The Informational-Interpretative Aspects of Large-Scale and Global Crisis

Gustavo Rick Amaral*

Recibido: 14.09.2022 — Aceptado: 05.12.2022

Título / Titre / Titolo

Aspectos informativos-interpretativos de la crisis global y de gran escala
Aspects informatifs-interprétatifs de la crise mondiale et à grande échelle
Aspetti informativi e interpretativi della crisi globale e su larga scala

Abstract / Resumen / Résumé / Riassunto

This paper discusses informational and interpretative aspects of large-scale crises like the COVID-19 pandemic and Climate Change. Laypeople might have difficulties interpreting information about «how a vaccine or the climate works» or «why a specific medication is safe and some particular research results are reliable» once this type of information requires some basic cognitive tools like statistical reasoning. This paper introduces the concept of *adaptational lag* to explain the general interpretative difficulties involved in abstract and scientific topics, which are basic in the modern complex world, particularly in large-scale crises. Statistics is a recent cultural cognitive development whose learning process in the individual mind is costly and, in many aspects, problematic due to cognitive bias and the automatic and intuitive mode of thinking. In comparative terms, the human mind is prewired to language. Humans are adapted on a genetic level to acquire language. From an adaptational perspective, statistical reasoning is a very different type of cognitive acquisition. In order to establish the concept of *adaptational lag* on some important contemporary scientific frameworks about the human mind, this article presents a brief comparative study of three cognitive acquisitions: (a) language, (b) written systems, (c) statistics and statistical reasoning. In the case of the human language faculty, the analysis is based on the theoretical framework developed by psychologist Michael Tomasello. In the case of the human capacity to write and read symbols, the analysis is based on the empirical and experimental work developed by neuroscientist Stanislas Dehaene. Finally, the analysis of the difficulties faced by the human mind in dealing with statistical reasoning is based on the «dual process theory» proposed by psychologists Daniel Kahneman and Amos Tversky. The present article argues that the major crises in the Anthropocene – the COVID-19 pandemic and the Climate Change are only two of them – will demand considerable reformation in the modern world epistemic institutions (universities, schools, and press media) to overcome the *adaptational lag*.

Este artículo analiza aspectos informativos e interpretativos de crisis a gran escala como la pandemia del COVID-19 y el cambio climático. Por ejemplo, los legos pueden tener dificultades para interpretar información sobre «cómo funciona una vacuna o el clima» o «por qué un medicamento específico es seguro y algunos resultados de investigación en particular son confiables», una vez que son cuestiones que requieren algunas herramientas cognitivas básicas como el razonamiento estadístico. Este documento introduce el concepto de *retraso adaptativo* para explicar las dificultades interpretativas generales involucradas en temas abstractos y científicos, que son básicos en el complejo mundo moderno, particularmente en crisis a gran escala. La estadística es un desarrollo cognitivo cultural reciente cuyo proceso de aprendizaje en la mente individual es costoso y, en muchos aspectos, problemático debido al sesgo cognitivo y al modo de pensar automático e intuitivo. En términos comparativos, la mente humana está pre-programada para el lenguaje, o sea, los seres humanos estamos adaptados a nivel genético para adquirir el lenguaje. Desde una perspectiva adaptativa, el razonamiento estadístico es un tipo muy diferente de adquisición cognitiva. Con el fin de establecer el concepto de *retraso adaptativo* en algunos marcos científicos contemporáneos importantes sobre la mente humana, este texto presenta un breve estudio comparativo de tres adquisiciones cognitivas: (a) lenguaje, (b) sistemas escritos, (c) estadística y

* Universidade Anhembi Morumbi

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

razonamiento estadístico. En el caso de la facultad del lenguaje humano, el análisis se basa en el marco teórico desarrollado por el psicólogo Michael Tomasello. En el caso de la capacidad humana para escribir y leer símbolos, el análisis se basa en el trabajo empírico y experimental desarrollado por el neurocientífico Stanislas Dehaene. Finalmente, el análisis de las dificultades que enfrenta la mente humana para manejar el razonamiento estadístico se basa en la «teoría del proceso dual» propuesta por los psicólogos Daniel Kahneman y Amos Tversky. Argumentase que las principales crisis en el Antropoceno, entre las cuales la pandemia del COVID-19 y el cambio climático son solo dos de ellas, exigirán una reforma considerable en las instituciones epistémicas del mundo contemporáneo (universidades, escuelas y medios) para que se supere el retraso adaptativo.

