Towards a *gambiarra* epistemology: invention, complexity and paradox in digital technical objects[a]

Por uma epistemologia da gambiarra: invenção, complexidade e paradoxo nos objetos técnicos digitais

JOSÉ MESSIAS[b]

Universidade Federal do Maranhão, Graduate Program in Communication. Imperatriz – MA, Brazil

IVAN MUSSA[c]

Universidade Federal do Rio Grande do Norte, Department of Social Communication. Natal – RN, Brazil

ABSTRACT

By associating processes of constitution of digital objects to the concept of *gambiarra*, we aim to uncover the modes of existence that render the *gambiarra* as a crucial operator in the relationship between techniques, bodies and society. The aesthetic, political, and cognitive dimensions of the concept form an alternative version of technicity that allows us to understand the complex and even paradoxical aspects of digital sociotechnical formations. The empirical demonstration of these ideas will take place in three levels: the redirection of capacities of processing in video game consoles and video cards; the reconfiguration of software and user interfaces; and the resulting invention of rhythms and ways of seeing, feeling and acting in video games.

Keywords: *Gambiarra*, digital technical objects, games, complexity

RESUMO

Associando processos de constituição de objetos técnicos digitais ao conceito de gambiarra, busca-se revelar os modos de existência que tornam a gambiarra um operador fundamental às relações entre técnica, corpo e sociedade. As dimensões estéticas, políticas e cognitivas do conceito compõem uma vertente alternativa da tecnicidade que permite elucidar o caráter complexo e muitas vezes paradoxal das formações sociotécnicas digitais. A demonstração empírica dessas ideias se dará em três níveis: o redirecionamento das capacidades de processamento de consoles de *video games* e placas de vídeo; as reconfigurações do *software* e das interfaces gráficas; e a consequente invenção de ritmos e formas de ver, sentir e agir nos *video games*.

Palavras-chave: Gambiarra, objetos técnicos digitais, games, complexidade

[a] This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

[b] Adjunct professor of the Social Communication/Journalism course and of the Graduate Program in Communication at the Universidade Federal do Maranhão. Former post-doctorate researcher (Capes/PNPD) at PPGCOM/UFF. Head of the research group GamerLab/UFMA. Orcid: http://orcid.org/0000-0001-6950-220X. E-mail: jose.cmsf@ufma.br

[c] Assistant professor of the Social Communication Department of the Federal Universidade Federal do Rio Grande do Norte (Decom/UFRN) and vice-coordinator of the Games research group of the Intercom research association. Orcid: https://orcid.org/0000-0003-1831-2822. E-mail: ivanmussa@gmail.com

DOI:http://dx.doi.org/10.11606/issn.1982-8160.v14i1p173-192

From the point of view of Complex Systems Theory, life is organized matter that, learning how to modify its own structure to answer changes in the environment, started to connect molecular reactions' durations at the billionth order to the thousands of years of environmental transformations, to the millions of years of geological transformations, to the hundreds of millions of years of astrophysical transformations. The undergoing technical acceleration in contemporaneity overlaps the connection between the material and biological rhythms and the prestissimo *of cultural production*[1].

Luiz Alberto Oliveira (2003, p. 167)

Modernity ends with the rise of a technological consciousness, meaning both the consciousness of the power of technology and the consciousness of the technological condition of the human.

Yuk Hui (2016b, p. 42)

INTRODUCTION

THROUGHOUT THE HISTORY of digital technologies, it is possible to identify a myriad of phenomena that reveal a paradoxical finding: billion-dollar industries, with their rigid, rationalized circuits of production, often impose more obstacles to innovation than environments mostly devoid of resources and investment would. One could argue that the absence of coercive schemes and the demand for profit allows "free" creativity to flourish. This paper, however, seeks an inverse approach: instead of pointing out the lack of such constraints as the engine behind innovation, we intend to investigate the nature of the interactions whose presence enable new modes of production. Some of those are based on the abundance of resources and on the established rational logics, while other processes of conception and construction are born of aberrant movements and irrational logics, based on precariousness, improvisation and the divergent functions. The latter is the mode of production we will call *gambiarra*[2].

