

Technology and cognitive ability: the use of new technologies and the design of digital interfaces

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Abstract. This study is guided by the principle that there is no technology detached from an ideology. This ideology appears in the interfaces conditioning the relationship between people and digital artifacts. This article adopts as theoretical reference the User-Centered Design (UCD). Under the UCD principles it is presented a key to understand how technology is a vehicle of ideological content that affects the design practices.

Keywords: usability; interaction; UCD; interface, technology

1. Introduction

The word *technique* must be readily distinguished from the word *technology*. Technique in this study is understood as a set of rules that leads to a specific application of scientific knowledge useful to achieve an end. Technology, instead, is interpreted as the theoretical study of the technique or a set of technical knowledge. We do not want to discuss epistemological or ontological issues existing in the relations among technology, science and politics. We want rather to point out that the ideological context of knowledge appears on the interfaces of technological devices with which people must interact. In short, we do not want to investigate the instruments of power with backgrounds in technology, but note that technology is a vehicle of ideological content that affects the design practices. There is no technique or technology, apart from an ideology, both in its formation and in its approval instances. From product design, through the packaging, the manufacturing and transportation, until to reach the consumers' houses, the entire production process is outlined by ideological decisions that affect the interfaces of consumer devices.

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2. Technique, technology and interaction

Interface is the possible interaction between two independent systems [37]. The human interaction with technological devices is therefore only one of many possible types of interaction between two or among many independent systems. To say that humans and technological devices are two independent systems means to say that both have different structures. By filtering these structures, some possibilities of interaction appear. In this context, the way internal processors are organized, displays, dials and controls are filters. As well, the mechanism of perception and the people cognitive processes are filters too. But we can note that it has fewer and fewer boundaries between technology and people. Furthermore, less and less we have to learn how to use devices which are becoming more a part of us [27].

3. Technology, interfaces and ideology

Many authors [34] [23] [10] [12] [1] [20] [27] state their pessimism about technology, blaming it to

create totalitarianism and to deprive humans of freedom by imprisoning them inside a cage.

The scientific propositions of the late 1800s overestimated the technical relevance, leaving people defenseless. The binomial science-technology since then have the prerogative to state the truth, giving to human sciences the important and difficult role to bring to light the whole at the same time: differences and similarities; tradition and novelty; regional, national and transnational aspects, all these concerns at once [30]. The technique and therefore the technology are not limited to the relevance of a scientific success or are not a simple subject of economic order. In a Marcusean sense, we can say that scientific progress is a major statement of civilization, in which political disputes are based on ideologies of technical progress [23]. On the other hand, these ideologies announce huge potentialities and uncover new horizons to the scientific advancement [30]. The technique makes a seductive offer and brings us to the illusion that through it we can become the master of the world. Behind this illusion of power there is rather a submission to the technical rules used to control the tools and machines that humans think they employ to “dominate” the world [27].

The ability of technique to address new challenges is not enough to hide his appetite for power and control. Nacci [27] states that the dangers which the technique poses to freedom have been interpreted as a situation of dictatorship from what one cannot escape. These dangers are often identified with restrictions of individuals’ freedom. According to the author, the tyranny of technology leads to an impersonal industrial production and removes from the human work the characteristics that earlier lead people to create exclusive artifacts. This tyranny removes the differences among products. By equating the products, the technique also equals consumers [27]. In 1930s Jaspers [15] stated that the goods are mass produced, consumed and discarded without the technique consider the advantages of having unique items and without considering the benefits of what is original. There is no doubt that technology moves people away from their freedom of choice; however, we cannot say that the technique will decide on what people need. It is rather as Nacci [27] says: “If we do not choose, it does not mean that ‘we are being chosen’ by the technique – as it is often said – but the alternative is that someone is choosing for us” (p.35).