Cet article analyse les aspects informatifs et interprétatifs des crises à grande échelle telles que la pandémie de COVID-19 et le changement climatique. Par exemple, les personnes laïques peuvent avoir des difficultés à interpréter les informations sur «comment fonctionne un vaccin ou les changements climatiques» ou «pourquoi un médicament spécifique est sûr et des résultats de recherche particuliers sont fiables», car ce sont des questions qui nécessitent des compétences cognitives de base telles que le raisonnement statistique. Ce texte introduit le concept de *décalage adaptatif* pour expliquer les difficultés générales d'interprétation impliquées dans les questions abstraites et scientifiques, qui sont fondamentales dans le complexe monde actuel, en particulier dans les crises à grande échelle. La statistique est un développement cognitif culturel récent dont le processus d'apprentissage dans l'esprit individuel est coûteux et, à bien des égards, problématique en raison de biais cognitifs et de la pensée automatique et intuitive. En termes comparatifs, l'esprit humain est préprogrammé pour le langage, c'est-à-dire que les êtres humains sont génétiquement adaptés pour acquérir le langage. D'un point de vue adaptatif, le raisonnement statistique est un type très différent d'acquisition cognitive. Afin d'établir le concept de *retard adaptatif* dans certains cadres scientifiques contemporains importants sur l'esprit humain, cette recherche présente une brève étude comparative de trois acquisitions cognitives: (a) le langage, (b) les systèmes écrits, (c) les statistiques et le raisonnement statistique. Dans le cas de la faculté de langage humain, l'analyse est basée sur le cadre théorique développé par le psychologue Michael Tomasello. Dans le cas de la capacité humaine à écrire et à lire des symboles, l'analyse s'appuie sur les travaux empiriques et expérimentaux menés par le neuroscientifique Stanislas Dehaene. Enfin, l'analyse des difficultés auxquelles l'esprit humain est confronté dans le maniement du raisonnement statistique s'appuie sur la «théorie du double processus» proposée par les psychologues Daniel Kahneman et Amos Tversky. Il y a lieu de considérer que les principales crises de l'Anthropocène – et la pandémie de COVID-19 et le changement climatique ne sont que deux parmi elles – nécessiteront une réforme considérable des institutions épistémiques du monde contemporain (universités, écoles et médias) afin de les surmonter.

Questo articolo analizza gli aspetti informativi e interpretativi di crisi su larga scala come la pandemia di COVID-19 e il cambiamento climatico. Ad esempio, il senso comune può avere difficoltà a interpretare le informazioni su «come funziona un vaccino o il cambiamento climatico» o «perché un farmaco specifico è sicuro e determinati risultati di ricerca sono affidabili», poiché sono domande che richiedono alcuni strumenti di abilità cognitive di base come il ragionamento statistico. Questo testo introduce il concetto di *ritardo adattivo* per spiegare le difficoltà interpretative generali riguardo a questioni astratte e scientifiche fondamentali nel complesso mondo moderno, in particolare nelle crisi su larga scala. La statistica è uno sviluppo cognitivo culturale recente e il suo processo di apprendimento nella mente individuale è laborioso e, per molti aspetti, problematico a causa del pregiudizio cognitivo e del pensiero automatico e intuitivo. In termini comparativi, la mente umana è preprogrammata per il linguaggio, cioè gli esseri umani sono geneticamente adattati per acquisire il linguaggio. Da una prospettiva adattiva, il ragionamento statistico è un tipo molto diverso di acquisizione cognitiva. Al fine di stabilire il concetto di *ritardo adattivo* in alcuni importanti studi scientifici contemporanei sulla mente umana, questo testo presenta un breve studio comparativo di tre acquisizioni cognitive: (a) linguaggio, (b) sistemi scritti, (c) ragionamento statistico. Nel caso della facoltà di linguaggio umano, l'analisi si basa sul quadro teorico sviluppato dallo psicologo Michael Tomasello. Nel caso della capacità umana di scrivere e leggere simboli, l'analisi si basa sul lavoro empirico e sperimentale svolto dal neuroscienziato Stanislas Dehaene. Infine, l'analisi delle difficoltà che la mente umana deve affrontare nel gestire il ragionamento statistico si basa sulla «teoria del doppio processo» proposta dagli psicologi Daniel Kahneman e Amos Tversky. Si sostiene che le principali crisi dell'Antropocene – tra cui la pandemia di COVID-19 e il cambiamento climatico sono solo due casi concreti – richiederanno una notevole riforma delle istituzioni epistemiche del mondo contemporaneo (università, scuola e media) al fine di superare il ritardo adattivo.

Palabras clave / Mots-clé / Keywords / Parole chiave

Communication, cultural adaptation, cognitive bias, misinformation, Anthropocene

Comunicación, adaptación cultural, sesgo cognitivo, desinformación, Antropoceno

Communication; adaptation culturelle, biais cognitif, désinformation, Anthropocène

Comunicazione, adattamento culturale, bias cognitivo, disinformazione, Antropocene

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

Introduction

The Anthropocene tragedy consists of having the conditions to modify the environment significantly but not adapt to it. In this paper, we focus on an informational-interpretative aspect of this tragedy. Humans alter the environment and the general conditions in which their lives take place faster than their abilities to absorb the information, understand the changes and deal with them. The informational drama inside the Anthropocene tragedy can be observed in large-scale crises like the coronavirus pandemic and the climate change crisis.

Although the obvious differences in the leading causes and the nature of the threat, there are significant similarities between the coronavirus pandemic and the climate change crisis. In both cases, we face a global issue that requires collective efforts to address and demands a coordinated response, organized and implemented at multiple levels (local, national, global). In both cases, it is assumed that the measures that must be implemented involve considerable economic costs and interest conflicts.

Taking the coronavirus crisis as an example, one can clearly see the kind of war we are engaged in. At least in healthy democracies, the citizens and leaders concerned with this type of large-scale crisis have to struggle on two different fronts simultaneously. There is an abstract-informational battlefront where we have to inform people about the existence of the problem and the need for action, where we have to struggle with disinformation campaigns to convince and inspire people to act. And there is a concrete-pragmatic battlefront where the measures against the threat are effectively taken; on this front, we have to debate in the political arena, choose a program of action, mobilize the economic means required to implement the chosen program, and finally act. Our fate in the whole war is determined by the outcomes of this concrete-pragmatic battlefront, which in turn is conditioned by our success in the abstract-informational front. From our dramatic experience with the coronavirus crisis, we have learned that we are too vulnerable to disinformation. Much more vulnerable than we would like to admit. The news from the abstract-informational front are not good.

