., Myers, 1994). However, there are also instances of strong claims (expressed in phrases like “direct links”). It is notable that the notion of scenario is referred to as a common term understood by the readers, without in-depth elucidation. It is acknowledged that there are plural scenarios (and that the plural scenarios have been used in climate change discussion since the 1980s, since the by now classical work of James Hansen, who proposed both moderate and extreme possible scenarios) (Oreskes and Conway, 2010, p. 184). Neither the classic or new scenarios are presented in full, that is, the reader will have to seek out the detailed picture elsewhere. For example, Hansen’s relatively optimistic 2000 scenario in which he explains the effects of limiting aerosols on climate change can be found on a different site of NASA (Hansen et al, 2000) and the IPCC website describes 40 scenarios, but this search has to be performed separately).

In the climate change denial sites, the term scenario is used mostly in an ironical manner, in exaggerated phrases like “worst-case scenario”, “horror scenario”, “doomsday scenario”, rather than with the precise meaning given the term in scholarly literature. The focus is on critiquing climate change scenarios, instead of offering alternatives. Moreover, in most of these texts, the very fact that for decades climate change scenarios have offered multiple possible outcomes goes unmentioned. The authors seem to disregard the fact that scenarios are hypothetical and hence cannot be rebutted like arguments. There is one instance in which the existence of multiple scenarios is acknowledged and the text has references to sources. The attempt to create a discussion on scientific merits is welcome, although there are reasons to doubt the academic objectivity of the author. There is a historical look back at Hansen’s scenarios in another text, with a focus on the errors that Hansen did not foresee. The third serious example engaging with scenarios refers to a reputable study by a reputable scholar but does so via a tabloid and misstates the core of the original study. These instances are exceptions in the largely emotion-driven corpus

that tends towards absolute claims. Differently from the material that they are trying to “debunk”, the climate denial blogs use emotional vocabulary (“stunning”, “silly”, etc.). In conclusion, it can be said that we see an expected pattern in the scenarios presented by the two opposing sides. The climate change awareness websites describe climate change scenarios in typical scholarly language, although without fleshing out any of the scenarios in the 2018 articles, while denialist scenario criticism is characterized by definitive and absolute claims and relatively little actual discussion of scenarios.

Even though this cursory discussion shows that the concept of scenario recurs in texts communicating climate change, their use now does not necessarily lead to a better understanding of future risks. For example, NASA site refers to “a scenario where greenhouse gas emissions continue at the current rate, there will be about 10 percent fewer atmospheric rivers globally by the end of the 21st century”. However, the precise details of the scenario or how it was created are not the focal point of the article. The article refers to the fact that a more conservative climate scenario produced comparable changes. The reader, however, is not told that the plurality of scenarios is central to the effectiveness of the method. Climate science sites seem to take knowledge of the classic climate change scenarios for granted. Both climate change awareness websites have excellent sections that explain the facts about climate change, with detailed references, but they lack (as far as this research was able to tell) a clear explanation of the use of scenarios. This lack of understanding of the notion of scenario and its in-built multiplicity and uncertainty is thus exploited by sources seeking to discredit climate science.

To exploit the full pragmatic potential of scenarios for the imaginative envisioning of possible futures that could inform decision-making processes, the nature of scenarios should be made explicitly clear in all instances. The narrative structure of the scenario also has to be spelled out to demonstrate the logical sequences of events, even in the case of seemingly improbable or politically unpalatable scenarios. A lot of effort in the present scenario discussion, in the context of climate change, goes into the precision of measurement and projections, but less attention is given to the narrative aspect, making it possible to politically misuse scenarios. To avoid manipulative uses, audiences should be equipped with critical thinking skills to operate, not just with facts, but also with scenarios.