4. Ideologies and consumer’s freedom of choice

But what can we – or should we – choose? In any case, there will be always an ideology saying what people must choose. We may illustrate with the Bonfantini’s [7] worthy advice about what people have to adopt. Even if the author argues with an accurate perception and proposes a solution more concerned with people, there is already a strong ideological content in his proposal. He, indeed, sheds light on the human thinking in his speech on “New Technologies and Subjectivity”. He says that “some vital emerging issues for mankind are: the hunger, the threat of ecological catastrophe and the danger of nuclear war (...)”. He continues to say that “the capitalist modality of industrial production does not solve these problems and, actually, exacerbates them even more”. In plus, the author states that “to solve these problems is necessary to interrupt the current mode of production-reproduction, and then replace it with a more appropriate way to survive”. Therefore, says Bonfantini [7] “we need a maximum diffusion of new mental habits to overthrow ingrained habits” (p. 110–111). The same ethic that generated the modern pattern of production, however, is also generating tools and machines that people today are constrained to use. Among other issues of lesser importance to this study, Bonfantini [7] says that “it is about stopping the privilege of the quantity and ownership of industrial goods to focus on the intensity of use” (p.111). So far, there are two problems related to each other that must be addressed: (1) the *quantity* of goods should give way to the *quality* and, also, (2) *ownership* should give rise to the *intensity of use*. The question is: what is the ideology behind this proposal of change? Firstly, the nuclear war, for example, in the 80’s was on the focus of human worries, but nowadays it is no longer a central preoccupation. The fear concerned with the nuclear war is clearly an ideological issue. But, considering that we correctly identify the important emerging issues to the human survival, it does not guarantee that our proposals for solving such problems will be as so well addressed. It seems like Bonfantini’s speech is more warrantable because he bear his words on the theories about the survival of species. Therefore, we can say that we are destroying the Earth, but to say that focusing on the intensity of use will solve the planet environmental troubles, it is only our ideological opinion. This kind of opinions is guiding many design actions (mainly on the service design, but it also echoes on design of interfaces). Although these opinions may disentangle

many problems, it is not the only way to solve them. Moreover, these opinions are pointing to solutions not necessarily the same as other people would choose to take into account.

The problem of the limitation imposed by the established authoritarian model is reported in the recognized work of Hirschman [13] that, in the 70s indicated that users had only three options in front of the arrogance of the designers: (1) stop using the product; (2) use it, but to raise the voice in protest or (3) become loyal to the product (“loyal to” should be read as “conditioned to”).

5. The consumer’s choice beyond the ideology

We can mention many researchers that deal with links between technique and mass as Jünger [16], Jaspers [15], Keyserling [18], Spengler [34], Ortega y Gasset [29] and Anders [3]. Relying on Keyserling humanistic interpretation of the relationship between technology and democracy, Nacci [27] says that the choice consented to people is whether to be mediocre or to be savage. The author argues that mediocrity is a result of the mass production that connects the technique with the spirit of the mass by means of intellectualization. The author states that “nowadays the production in large quantity is a concern more important than what is conveyed by technical or mechanical-materialistic thought. The result is the institution of the masses as a main worry”. (p.29).

Hiuzinga [14], instead, argues that the prodigious development of technology has caused on the mass a permanent state of puberty and asserts that persons literally live in their world of wonders such as teenagers. The author asserts that we can travel by plane, talk to another hemisphere, find goodies with some coins in a vending machine, bring to home a piece of the world together with a radio receiver (it is a 60’s text), as well, – he says – we can press a button and the life runs to find us. The author asks if such a way of life can make a people emancipated. For him the answer is “quite the contrary!”. Hiuzinga [14] refers to the world to our fingertips, but usually both in the formal appearance and in the functional aspect this is only a fictional world. About this case, Nacci [27] says that the technique is not identified solely, or mainly, with the industry, but especially with the media. The author cites Gehlen [11] who argues that once we learned through the hearsay and now the knowledge is communicated by the information industry as a collective action. The collective actions bring the individuals to lose their personality

and they are prone to have a simplified thought. In this way, by means of collective action, the author states that appear the fury of mass in detriment of the individuality. The simplified thought is typical of the technique, thus, also of the mass. From the lack of humans critical assessment born the savage attitudes expressed in the mass psychosis, in the psychic repression, in the uncontrolled bursts of pulses, in being suggestible etc. This savage state is ironically mentioned by Polistchuk and Trinta [30]. They say that, the machines become ever more sophisticated and human brains more primitive. Mumford [26, apud 27] states that: “the direct result of the use of machines was to make humans materialists and rationalists; the indirect result was instead to make them emotional and irrational” (p.303).