The main argument presented in this paper is that the vulnerability to misinformation is an essential part of a deeper problem: we have created a world that is so complex that we are not able to comprehend it without some cognitive tools, such as statistics, probability theory, modern logic, evolution theory, just to name a few. The adaptation of the human mind to these cognitive cultural tools is not automatic, nor is it guaranteed. In this paper, we propose the concept of *adaptational lag* to designate the informational-interpretative gap between the demands (in terms of understanding) of the modern world and our abilities to comprehend them and make justified decisions about them.

In order to establish this central concept of our argumentation on some important contemporary scientific framework about the human mind, we present in this paper a brief comparative analysis between three significant cognitive cultural acquisitions: (a) language, (b) written systems, (c) statistics and statistical reasoning. In the case of the human language faculty, the analysis is based on the theoretical framework developed by psychologist Michael Tomasello (2003, 2008). The analysis of the human capacity to write and read symbols is based on the empirical and experimental work developed by the neuroscientist Stanislas Dehaene. At last, the analysis of the difficulties faced by the human mind in dealing with statistical reasoning is based on the «dual process theory» proposed by psychologists Daniel Kahneman and Amos Tversky (Kahneman, 2011).

The concept of *adaptational lag* and other auxiliary concepts are introduced and discussed in the first section, where we also present the general lines of our argumentation. The second section develops the comparative analysis between the three «cognitive cultural acquisitions» mentioned above. In the third and last section of the paper, we elaborate on why the *adaptational lag* is, especially in democracies, an important challenge in the ambit of large-scale and global crises.

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

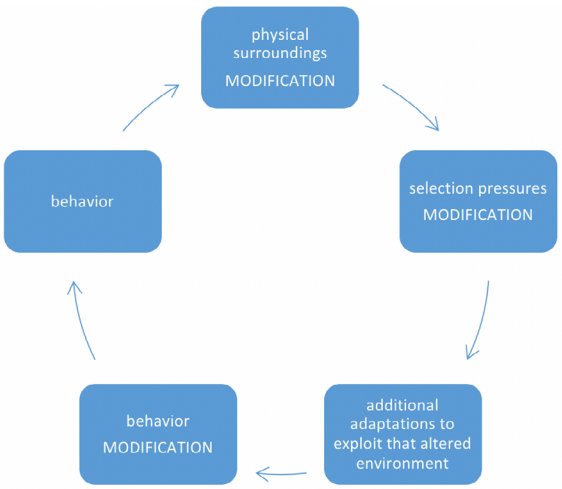
1. The anthropogenic condition and the adaptational lag

In the heart of the Anthropocene tragedy mentioned in the introduction, there is a fundamental relation between modification and adaptation. The primary issue is that the significant modification of the environment caused by human activities demands a high degree of adaptation. This paper focuses on the informational and interpretative aspects of these adaptation demands. Before we introduce the basic concepts of our argument – *anthropogenic condition* and *adaptational lag* – let us present a technical concept that has gained importance in recent years in Biology and will be in the background of our analyses in this paper: niche construction.

The biologists call «niche» the functional role an organism plays within an ecosystem. The term «niche construction» first appeared in a paper by John Odling-Smee (1988), where the author argues that it should be considered an evolutionary process. One decade later, Odling-Smee, in collaboration with Laland and Feldman, dedicated a whole book to explain the concept and its relevance to evolutionary biology. In the very first lines of their book, the authors affirm that organisms play two roles in evolution. The first one consists of «carrying genes; organisms survive and reproduce according to chance and natural selection pressures in their environments» (Odling-Smee, Laland, and Feldman, 1). According to the authors, this role is not only the basis for most evolutionary theory but has been object of detailed study and reasonably well understood. The second role is in the opposite situation. Not well studied and understood. The second role consists of what they call «niche construction». Its central idea is that organisms, in fact, interact with the environment and modify it: «organisms take energy and resources from environments, and by doing all these things, modify at least some of the natural selection pressures present in their own, and in each other's, local environment» (*ibid.*). The textbook example of niche construction is the beavers' capacity to transform the ecosystem (Naiman *et al.*) and create a modified habitat that supports many other creatures. Beavers construct dams on streams and rivers and use the resulting pond to build their houses.

In the light of this new understanding, a niche cannot be considered an immutable place in a fixed structure. In a paper about the origins of human intelligence and language, the cognitive psychologist and psycholinguist Steven Pinker explain that «a niche is something that is constructed, rather than simply entered, by an organism» (Pinker, 8995). Let us borrow the terms that Pinker employs to describe the relation between, on the one side, the modification of the niche caused by the organism's behavior and, on the other side, the organism's adaptation to the new conditions of the altered environment. In the author's words, «an organism's behavior alters its physical surroundings, which affects the selection pressures, in turn selecting for additional adaptations to exploit that altered environment, and so on» (*ibid.*). The following diagram illustrates the «cycle of modifications» occurring in the «niche construction» process.