First, it is necessary to point out the difference between the conventional definition of *gambiarra* (Rosas, 2007) and the conceptualization that we intend to develop in this text. The goal is to extend the analysis beyond objects and constructions marked by the socioeconomic context of poverty, especially in Brazil. Our hypothesis is that the precariousness and improvisation parameters that characterize this framework can be taken as conceptual vectors capable of enhancing our ability to understand technical phenomena and their political and aesthetic repercussions as a whole.

[1] In original: "Do ponto de vista da Teoria dos Sistemas Complexos, a vida é uma matéria organizada que, aprendendo a modificar sua própria estrutura para responder a alterações do meio, passou a conectar as durações bilionesimais das reações moleculares aos milhares de anos das transformações ambientais, aos milhões de anos das transformações geológicas, às centenas de milhões das transformações astrofísicas. A aceleração técnica vigente na contemporaneidade superpôs a essa conexão entre os ritmos materiais e biológicos o prestíssimo das produções culturais." This and other translations done by the authors.

[2] The usual meaning of the word *gambiarra* refers to improvised, deviant constructions - for example, a diversion of wires to steal electricity - and has its etymology rooted in the word gamba, which means "leg," in Italian (Bruno, 2017, p. 137).

This type of work must be approached on a triple basis: firstly, through a cognitive lens (Kastrup, 2008; Varela, Thompson, & Rosch, 2001) of the *gambiarra* phenomenon combined with an analysis of its political and aesthetic biases (Souriau, 2015); secondly, by referencing the philosophy of techniques (Hui, 2016a; Simondon, 2017) complemented by an epistemology of complexity (Delanda; 2002/2005; Oliveira, 2013); and finally by discussing the affective and political dimensions of the *gambiarra*, as well as its paradoxical and dissonant attributes (Lapoujade, 2016; Massumi, 2002).

By embracing the political dimension, this notion of *gambiarra* seeks to express a cosmology that mobilizes the vectors of complexity, paradox and otherness towards an investigation of the technical dimension of knowledge. This cosmology feeds on the idea of invention (Kastrup, 2007) and the Amerindian perspectivism of Viveiros de Castro (2013), as well as on other authors of the so-called ontological turn[3]. The idea of *gambiarra*, therefore, translates a process of concretization (Simondon, 2017), and its characteristics reveal the modes of existence of technical objects through the lens of the epistemology of complexity and its dissonant derivations, affective connections and possibly paradoxical aspects. For this reason, the empirical exploration present in this paper privileges a notion of technique that displaces the human dimension and the essentially anthropocentric aspect of politics at the heart of the discussion. In this context, the dynamic configuration of *gambiarra* is a complex and dissonant process of concretization, governed by precariousness and improvisation, as it will be explained below. Based on Gilbert Simondon (2017) and his theory of the modes of existence, our paper proposes a conceptualization of *gambiarra* that seeks to rethink the status of the digital technical object within the theories of communication. The concept of *gambiarra*, therefore, has the potential to express the derivations and contingencies of both sophisticated and precarious technologies; or, more precisely, it can show how precarious and contingent the connections or bonds (Sodré, 2014) that aggregate these technologies really are. In digital technologies, these connections appear as a potential of hardware manipulation, graphic processing and the form they take in human-computer interaction.

[3] Represented mainly by authors such as Eduardo Viveiros de Castro, Phillipe Descola, Tim Ingold and Bruno Latour, the so-called ontological turn in anthropology deals precisely with a group of concepts and themes that shift the centrality of the human as the subject of the knowledge process, both in the field from which it originates and in a more general perspective.

Based on this theoretical platform, an empirical framework is designed, one that highlights the contingency, limitations, improvisations and mediations found in three scales of analysis in digital culture. Firstly, the manipulation of hardware that redirects its functions and reconfigures its action capabilities – in this category, we will approach the use of networked video game consoles for the assembly of supercomputers, and the use of consumer-grade video cards sold to run electronic games that are repurposed for cryptocurrency mining. In the software and graphical interface layer, we will examine the improvisation

and precariousness that drove the invention of the mouse and the context of restrictions and limitations that surrounded the advent of three-dimensional space in video games. And, finally, we will explore the human-machine connection, that is, the cognition of the player who is faced with irrational schemes and logics moved by the sensory rhythms of video games.