Conclusions : Scenarios in critical thinking and in pedagogical practice

In the final section of the paper, we will try to use the results of our small empirical study to develop pedagogical guidelines for using scenarios in teaching critical thinking. As can be seen, the two sides approach climate change, as well as the notion of scenarios, in different ways, and this allows for the creation of a sense of controversy where it does not exist, in a scholarly sense of the word. It is clear that critical thinking about cases like this is vital, but teaching with the help of false and misleadingly presented information is not without its problems either. Using misin-

formation for pedagogical purposes can increase students' exposure to misleading material and thus cement misperceptions. Nyhan & Reffer (2010) have coined the term "backfire effect" for this phenomenon where people's misperceptions are, ironically, strengthened, even when they are presented with facts to the opposite. This becomes a challenge in the educational contexts where we are attempting to teach the controversy, as instead of reducing misinformation we may inadvertently strengthen pre-existing biases. Cook et al (2017) experimentally showed that media coverage that seeks to present both sides of the controversy and thus also indirectly maintains the validity of non-scientific misinformation actually reduces public belief in climate change.

Scholars, therefore, have also warned about the use of misinformation in teaching about contested issues in which science is complex and misinformation plentiful. Notably, in the case of climate change, there is no disagreement among scientists, that is, we are not dealing with a scientific controversy. Thus, when teaching the climate debate, the grounds of the two sides need to be elucidated more fully to show that we are dealing with debates with two focal points: on the one hand, the scholarly discussion about climate change and, on the other hand, a political discussion about government regulation. The anti-regulation stance should be viewed on its own merits, as a possible approach to social organization, but it has to be perceived as such first. Presenting climate change denial that grows out of a broader political distrust of government as an adequate theoretical view on climate would confuse the discussion and prevent an adequate critical weighing of evidence. If we can separate the climate change debate from the political debate, we would also be able to build better scenarios for both different climate outcomes and for different forms of political organization. Only when we compare scenarios that address the same concern can we use them to creatively explore the future and make adequate decisions today.

Until this clarity can be achieved in the scenarios discussed in public debate, the first step is to show the difference between scholarly and social controversies and teach students to separate them. A second step is giving students critical thinking strategies to take apart claims and thus to show them how they are being manipulated, which is likely to have a long-range effect. We are inspired in this by the work of Cook et al (2018) who believe that critical reasoning can teach people to analyze how claims are made. They believe this approach to be more effective than focusing on the truth content of denialist claims because research has shown that misinformation is capable of overriding facts. Cook et al (2018) persuasively demonstrate that providing a basic understanding of argumentation and its analysis was effective in refuting misinformation.

We believe that scenarios can also be fitted into a similar framework. That is, if we begin by a clear elucidation of the strategic value, as well as limitations of scenarios, we will be able to inoculate students against manipulative uses of scenarios. Students can learn how to creatively explore the future while also honing their critical thinking by being aware of the limitations scenarios have, so as to not mistake

the challenge to the scenario as an analytical tool for a challenge against the underlying factual and knowledge base.

The case study that we have presented shows that socially relevant debates can be harnessed for the development of critical thinking skills, above all critical reading, analytical reasoning and argumentation analysis. Critical thinking has mostly focused on analytical skills of deconstructing and problematizing arguments. This type of thinking is of utmost importance, but it has to be combined with productive and creative skills. We believe that this type of critical thinking pedagogy can be combined with creativity. In the work of de Bono (1970) creativity is a form of lateral thinking that he juxtaposes to vertical logic. We believe that such a sharp distinction between the two might be unnecessary for our purposes. In fact, Bailin (1993, p. 162) has argued that critical and creative thinking are the two sides of any “good thinking”. Ideally, this nexus will result in a critical creativity that entails the ability to assess the feasibility of new ideas and the ability to communicate them in cognition, action, and speech (Brodin, 2016, p. 974). Vidergor (2018, p. 100) also outlines three dimensions of thinking processes: scientific, creative and thinking processes, viewing creative thinking as a type of critical thinking. Perkins et al (2000) also believe that critical and creative thinking are distinguished by aims, not the actual processes of reasoning. Thus, we believe that the types of critical reading and analytical thinking skills that can be developed with the help of scenario thinking have the twin benefits of developing both critical and creative thinking skills.

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