In a general way, all living beings alter, to some degree, the environment. Therefore, the alterations caused by human activities in the environment and the adaptations that generally follow these modifications



ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

are a special case of a general phenomenon. In this paper, we are concerned with this special case and particularly concerned with how special it is. Let us call the human modifications and their subsequent adaptations *anthropogenic condition*. It can be described as the general situation where humans modify – through accumulated knowledge and technology – the environmental system, which in turn, once sufficiently altered, demands an adaptation process on the part of humans. The greater the modifications, the greater the adaptations. It is a matter of degree.

In addition, let us differentiate two types of this general situation: *basic anthropogenic condition* and *advanced anthropogenic condition*. The first one designates the condition where human activities cause a low level of impact on the surroundings. For most of our time on this planet, we were hunters and gatherers, and our activities based on what was then our best knowledge and technology had only a local impact. In this context – our humble beginnings – we were not far from the proverbial beavers mentioned above. The second type of *anthropogenic condition* designates the condition that has led us to what has been called *Anthropocene*. In the *Anthropocene era*, our activities – based on accumulated knowledge and technology – have had a significant impact on a global scale.

When it comes to the discussion on *Anthropocene* and the intricate net of political, economic, cultural, and ethical issues that go with it, we tend to understand the whole problem as a challenge that requires our societies to deal with the external impact of the anthropogenic action and its adaptational demands. In other words, when we talk about *Anthropocene,* we tend to focus on how human activity alters the environmental system understood as a space outside society and how the new conditions of the altered environment demand adaption. Unfortunately, the problem hiding behind this new term, *Anthropocene,* is even worse than this understanding suggests. What we defined above as *advanced anthropogenic condition* imposes specific challenges not only because it has been altering the external ambient of our modern society (the so-called environment) but also because it has profoundly altered our societies. This situation brings a challenge that is internal to our societies and, to a certain extent, to our minds. The *advanced anthropogenic condition* created a world with some large-scale problems (political and economic ones, for example) that are not only hard to solve but to understand and explain to lay people. These large-scale problems are usually presented within a scientific framework designed to describe a social and natural world that goes far beyond what our senses and bare intuition can capture. Bearing in mind these internal and external "sides" of the *Anthropocene* challenge, let us introduce the central concept of our exposition in this paper: *adaptational lag*.

The *advanced anthropogenic condition* induces a modification process that is so profound and fast-paced as to cause a lag between the demands of the current scenario and our abilities to comprehend them and make justified decisions about them. Throughout this paper, we will refer to the distance between those demands and those abilities as *adaptational lag*. What kind of demand and ability is at stake? On the one hand, the problem resides in the recentness of the modern industrial scenario: large-scale societies with profound and structural issues and large-scale production with its impacts on the environment. On the other hand, the problem resides in the recentness of some specific intellectual tools like statistics and probability theory (among others) that have been proven indispensable for dealing with modern world crucial issues (both to understand and to solve them).

The concept of *adaptational lag* and the discussion proposed in this paper is based on what the evolutionary biologist Kevin Laland and the psychologist Gillian Brown called the «*adaptative-lag hypothesis*». Their hypothesis is that «modern humans experience a large discordance in their selective environments compared to those to which they are adapted» (Laland and Brown, 98). Our focus in this paper is on the informational and interpretative aspects of the cultural gap involved in the situation described by the hypothesis. In further studies, we intend to deepen the investigation with the help of

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

another recent conceptual development of the Evolutionary Biology field of study, the concept of «cognitive niche» (cf. Pinker). In the next section, we establish the concept of *adaptational lag* through a comparative analysis of specific mental tools developed by humankind in different eras (from ancient evolutionary to cultural-historical times).

2. Comparative analyses of cognitive acquisitions

In order to observe the *adaptational lag* phenomenon, we must focus on some intellectual tools, i.e., some cognitive acquisitions. Let us compare, from an adaptational point of view, three different (and significant) cognitive acquisitions: a) language (and the correlated talking and listening abilities); b) writing system (and the correlated writing and reading abilities) and statistics (and the correlated abilities to produce and interpret statistical information). The essential point is that these cognitive acquisitions are distributed along a continuum that extends from biological to cultural adaptation. The oldest cognitive acquisition cited above is biologically entrenched in the human brain. Human beings are naturally prepared to acquire language (through what some linguists call the «language acquisition device»). The second one is much more recent. As we shall see in the next section, the writing systems are so recent that humans have not had time to evolve a specialized brain structure for reading. The structure we use is «borrowed». Thereupon, we had to invent institutions designed to teach how to write and read. The third acquisition cited above is not only very recent but is in conflict with our automatic and intuitive mode of thinking. In this case, we can hardly say that our educational institutions have properly understood the magnitude of the challenges. To understand why this particular case – the conflict between our automatic brain and statistical thinking – is an instance of the *adaptational lag* caused by the *advanced anthropogenic condition* in the modern world, we have to discuss in further detail how humans are culturally and, in some cases, biologically adapted to this cognitive tools.

Let us begin with the comparison of the first two acquisitions. When people think about the origins of language, they usually consider it a system that evolved naturally. It is regarded as a natural gift, understood as something given by nature, not made by man. On the other hand, written language is understood as a culturally developed system. It is considered a cultural invention made in historical times. However, the dichotomy Culture-Nature (or nurture-nature) is misleading, especially in this case. The emergence of language in our species can also be considered a cultural development, but an ancient one. So old that it had time to create biological roots. This paper argues that the primary difference resides in a specific variable: time for adaptation. Looking into our «reading brain» may help us to understand these differences.