This work is anchored in research currently under development in the Brazilian context, such as the work of Bruno (2017). Based on such initiatives – and others that will be mentioned as they become relevant to the text – we try not only to list epistemological views and illustrate them with examples in the world of games. More than that, our idea is to contribute and advance the study of *gambiarra* as an epistemological perspective, demonstrating the viability of this kind of knowledge in the context of video games – in addition to exposing the mechanisms from which our conclusions could be obtained and defended.

By demonstrating that these highly complex processes also incorporate the *gambiarra*'s mode of existence, we seek to leave a post-colonial context of precariousness as regional socioeconomic inequality, to an idea of precariousness and improvisation as a way of knowledge. It is not about what can be known (ontology), but how can it is known in the communication/mediation between orders of magnitude (Simondon, 2017). In this context, the *gambiarra* would cross these orders as a form of technical knowledge, whether in the socioeconomic, aesthetic, cognitive or political spheres. We would move from a post-colonial context (of socio-economic scarcity, inequality and exploitation) to a post-colonial epistemology, contributing to the invention of a cannibal and perspectivist cognition. "To absorb the other and, in this process, change", as stated by Viveiros de Castro (2013, p. 207).

THE AESTHETIC DIMENSION OF COMPLEXITY

Gilbert Simondon (2017) believes that, after the industrial revolution, the human has moved from the center (the artisan surrounded by tools) to the periphery of the productive logic (the machines surrounded by workers). However, from an embodied cognition point of view and a cannibal (anthropophagic) perspective, this supposed alienation of the role of technology in daily life does not occur in all orders of magnitude (Simondon, 2017) or levels of mediation (Grusin 2015). In a complex take on knowledge, *gambiarra* represents a connection between the human and technology in which the body itself is impacted at the level of affects (Massumi, 2002), of biology (Varela et al., 2001), and, of course, culture – without conscious perception being involved.

Andy Clark (2001) recalls the anecdote of the bartender that uses the order and shape of glasses to remember which drinks to prepare. Donald Norman (1993) points to the repetition and sharing of information among the crew members of a ship or airplane as a more efficient way of running the vessels. These examples refer to the process that Lakoff and Johnson (1999) called cognitive unconscious, in which "the mind is not merely embodied, but embodied in such a way that our conceptual systems draw largely upon the commonalities of our bodies and of the environments we live in" (p. 6).

In sum, human beings do not necessarily have to be in charge, even in processes in which they are apparently an integral and essential part, such as flying a plane or steering a ship. As in the anthill example, intelligent behavior can emerge from what appears to be pure chaos (Oliveira, 2003). Complex forms of organization alter the centrality of consciousness, countering rationality and building a logic in which action – or agency – is shared among human and non-human actors, even in the "evolutionary" process of designing objects apparently anthropocentrically planned, as Norman (1993) puts it:

> Many of the essential properties of effective shared action seem to result from 'accidental' side effects of the old-fashioned way of doing things. . . . I suspect the procedure is not quite as accidental as it might seem, even if it was never consciously designed. . . . This is a process of natural evolution, and it can lead to remarkably efficient results, even if nobody is in charge, even if nobody is aware of the process. (pp. 144-145)

This illustrates an embodied epistemology, which depends less on a human intentional faculty, and more on a process of codetermined drifts, in which invention, in the sense given by Virginia Kastrup, mobilizes individuals rather than being mobilized by them. In this context, the specificity of *gambiarra*, when compared to other concepts employed in the analysis of digital culture, lies in its engagement with the ideas of precariousness, improvisation and otherness. Or better, it enables an encounter with otherness conditioned by the categories of precariousness and improvisation taken from a complex point of view that includes non-human agencies of public policies, technical-scientific infrastructure, socio-historical contexts, cognitive skills and literacy, among other effects and demands of capitalism in Modernity.