In any case, both about the mediocre humanity and the savage humanity, these authors argue that the technique submits individuals, standardizes them, destroys their cognitive ability or leads them to irrational levels. The lack of criticism and freedom (due to the submission to the rules laid down by technique) can be observed in the use of any interactive device produced for the mass. To use these tools and machines is not very interesting to have an interpretative reasoning, but it is particularly required that the individual knows the operational rules to get this or that outcome. Typically these devices, taking them as they were designed, are conceived to achieve preset goals and they have a default operating procedure. We can suppose that someone could use a device in an unusual way. Also in this case, even if someone uses these devices atypically, the rules that determine their functioning are still the same.

6. Another possibility for consumer’s choice

Some theorists [7] [11] [25] [17] [30] see the new technologies in a less pessimistic way. Polistchuk and Trinta [30] argue that the technique – human ability to manufacture and use tools and machines – from one side is defined by an ordered set of procedures, established by a rigid scientific protocol; from the other side may also suggests some creativity in view of the result to be achieved. Bonfantini [7] states that it is worth risking the possibility that new technologies (although they may aggravate the evils that afflict our society) lead us to new and more open subjective habits. By means of this new subjectivity, we could “broaden the taste and praxis for a radical transformation of production relations” (p.114).

There is no doubt that the technique imposes a rigid grammar and, even if rigid, it continues to evolve and change over time. Every age has its own technique, supported by scientific knowledge and driven by a political will, and every technological device stops a moment of the history and carries an instantaneous of the world. From a set of these instantaneous, we can understand the evolution of technology. New technologies integrate the collective imaginary. This is a simplified imaginary that inevitably leads to standardizations as well to mediocrizations, but also generates a discourse about a culture [30]. New technologies reveal their real chance only if they get older and walk towards obsolescence.

7. New technologies and ideology

It is very common to bind the term *new technology* to the telecommunications field. In fact, devices that incorporate automatic management of information and processes can be understood as products of new technology, especially if it includes a high level of technical development. What is defined as new technology should not necessarily be conceived by a need determined through the rationality; as well it should not be scientifically proved (mainly if it is related to telecommunications). Moreover, it is not even obliged to use technology of the latest generation. More than anything else, new technologies can be related to things conceived in order to awaken the curiosity, interest and sensations of consumers. This kind of new technology “is not interpreted as new by greater or lesser technical sophistication it employs, but by the cultural impact it can cause; by its many interconnections with the socioeconomic structure [...] and because its implementation is oriented to meet more the corporative business dealings than any other imperative interest” (p.41) [30]. When it comes to adopting new technologies in domestic systems, automatically stirs the idea that interactions should be obtained by means of computer interfaces, epitomized by screens and keyboards that impose humans to learn strict procedures. Objectively this is not the only type of products, but is that routinely available to the mass. We could use a range of technological solutions found in the electronic market to create interfaces completely different from those we have now. We could, for example, make use of voice commands, but talk to machines will not make them more intelligent and will not change too much the requirements of cognitive ability we need to lead this kind of device to work.

Anyway, we can understand from the pessimistic authors that there is a loss of cognitive ability due to the equalization that pushes the taste of the mass towards to the mediocrity. However, in an optimistic view some authors believe that the use of these new technology tools do not necessarily bring people to a cognitive loss. On the contrary, these theorists deem it likely that these devices require new cognitive structures to allow a broader interpretation of digital artifacts and a more rational use of them.

Despite some pessimism, Marcuse [23] argues, for example, that the improvement of the machinery performance and the technological development allowed workers to augment their free time. This time in plus has also abetted the consolidation of “Eros” and the creative activities. At the mercy of technological advances, it is possible that future languages emerged from these new technological tools and machines acquire a dynamic character and a more changeable structure. Perhaps, technological developments play an important role in the satisfaction of new wishes of expression that have nothing to do with technique or technology. Without doubt they are tools and machines with rigid command syntax, although they are also renewed ways of communication that require new abilities of signification to understand them. Bonfantini [7] in his speech about “New Technologies and New Subjectivity” says: “I do not think that new technologies could itself solve or positively revolutionize the evils, the problems, the nodes of our social life, but I do not believe also they constitute an additional obstacle on the way of helpful changes. I do not believe that new technologies will revolutionize the history, but I do not believe also they will make the history sleep” (p.108).