According to the neuroscientist Stanislas Dehaene (53), a small sector of the brain's left visual system «plays such an essential part in reading that it can aptly be called 'the brain's letterbox'». It extracts, in less than one-fifth of a second, «the identity of a letter string regardless of superficial changes in letter size, shape, or position» and then, explains Dehaene, «transmits this information to two major sets of brain areas, distributed in the temporal and frontal lobes, that respectively encode sound pattern and meaning» (*ibid.*). Although such a specialized neural circuitry may suggest some type of genetic predisposition, Dehaene clearly states that it is not *logically* possible.

> The remarkably universal characteristics of the brain areas for reading bring us face-to-face once again with the enigma surrounding their evolution. How has our brain come to possess cerebral circuits specialized for reading? Why does visual word recognition always engage the same region of the brain in all readers, at positions that are always within a few millimeters of each other? By what impossible coincidence is this region equipped with all the features needed for efficient reading, including a capacity for spatial invariance, an ability to learn the abstract shapes of letters, and adequate connections to other language areas? Wouldn't these properties appear to imply that our brain is predisposed to reading? Not at all—irrefutable lo-

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

> gic dictates that this is impossible. The invention of reading is far too recent for our genome to have adapted to it. During the hundreds of thousands of years that saw the slow emergence of our species, specific devices for language and socializing may have evolved in our brain—but this cannot apply to reading, which dates back only a few thousand years (Dehaene, 119).

In contrast to language (the original and oral versions), in which some fundamental constituents go back deep into our evolutionary past, the writing system is much more recent. To emphasize the distinction between a recent cultural invention – the writing system– and the general human capacity for language, which is entrenched in our biology, we have to pay attention to the contemporary scientific approaches to what is called «the language faculty».

The contemporary studies on the origin and the development of the language faculty tend to integrate perspectives from three different temporal scales: the development of language in the individual (i.e., the development in the lifespan of an individual); the development of language in a cultural-historical time; and in an evolutionary time-scale. Since the theoretical approach that psychologist Michael Tomasello has developed is an excellent example of this kind of integrated study, let us take a brief look at his framework.

Tomasello usually focuses the explanatory power of his theoretical models to expound on how our species is able to employ (to linguistic and communicational objectives) abilities that are, on the one hand, uniquely human (i.e., specific human capacities) and abilities that, at the other hand, have an ancient and more profound evolutionary past (i.e., some abilities that we share with other species in our evolutionary branch). In the ambit of his models, Tomasello proposes explanations on two levels. On a phylogenetic level, the focus is on presenting the emergence and development of some capacities (specifically human or shared) of our species against the background of evolutionary history. On an ontogenetic level, the focus is on presenting the emergence of some capacities throughout the development of the individual (i.e., the development of the specimen over time).

According to the author, important empirical studies have revealed that we share some of the basic abilities of our linguistic and communicational toolkit with other primates. These studies might indicate, for example, that some «apes have the ability to, in effect, parse a conceptual situation into two different elements, such as event and participant, that is not so different from the way humans do it» (Tomasello, 2008, 255).

In the book *Constructing a language*, Tomasello (2003, 40-41) presents the following summary of his general ideas and argumentation. In the context of what the author calls a *usage-based perspective,* he proposes some hypotheses about language's phylogenetic and ontogenetic origins.

> First, the symbolic dimensions of language derive from a uniquely human biological adaptation for things cultural. This adaptation may be characterized as the ability to understand that other persons have intentional and mental states like one's own — which leads, quite naturally, to a desire to manipulate those intentional and mental states via social conventions. Second, the grammatical dimensions of language derive from people's uses of linguistic symbols in patterned ways for purposes of interpersonal communication, as these are played out repeatedly over historical time. In the evolution of human languages, various kinds of primate-wide pattern-finding and categorization skills — in combination with such things as pragmatic inferencing and automatization—worked over historical time in processes of grammaticalization and syntacticization to create in different linguistic communities a variety of different types of grammatical constructions. There was no biological adaptation for grammar (Tomasello, 2003, 40).

The objective here is not to go into the specific details of such theoretical debates on the origins and development of language but to point to the great distance that separates the emergence of language and the invention of the written systems.

The reading and writing competencies come at a considerable cost not only in cognitive terms to the individual (the learning processes that underlie the acquisition of these skills is considerably tricky) but in institutional terms to the society (the institutions deve-

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

loped to provide educational formation, especially literacy, are complex and relatively costly). The high cost to form and maintain these institutions explains the global education inequality, especially literacy rate inequality. According to Unesco data, in 2018, the global adult literacy rate was 86%, but only 65% in poorer countries (Unesco, 179). In addition, reading competence comes in degrees. As such, even if a person meets the basic standard for this competence, he may still be incapable of understanding, interpreting, and dealing with some products of the cultural world. The cultural landscape of the modern and industrial world is full of complex abstractions that require a high level of competence in literacy.

The last cognitive acquisition cited in our list is statistics and statistical reasoning. Clearly, it does not comes so "naturally" as language. Considering general learning difficulties, statistics is a cognitive tool that is in a much worse situation than our abilities to read and write. In a normal human mind, statistical reasoning has to swim against the currents of cognitive biases and, not infrequently, face the stormy waters caused by the conflict between scientific conceptual tools and culturally deep-rooted and wide-range beliefs.