There we find the political bias of *gambiarra*, invested in a decolonial[4] (Mignolo, 2011) cosmology and represented by a "regional" perspective, a point of view of "locality", but which – paradoxically – is not restricted to a single geographical location. This approach is inspired by what Hardt and Negri (2005)

[4] Walter Mignolo, in *The darker side of Western Modernity* (2011) gives a detailed account of the different ways of criticizing and presenting alternatives to the effects of Modernity. These "schools," like the Subaltern Studies in Asia, which started much of what is understood as post-colonial studies; and, in contrast, the decolonization, from Anibal Quijano, and the decoloniality, from Mignolo himself (the latter closest) have become references for some of the main concepts within the anti-hegemonic struggle. However, for the author, it is clear that each one has a certain scope, use and theoretical background, and they should not be casually grouped nor used interchangeably. For the purposes of this paper, Mignolo's and post-colonial studies' points of view are relevant, therefore the use of both terms.

proposed with the idea of multitude and the common condition of poverty[5], or Achille Mbembe (2017) with the becoming black of the world, in which the subjugation of black men and women is the constant that defined modernity and the very notion of humanity. Far from being abstract generalizations, the similarity between these proposals and the *gambiarra* is in the way they produce worlds and, therefore, their own cosmologies.

[5] In the *Empire* trilogy (Hardt & Negri, 2001, 2005, 2016), the authors termed "differential inclusion in the computerization of production" the process by which the poor, underemployed and migrants are included in the productivity of capital (and in the technical/digital instrumentalization that it produces).

For Hardt and Negri (2001, 2005, 2016), the relationship between poverty and the Multitude deals precisely with orders of magnitude, not ontological categories of prescription, in a critique of the rigid class concept of traditional Marxism. In Mbembe (2017), the becoming black of the world exposes a property of the modern era that underlies daily relations. With the introduction of the technical dimension, we want to highlight the divergent forces that run through the ways of producing knowledge; it is the fact that these divergent forces exist that establishes something in common among them. Thus, as Yuk Hui (2016b) argues in proposing his Chinese philosophy of technique, "a radical alterity will have to be asserted in order to leave room for heterogeneity, and thereby to develop different *epistemes* based on traditional metaphysical categories, a task which opens the way to the veritable question of locality" (p. 30). In other words, a "regional" investigation about technology needs to consider the global constraints and impositions that stem from a modern hegemonic heritage. It is in this border space that *gambiarra* is located.

It is possible to point to precariousness and improvisation, and therefore to *gambiarra*, as determining factors for the understanding of the socio-technical constitution of digital culture. From brief remarks on the conditions of usability of technical digital objects (unfolded in the fourth part of this article), we seek to demonstrate how the precariousness and improvisation of *gambiarra* guide complex, dissonant and paradoxical processes of individuation, because "the orders of magnitude may give us different bodies of knowledge that appear to be *exclusive* to one another" (Hui, 2016a, pp. 29-30).

Through *gambiarra* and related practices, one sees the potentially excluding encounter between subjectivity and technique, whose friction would not be an obstacle, but rather a vital factor in understanding the current state of digital culture and the levels of description that underpin human-machine interaction in the information society. For instance, Alexander Galloway's (2012) discussion on the arbitrary character of digital graphic processing. For the author, the raw power of data processing can lead to multiple directions in terms of human-computer interaction. Exploring this premise, a critical analysis of the different uses of these processing unities and their graphical results will demonstrate the presence of *gambiarra*, even in sophisticated computing technologies.

To this technical-political pairing, we can add the dimension of affects and aesthetics. In *The different modes of existence*, Etiene Souriau (2015) builds concepts that can be operated in conjunction with the *gambiarra*, provided it is regarded as a process of cognitive invention and technical individuation that feeds on these multiple forms of precariousness. Souriau considers epistemology and aesthetics as facets of the same movement, as Isabelle Stengers and Bruno Latour (2015) state:

> He [Souriau] had a grand ambition, a monumental project, in mind for his field, one that began to take shape after 1925. Aesthetics must become a type of scientific discipline directed toward the multitude of beings that constitute works, beings that are now understood in terms of the forms they realize. These works therefore constitute what Souriau calls a pleroma, a world of beings instaured in "patuity": each one in its total radiance, its own singular and fundamental presence. (p. 24)

This connection between aesthetics and epistemology is analogous to what we intend with the understanding of the various layers of digital culture. To find the *gambiarras* that reside in the gestures and aesthetic apprehensions, in the ways of being, thinking and interacting and in the socio-technical arrangements formed from their heterogeneous (unusual or even unlikely) assemblages. The methodological key to this venture lies in a speculative approach that aims to assign intentionality/agency, much like the shamanic practices of Amerindian perspectivism (Viveiros de Castro, 2013), but taking into account the instauration of existences without substance and to be done. At least that is what Peter Pál Pelbart (2017) channels from Souriau and his idea of incompleteness.