8. Technique, new technologies and interfaces

Even if consumers are defined by marketing strategies, the interface of devices, however, are selected by people who can make their own choices as consumers. Choosing a better technology for humanity also depends on an ethical position. It raises a discussion in the way Tonkinwise [35] think ethics. The author states that when a society needs to establish a discourse on ethics, on how to act ethically, it is a society in trouble. If we have to teach someone how to act properly, by the ethical point of view, this ceases to be an ethical action and becomes to be a moralizing action. The author sustains that ethics must be learned “osmotically”, just because a person belongs to a culture, without the need to establish

rules of conduct or instilling artificial behaviors; otherwise it becomes an unsustainable society. To the author, the lack of ethics as ethos is essentially a lack of road that could integrate what is known with what is done. This means that there is a problem that must be faced in the field of Education.

The immediate conclusion is that the political principles that support the current model of application of the technique, along with new technologies, resulted in a significant change in the human relationship with their tools. These changes are (1) a simplification of language that leads to a decrease of reasoning (human mediocrity), (2) a simplification of human interaction with the world that, ultimately, leads people to search for strong stimuli of the senses (human savagery) but (3) we can also talk about a flat ground that could open new possibilities of interaction not yet experienced (human creativity?). Anyway, technical applications, i.e. technologies, are pervaded by political ideologies, which come to end in the devices interactive interfaces (to want the interfaces be more flexible is, in itself, an ideological concern). Some theorists argue that the choice about how to apply technology leads to a severe cognitive constraint. Other theorists, however, maintain that the current model of technological development is not closed to new forms of expression; hence, it requires new cognitive structures. Clearly, the creative use of technological resources will depend also on both the scope of the users and on their signification ability.

9. Consumers' inventiveness

Products made for the mass can be creatively used. By the way, Aune et al. [4] mention the study of Keat et al. [17] in which, through a process of appropriation, people transform the product for the mass into something personal and private. In the words of the authors [17]: "In the modern societies the most important of this mechanism is the control of meaning. The manufacturer authority is supported by his ability to define a meaning for the objects and to decide how to operate them. The manufacturers lose the control proportionally as consumers start themselves to get ability of use. Such a situation is on the whole likely in a society which consumption is organized around images and lifestyles and when active consumers continuously rethink the meanings of things they consume" (p.7). This way of looking the consumers-products relationship has dominated the studies on consumption culture of the 80's [25] [4].

McCracken [25] investigated about the acquisition of things in the broadest sense (acquisition also from the cognitive point of view) and identified four evolutionary stages of the user-product relationship. The author calls the last stage "a domestication process" that focuses on the relationship between consumers and manufacturers. We can say that at this stage, manufacturers should take care to propose designs more easily appropriable by users. What emerges from these studies is that designers must consider both the meanings that consumers give to these products, and practices that users adopt while they are using it. According to McCracken [25], this way of conceiving the product promotes a rapid shift to what attracts people. However, unfortunately, teenagers were the emphasized target and, thus, the market has turned only to the needs of this segment of consumers. The focus was then on the production of clothing, mobile phones, computer games etc.

Some authors [25] [17] [21] [5] [28], [4] demonstrated that the default function of the artifacts can change when they are handled by consumers. So, the relationship of consumers with products made for mass is not as passive as the pessimists would led us to understand. Aune et al. [4] argue that these changes have symbolic and pragmatic aspects. The dynamics of these changes on the one hand point to the problems that arise when attempting to describe the needs of users as something stable, on the other hand, emphasize the need to give to the products a few features that make the user experience more malleable. The users experience pattern should swap, according to shifts in the meaning they give to consumer products.

10. The meaning of new technologies

According to Bonfantini [8], the construction of a meaning depends on the relationship among many different significations that express the performance of a phenomenon. If we want to give a meaning to a phenomenon, it is not enough to consider only the subject, the object and the action. We must to move along the time axis to build a sense of reading. The construction of meaning is a rhetorical dialectic process that occurs between the structure present in the object being read (text) and the reader's interpretation strategy. The relationship between text and reader has some limits of interpretation [9]. These limits are given by both the possibilities of meaning that the text can take within its own structure and the subjectivity of the reader who according to the con-