In order to approach the specificities of this third cognitive acquisition and compare it with the other two presented above, we bring to our discussion in this paper a theory proposed by psychologists Daniel Kahneman and Amos Tversky to explain human cognition, especially in decision-making processes: the dual process theory. This dual model of cognition was developed based on some groundbreaking empirical studies made by Kahneman and Tversky in the decades of 1970 – 80 (Kahneman, Tversky, 1979) and has been used to explain an enormous variety of human cognitive vulnerabilities.

Let us take as a guide the more simplified version of the dual model presented by Kahneman in the book *Thinking, Fast and Slow* (Kahneman, 2011). The author proposes that the human mind operates in two distinct thinking modes called System 1 and System 2, or «fast thinking» and «slow thinking». To exemplify the «fast mode» Kahneman shows the reader an image of a woman with an angry expression. The experience as we look at the woman's face «seamlessly combines what we normally call seeing and intuitive thinking» (Kahneman, 2011, 19). The identification of the facial expression not only comes quickly to our mind but what we see extends into the future. When we look at this kind of image (with human facial expressions), our mind tends to anticipate likely actions. «A premonition of what she was going to do next came to mind automatically and effortlessly» (*ibid.)*. There is no conscious intention to read her emotions or to anticipate her actions. The set of reactions comes automatically to our minds. This, according to Kahneman, is an instance of «fast thinking».

To exemplify the «slow mode», Kahneman asks the reader to look at the following problem: 17 X 24. Compared with the previous example, we are now in a different situation. Although we can quickly identify it as a multiplication problem and have some vague intuitive knowledge of the range of possible results, a precise solution does not come immediately to mind. In contrast with the previous situation where we did not choose to engage in the process that led us to identify the facial expression, we feel that we have to decide whether or not to engage in the computation (Kahneman, 2011, 19).

According to the description made by Kahneman, if we, in fact, decide to engage in the task, we experience slow thinking as we pass through a sequence of steps: in the first place, retrieve from memory the cognitive program for multiplication that we learned in school; and, then implement the program. While holding on to the intermediate result, we can feel the burden of holding much material in memory, as we need to keep track of where we were and where we were going. «The process was mental work: deliberate, effortful, and orderly — a prototype of slow thinking» (*ibid.)*. Kahneman calls attention to the fact that this kind of process involves the mind and the body. When we engage in the slow mode of thinking, muscles tense up, blood pressure rises, heart rate increases, and pupils dilate (*ibid.)*. The

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

author explains the «division of labor» between the two systems in the following passage:

> The division of labor between System 1 and System 2 is highly efficient: it minimizes effort and optimizes performance. The arrangement works well most of the time because System 1 is generally very good at what it does: its models of familiar situations are accurate, its short-term predictions are usually accurate as well, and its initial reactions to challenges are swift and generally appropriate. System 1 has biases, however, systematic errors that it is prone to make in specified circumstances. As we shall see, it sometimes answers easier questions than the one it was asked, and it has little understanding of logic and statistics. One further limitation of System 1 is that it cannot be turned off. If you are shown a word on the screen in a language you know, you will read it — unless your attention is totally focused elsewhere (Kahneman, 2011, 25).

The psychologist and neuroscientist Joshua Greene suggests that the dual-process brain is an elegant solution to a ubiquitous design problem: the trade-off between *efficiency* and *flexibility* (Greene, 133). The idea of the «division of labor» presented by Kahneman (in the citation above) seems to be based on the interplay of basic principles like *efficiency* and *flexibility*. System 1 is very good at simple tasks where our cognition deals with a scenario that is in accordance with the automated forms of action established by previous experience. In this scenario, the mind can operate efficiently in an automatic mode. However, in a situation where our cognition deals with a complex task whose details and variations cannot be predicted based on previous experience and, for this reason, demands effortful thinking, System 2 has to come in, and System 1 has to stay in the background. The automatic and fast mode goes to the background because our mind has to operate flexibly to handle the situation in a satisfactory way.

According to Kahneman (2011, 36), System 2 comes in when the task demands our mind to keep in memory at the same time several ideas that require separate actions or need to be combined in order according to a rule (for example, «rehearsing the shopping list as we enter the supermarket»). System 1 is good at detecting simple relations («form A resembles form B» or «the son is taller than the father») and integrating information about one topic. However, System 1 «does not deal with multiple distinct topics at once, nor is it adept at using purely statistical information» (*ibid.*).

Two fundamental remarks. In the first place, even though System 2 comes to the foreground to conduct the thinking process, it does not mean System 1 can be deactivated. Kahneman states clearly: System 1 cannot be turned off. In the second place, we can fail to identify a specific task as a complex task that demands System 2, i.e., we can fail to "switch" to the slow mode of thinking. That is the heart of the problem with the conflicted relationship between the human mind and the third cognitive acquisition in our list in this paper: statistics and statistical reasoning. The problem can be observed in a phenomenon called *heuristics,* especially in the *availability heuristic*.

Heuristics is the process by which the mind substitutes a difficult question for an easy one and gives an answer to the easy question as if it was an answer to the difficult one. In the *availability heuristic* (Kahneman, 2011, 130), our mind substitutes a difficult question about the frequency of an event for an easy question about the ease with which instances (of this event) come to mind. The hard question «how frequent an event is» is substituted for the easy question «how easy to remember an instance of the event». Obviously, the conscious mind does not give an order to act that way. The process is carried out in an automatic mode. Our conscious mind accesses only the outcome of the substitution process.