For this purpose, a point of view anchored in the complex systems allows us to identify these non-human agencies and instances of inventive mediation (Kastrup, 2007; Messias, 2020) in order to seek, propose and eventually experience cosmologies that confront the hegemonic bias of Modernity. Thus, we perform a double movement: the unveiling of these imbrications and the proposal of alternatives to these programs and normalizations.

In order to fulfill the paradoxical attempt to access the modes of existence that humanism itself refutes – or that are at least beyond its comprehension – speculation helps us recognize, at least partially, processes such as that of non-conscious cognition (Lakoff & Johnson, 1999), the nanosphere of quantum mechanics, the labyrinths of the psyche and affects, the production of subjectivity, and of course, aesthetic fruition. The speculation of agency meets what Souriau (2015) called white light in a metaphor apt for references to quantum physics and relativity. According to him:

> If it is true that, in order to apprehend the universe in all its complexity, it is necessary to equip thought not only for all the multicolored rays of existence, but even for a new light, for a white light, unifying those rays in the luminosity of a *surexistence* which surpasses all those modes without subverting their reality. (p. 101)

Embodying one of the main adages attributed to complexity: the whole is greater than the sum of its parts (Oliveira, 2003), the *surexistence* of which Souriau (2015) alludes is exemplary in the discussion of affects in post-structuralist philosophy. Brian Massumi (2002) translates this question as a problem between immanence and transcendence, as presented in Deleuze's work:

> Although the realm of intensity that Deleuze's philosophy strives to conceptualize is transcendental in the sense that it is not directly accessible to experience, it is not transcendent, it is not exactly outside experience either. It is immanent to it – always in it but not of it. Intensity is immanent to matter and to events, to mind and to body and to every level of bifurcation composing them and which they compose. (p. 33)

The iridescence of Souriau's work and the binomial intensity-multiplicity in Deleuze consist of modes of existence that are not phenomenological, but potentially communicable on a non-human level – like the subatomic particles for physics, to continue the analogy about light (part matter, part wave). In this sense, speculation as a form of immanent knowledge brings together epistemology and aesthetics in modes of existence. Affects operate a link between the two, bringing out speculative and multiple realities:

> The organization of multiple levels that have different logics and temporal organizations, but are locked in resonance with each other and recapitulate the same event in divergent ways, recalls the fractal ontology and nonlinear causality underlying theories of complexity. These could be seen not as binary oppositions or contradictions, but as resonating levels. Affect is their point of emergence, in their actual specificity, and it is their vanishing point, in singularity, in their virtual coexistence and interconnection that critical point shadowing every image/expression-event. (Massumi, 2002, p. 33)

The resonance of different and even divergent levels in Massumi (2002) is precisely what strengthens our claim about *gambiarra* as a concept for this study. Resonance means a communication: a form of mediation that does not necessarily result from cooperation. It is a form of communication that is established by dispute, noise and the paradox caused by the resonance of dissonant logics.

The concept of *gambiarra*, even though it refers to the notions of individuation and instauration, from the association with the Amerindian perspective represented mainly by anthropophagic predation and the invention of Virginia Kastrup (2007, 2008a, 2008b), ultimately seeks an autopoietic dimension of mediation. Certain cannibal cognition that mobilizes inventive speculation. Thus, the invention as a process of cognition puts this understanding of *gambiarra* in the interstice of the works of these two authors.