text may slightly change the meaning. In a way or another, during the interpretive process, the individual makes the meaning to slip on the signifier [19]. Unfortunately, the text read at the interfaces of machines and tools still implies a very limited possibility of interpretation. This is a limitation set by the very restrictive syntax of the technique, excessively based on rigid rules, even if the devices with the current technology could provide a more flexible language. In the case the operator cannot respond unexpectedly and the result of his action be jeopardized: the washing machine will not wash or will not wash properly; the phone will not start a call or will set up a wrong number; the calculator will not give an answer or the answer will not be worthy of consideration. But the meaning of dialogue between user and device is defined by the change of status of the device. Obviously, the meaning can arise also from an unexpected change of the status of the device, either, by mistake during operator-device dialogue, as by the willingness to experiment without worrying, some situations that lead to an accidental change of the device status. In this case, does not have a "Finally!" or a "Hey, it works!" because the trial does not have a specific goal, as well, it does not seek to meet the purposes pre-defined by the device manufacturer. In any case, the interfaces play a crucial role in the cognitive process that allows the operator to assign a meaning while reading a device. Interfaces direct the choices of operators and their access to the contents of the devices. People, however, have an innate tendency to change the meaning. A language is radically incapable of defending itself from factors that change minute by minute the relationship between the signified (meaning) and the signifier (elements) [32]. People therefore feel a great discomfort when faced with languages that do not tolerate the slippage of signified under signifier. Most parts of devices still have an unchangeable interface, i.e., once an interface has been designed to be used in a certain way, will continue to be driven in that way until be replaced by another model. Either way, there are changes from one model to another, from one version to another. Changes made to devices cause a shift in how operators trigger them. As a consequence there is a change also in the operators' cognitive processes. But, rather than technical advances or technological developments, what is remarkable is that is the financial reward to push these changes to the fore, provided that such changes serve to rekindle the interest and curiosity of consumers.

11. Users and design of interfaces

Akrich [2] says that designers define actors with specific tastes, competences, motives, aspirations, political prejudices, and so on by assuming that morality, technology, scientific knowledge and economy will be developed in a certain way. Moreover, He says that the principal effort of an innovator designer is to inscribe his own innovative vision, or prediction about the world, inside the technical content of new objects. Even if a designer leads users to figure out a way to organize the elements of an interface, in fact he is only accomplishing what he technically already pre-determined about what he thinks should exist between objects and actors. Nevertheless, it is possible that any actor will perform the role as it was expected. It may even be that users themselves will define roles very different from that which were predicted.

To Redström [31] "are the people who inhabit the world, not users" (p.129). He argues that the central problem is caused by a designer unresolved misunderstanding. The author says that designers cannot distinguish the conception of an artifact being designed from the conception of who should use what is being designed. Hence, designers make a shift to planning what users must have to be. The author says that users are something that designers create. A person turns out to be a user when is faced with an object and makes it to become a part of her/im when s/he decides to use an object for any purpose. In this regard, Bessa and Pizzocaro [6] state that if the concept of user is based on the object-centered perspective – with persons defined in relation to the object – the User-Centered Design risks to becoming some kind of a "design of the user". So, in many cases, the principle of design for people hides the fact that, actually designers are only designing better users. This is a design of the users because this process shapes how the usage and users must to be and, as designers, we transform people into users when we are planning something to be used [31]. By the time we plan a willed function in an obvious way to the user and at the time we turn an object impossible to resist, we are actually planning not only the object, but also its perception – and even its experience. In the matter of designing the experience, we can state that people do not voluntarily seek the meanings of things, but especially they look for the experience of things. On the question of the meaning of things that stands out from the experience, Redström [31] indicates that, if the designer wants to plan the use of some object; then he must to be worry

about how – and to what extent – a particular product invites the user to interpret its own characteristics. A designer must also know that the appropriation of the object by the user is something that himself is controlling. To Redström [31], semiotic is particularly well articulated to deal with the experience design. To him, this kind of planning is useful to create interfaces that allow the receivers to reconstruct a meaning through their own experience. Likewise, Volli [36] states that semiotics can provide a theoretical framework to bring new and more open forms of interaction, which better corresponds to the subjective expressions of people.