For example, divorces among Hollywood celebrities and sex scandals among politicians receive extensive media coverage and usually attract much attention from the general public (Kahneman, 2011, 130). Therefore, the instances of this type of event come easily to mind. They are salient in the memory and easy to remember. The consequence is that people are likely to exaggerate the frequency of Hollywood divorces and political sex scandals due to the availability heuristic. When we ask people about the frequency of these events, their minds tend to go directly to "the easy question" about availability instead of consulting statistics about divorce

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

and sex scandals in the population and particular subgroups (celebrities and politicians).

In a book (published recently) about «rationality«, Steven Pinker makes some important remarks on this issue: «for most of human existence, availability and hearsay were the *only* ways to estimate frequency. Some governments kept statistical databases, but they were considered state secrets and divulged only to administrative elites» (Pinker, 119). Data came to be considered a public good only in the nineteenth century with the rise of liberal democracies, but even today, «when data on just about everything is a few clicks away, not many people avail themselves of it» (*ibid.)*.

The problem is that our automatic and fast thinking mode makes inferences based on our impressions, i.e., our particular experience with the world. In a situation with a non-negligible difference between the individual experience and the frequencies in the world, the consequence is a distorted understanding. Pinker explains that this kind of distortion happens when our experiences are a biased sample of the events «or when the impressions are promoted or demoted in our mental search by psychological amplifiers such as recency, vividness, or emotional poignancy» (Pinker, 119-20).

As we shall argue in the next section, the general problem imposed by psychological amplifiers, heuristics, and cognitive bias is that all these «cognitive vulnerabilities» create the ideal conditions for misinformation to thrive. Compared to the other cognitive acquisitions analyzed in this section, the status of statistics as a cognitive tool is considerably problematic. We can imagine it as mental software that is hard to install. Even when we successfully install it in a few heads, it does not seem to operate as expected in crucial situations. Statistics is precisely the kind of tool needed to deal with the complexities of the modern world: globally interconnected large-scale societies with some deep and structural problems. The modern world consists of phenomena that occur on such a big scale that human sensory-cognitive apparatus has difficulty dealing with it.

3. The adaptational continuum

In the second section, we affirmed that, in the context of the reflections presented in this paper, the dichotomy Culture-Nature (or nurture-nature) is misleading, and we would be better off using a *continuum* instead of a dichotomy. In order to return to this *continuum* proposal, let us clarify what we mean by the term «culture» here. In an evolutionary context, «culture» is a generic label to designate a type of variation in the behavioral repertoire of animals. Culture permits a range of behavioral variations that allow some populations to adapt to the environment without the need for genomic adaptation.

In this e, all the three cognitive acquisitions discussed in the previous section – language, writing system, and statistics – are cultural developments. To get to full development, each of these cognitive tools has to be used by individuals in the context of a cultural community. Nevertheless, the point here is that at least language has its roots seated in the «genomic ground». As explained, there are genomic adaptations that prepare us for language. Therefore, our point is that the human adaptation for language is much more hybrid and balanced – partially genomic, partially cultural – than our adaptation – mostly cultural – to the other two cognitive acquisitions.

We can imagine an «adaptation *continuum*» that goes from deep-rooted genomic adaptations that give rise to completely automatic behavior at one extreme to flexible cultural adaptations that give rise to conscious and controlled behavior at the other extreme. On the one hand, language is an acquisition situated in the culture side near the middle of the *continuum*. It is deeply rooted in the genomic portion of the *continuum*. On the other hand, the writing system, statistics, and their associated abilities are acquisitions situated in the culture part of the *continuum*. Far from the middle point, they do not have profound roots in the genomic portion, and their learning processes impose considerable cog-

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

nitive costs. Even if we consider that humans are born prewired for reading, it cannot be compared with the predisposition to speaking. In addition, statistical reasoning is not only a cultural development that is too recent and, therefore, too close to the «culture» extreme of the *continuum*, but it is in constant conflict with the «human mind automatic settings» (as explained at the end of the second section). This conflict creates the perfect conditions for cognitive bias to thrive, which, in turn, can establish the ideal conditions for misinformation to thrive and reinforce the initial bias. The cognitive bias reinforced by misinformation can create a vicious cycle that can result in severe distortions in our understanding of reality, especially the complex reality of the modern world. For this reason, the adaptional lag is more significant for this third cognitive acquisition than for the other two.

The point is not if (in a distant future) humans will be born with a brain structure exclusively dedicated to processing written symbols or statistical information. It may be a topic for future studies. However, in this paper, the point is a more pragmatic one: how can we prepare ourselves and our institutions to overcome adaptional lags? We defined adaptational lag as the distance between the demands of the current scenario, the modern complex world, and our abilities to comprehend them and make justified decisions about them.

Many societies around the world resort to specialized institutions and qualified professionals in order to overcome the problems that the human mind faces in the literacy learning process. Political issues and economic costs to maintain educational institutions explain the data about inequality in literacy skills presented in the previous section. In the case of statistics and statistical reasoning, the problem runs deeper. Our traditional educational apparatus simply is not prepared for the challenge. In this case, the *adaptational lag* is more significant than in the case of the reading skills not only because the learning process is arduous but because statistics is particularly designed to deal with a world of pure abstractions, which are very distant from the direct experience. Furthermore, as argued, this highly abstract cognitive acquisition is in conflict with the human fast, automatic, and intuitive mode of thinking.