12. UCD and design of interfaces

Despite the efforts of some approaches that defend the design of interaction *with* the users, the designer of interfaces continued throughout most of the time, to respond, not to the people, but to the demands of the market [24]. Even if the market is defined both by the marketing actions (that affects the users through an established mediocrity), and by the consumers standpoint who, despite the intentions of the marketing agents, still have the power to choose and move with some independence, especially when they have to give a meaning to the interfaces. However, the modality of interaction now present on devices is rooted not only in the marketing interests wished for the masses, but it is also affected by technological development. A clear indication that the technological development imposes to users a human constraint is the well known case of the QWERTY keyboards. This model of keyboard was designed to slow typists speed because the sluggish mechanism was causing the typebars jamming. This problem does not exist anymore, but this kind of keyboard is used even today. When the mechanical engineers solved the problem, Remington & Sons tried to propose other settings for the keyboard layout of the typewriter. They solved the problem by leaving the typebars visible and accessible to the typists, but consumers refused any kind of change. Today, electronic keyboards no longer have the problem of the mechanical jam. It is usually said that the human cost defeated the various proposals for altering the keyboard interfaces, but during the second war, the U.S. Navy's experimented different layouts of keyboards and Dvorak found another model (1932 patent) that had a significant higher yield of typing, and only ten days were enough for typists succeed in overcome the skill that had first [22]. While the alternative of reducing the human cost is more familiar with ergonomic

objectives (and the question that emerges is: “How to avoid the human costs in the use of new technologies?”), the alternative of creating more interesting and attractive products, is aligned with the marketing interests (and the question that comes out is: “How to reach the consumers acceptance?” Often, the answers to these questions are the same. The common feature of UCD theories is to believe that users involvement can improve outcomes, both in terms of functionality (usability, productivity, readability, etc.), and in ethical terms (democracy, justice, aesthetics, etc.). In this way, Aune et al. [4] state that “the user can be passive or active, communicative or silent, powerful or weak, but the chance he has of communicating his views about what exists in the mass market, is still severely restricted”. The theory of innovation, as illustrated by The authors [4] say that learning-by-interacting (when designers interacts with the users) is a solution to establish the users communication with designers reserved to a few companies with enough articulated infrastructure to allow people to democratically participate on the design decisions. Moreover, the results of actions learning-by-interacting are not always translatable into applicable design concepts, especially considering that people are more likely to talk about how they think a situation should be, than to talk about how they actually would like the situation dwelled [4]. The theories based on the Technology Assessment (TA) start from the premise that the usage of new technologies can be harmful to humanity and the “human cost” can and should be avoided by any kind of control that anticipates the impacts of its use. The TA may be directed: (1) to guide the choice between several possible uses for the new technologies and work as a tool to support its approval in order to avoid hazardous circumstances or (2) to orientate the project effort towards the creation of products more accepted by consumers intervening inclusive on the strategy of use [33]. The difficult role assigned to the TA is to decide when to promote and when to inhibit the use of new technologies. The TA demonstrates, thus, a genuine concern towards a social responsibility, often praised by his supporters. However, since the official institutions of the U.S. (OTA, Office for Technology Assessment) implemented the TA to investigate the dangers of new technologies to people, the TA came out from a situation of cultural and social distress to slip toward a political and economic concern [33]. To assess the risks that technology can make to humanity both is not inherently easy, and is not easy due to the different interests involved: shareholders, manufacturers,

users, government, etc. Each of these social actors has a different notion about the value of new technologies [33] [4], each has a different point of view about economic and political concerns. Considering that the TA is used as instrument of control by the executive governmental organizations, it is natural to understand that the questions about development of technology, although based on social and cultural interests, is inherently related to political and economic issues [4]. The application of TA is at risk to be a popular management directed to carefully fit the results.

13. Conclusions

The technique has an excessive preoccupation with the form instead of the content, but it could be changed by means of the flexibilization of interfaces. We must not forget that the techniques are defined within a culture. New technologies, therefore, are conditioned by this culture too. Thus the digital interfaces that adopt new technologies are steeped in this culture and as a result, the culture becomes visible at the interfaces as a cultural expression. However, We have always to ask what ideology is behind to our counter arguments that may change our way of thinking. The main difficult is to know if we had a good crossbreed idea, instead to be only influenced by an ideology to point a solution. By using the UCD approaches to find a solution to an interface, the biggest difficulty is whether in fact we had a good idea that gathers various points of view (overall the non-yet-user point of view) instead of having only been influenced by any ideology.

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