Statistics is part of an admirable collection of cognitive gems – like modern logic, probability theory, and game theory – developed by our formal sciences (mathematics and logic) in the last few centuries. The abstract world opened up by these cognitive gems is an entirely new territory. In cognitive terms, the mind of the modern man is challenged to fly to heights never before reached by any other species or any other man at any other time. The set of tools designed to combat cognitive bias and our general vulnerability to misinformation has been called «critical thinking». In the following passage, Steven Pinker suggests implementing a critical thinking program in educational institutions.

> Educational institutions, from elementary schools to universities, could make critical thinking a greater part of their curricula. Just as literacy and numeracy are given pride of place in schooling because they are prerequisites to everything else, the tools of logic, probability, and causal inference run through every human knowledge. Rationality should be the fourth R, together with reading, writing, and arithmetic. To be sure, mere instruction fails to provide lifetime immunity to fallacies. Students forget it as soon as the exam is over and they sell their textbooks, and almost no one makes the leap from abstract principles to everyday pitfalls. But well-designed courses and video games — ones that single out cognitive biases (...), challenge students to spot them in lifelike settings, reframe problems in mind-friendly formats, and provide them with immediate feedback on their errors — really can train them to avoid the fallacies outside the classroom. (Pinker, 314-315)

The suggestion and remarks above lead us back to the very first lines of this paper. The Anthropocene informational-interpretative drama consists in having, on the one hand, the necessary knowledge and technology to modify the environment significantly but not having, on the other hand, effective means to promote understanding about the consequences of these modifications. This understanding, in turn, is a fundamental step, at least in democracies, towards any solution for any of the many particular problems that constitute the Anthropocene general crisis. The problem is that the knowledge

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272

mobilized to modify the environment can be concentrated in the hands of a small elite, but in healthy democracies, the knowledge needed to understand these modifications should be distributed over the population.

One of the biggest problems in the climate change crisis is that, to most people, it is not much of a crisis. It does not look like a crisis. At first glance, it does not seem to be an event dramatically squeezed in a short period demanding us to act immediately. Climate change is a phenomenon that occurs on such a large scale that it cannot be captured by human direct experience. It is hard even to imagine such a large-scale phenomenon for most of us who do not have specialized knowledge. Recently, in the context of the COVID-19 pandemic, we could notice that people might fail to grasp the urgency of the situation even when the consequences are immediate (and not projected far in the future). The enormous dimensions of this type of crisis not only make it hard to convince the general public about the existence of the problem but also create, as explained, the ideal conditions for misinformation to thrive. That is why we affirmed in the introduction that, challenged by this type of large-scale crisis, democracies have to struggle on two different fronts simultaneously, a concrete-pragmatic and an abstract-informational battlefront.

The challenge is how to reform the epistemic institutions of our modern societies and qualify them to overcome the *adaptational lag*. Epistemic institutions are those responsible for knowledge production (universities and research centers), reproduction (schools and other basic education institutions), and distribution (the press and other institutions specialized in the divulgation of verified information). To renew our commitments to, at one hand, the highest ideals of the Enlightenment as the universal distribution of knowledge and to, at the other hand, the basic principles of the liberal democracies as the individual's right to take part in the decisions that affect the whole collectivity, our epistemic institutions must be attentive to what we called in this paper *adaptational lag* and must find ways to overcome it. The Anthropocene Era promises to deliver some complex large-scale crises that will arrive first, at least in democracies, in an informational form.

References

Dehaene, Stanislas. *Reading in the Brain: the new science of how we read*. USA: Penguin group, 2010.

Greene, Joshua. Moral Tribes: *Emotion, Reason, and the Gap between Us and Them*. New York: The Penguin Press, 2013.

Kahneman, Daniel. *Thinking fast and slow*. London: Penguin Books, 2011.

Kahneman, Daniel & Amos Tversky. *Prospect Theory: An Analysis of Decision under Risk*. Econometrica, 47(2), 263–291, 1979.

Laland, Kevin & Gillian Brown. *Niche Construction, Human Behavior, and the Adaptive-Lag Hypothesis*. Evolutionary Anthropology - EVOL ANTHROPOL. 15. 95-104, 2006.

Naiman, R. J., C. A. Johnston & J. C. Kelley. *Alteration of North American Streams by Beaver*. BioScience, 38(11), 753–762, 1988.

Odling-Smee, F. J. .«*Niche constructing phenotypes*». In Plotkin, H. C. (ed.). *The Role of Behavior in Evolution*. Cambridge (MA): MIT Press. pp. 73–132, 1988.

Pinker, Steven. *The cognitive niche: coevolution of intelligence, sociality and language*. Proc. Natl Acad. Sci. USA 107, 8993–8999, 2010.

Pinker, Steven. *Rationality: What Is It, Why It Seems Scarce, Why It Matters*. New York: Viking Press, 2021.

Tomasello, Michael. *Constructing a language: A usage-based theory of language acquisition*. Cambridge: Harvard University Press, 2003.

Tomasello, Michael. *Origins of human communication*. Cambridge, MA: MIT Press, 2008.

United Nations Educational, Scientific and Cultural Organization (UNESCO). *Global education monitoring report 2019: Migration, displacement and education: Building bridges, not walls*, 2018.

ISSN: 2174-8454 – Vol. 24 (otoño 2022), págs. 87-98, DOI: 10.72033/eutopias.24.25272