COSMOLOGY OF *GAMBIARRA*: THE MANY FORMS OF PRECARIOUSNESS

For Virginia Kastrup (2007), cognition as invention lies in the intersection between her field of origin, psychology, cognitive sciences, and philosophy. Among its embodied aspects, the enacted cognition that the author takes from Varela et al. (2001) extends the concept beyond the idea of mind or consciousness – although not excluding them. Cognition is, in that case, a process that integrates the body, its physiology, the environment and the layers of sociability and affects:

> Enaction is a type of action guided by local sensory processes, and not by the perception of objects or forms. Sensory-motor couplings are inseparable from lived cognition, including biological, psychological, and cultural couplings. . . The embodiment of knowledge therefore includes social, and also linguistic couplings, which means that the body is not only a biological entity, but is capable of inscribing itself and marking itself in history and culture . . . the invention of a world.[6] (Kastrup, 2007, p. 153)

Knowledge as an embodied and acted process presents a direct relation with the notions of mediation and individuation (Oliveira, 2003). Kastrup appropriates an argument analogous to Simondon's, dealing with the concept of information, which for him is the driving force of individuation. Kastrup (2008a) states something similar about inventive cognition: according to the author, "it is not a question of asking how cognition puts a subject and an object in relation, but how, from the concrete exercise of cognition, subject and object emerge" (p. 109).

While intelligence is only the human faculty of using rational logic, invention is the thread that stitches together all the previously mentioned elements (consciousness, body, environment and socio-technical dynamics) within an indeterminate and creative time. This idea is a response to the conceptions of knowledge as the decoding of prefabricated problems. Kastrup (2007) also reiterates that the concept of invention is not just the human ability of creativity

[6] In original: "A atuação [enaction] é um tipo de ação guiada por processos sensoriais locais, e não pela percepção de objetos ou formas. Os acoplamentos sensório-motores são inseparáveis da cognição vivida, aí incluídos acoplamentos biológicos, psicológicos e culturais. . . . A corporificação do conhecimento inclui, portanto, acoplamentos sociais, inclusive linguísticos, o que significa que o corpo não é apenas uma entidade biológica, mas é capaz de se inscrever e se marcar histórica e culturalmente . . . invenção de mundo".

(which is a kind of intuitive connection of a subject to the flow of creative time), as the invention displaces the human from the center of dynamics:

> Cars, telephones, fax machines or a computer network like the Internet are not solutions to the problem of the long distances that separate people, but they change our relationship with the space and the time it would take us to travel between them. They create the necessity of distant communication, which comes to us as a new problem[7]. (p. 212)

[7] In original: "o automóvel, o telefone, o fax ou uma rede de computadores como a Internet não são soluções para o problema das longas distâncias que separam as pessoas, mas mudam nossa relação com o espaço e com o tempo que levaríamos para percorrê-las. Criam uma necessidade de comunicarmo-nos à distância, que surge para nós como um novo problema."

This context also refers to a political horizon in the sense that, as the author herself also defends, such notion of cognition is closely linked to the production of subjectivity (Guattari, 2006). The epistemological discussion present in this meeting between philosophy, technique and cognitive sciences refers to knowledge itself as action of and in the world. Invention cannot be merely a human faculty, because it is part of the co-creation and codetermination – as Varela et al. (2001) point out – of reality, which arises from the resonance between biological organisms, objects and other agents/entities (mental, imaginary, linguistic). These couplings or agencies illustrate a way of seeing the inherent complexity of the systems that make up the social conjuncture, which often escape the limits of human perception. For Kastrup (2007):

> Cognition does not work as if it has closed conditions of possibility, rather, it accesses the complexity of its virtual condition, keeping in tension the old forms and what problematizes them. It is about learning to live in a world that does not provide a pre-established foundation, in a world that we invent by living, dealing with the difference that hits us[8]. (p. 225)

[8] In original: "a cognição não funciona como se tivesse condições fechadas de possibilidade, mas acessa a complexidade de sua condição virtual, mantendo em tensão as antigas formas e aquilo que as problematiza. Trata-se de aprender a viver num mundo que não fornece um fundamento preestabelecido, num mundo que inventamos ao viver, lidando com a diferença que nos atinge".

Invention, individuation and acting cognition are ways to initiate a conceptual dialogue with complexity, placing it at the center of the question of knowledge, which for Kastrup (2007) would be indicative of an autopoietic cognitive system. This movement follows, as Luiz Alberto Oliveira (2003) defends, some scientific discoveries in the field of Biology and Physics at the end of the 20th century, such as the mapping of the human genome, the general theory of relativity and, complementarily, quantum mechanics. They reconfigured the conceptions of reality and brought questions about paradoxes, challenging much of the scientific and philosophical assumptions established until then. According to Oliveira (2003),

> The paradigm shift corresponding to the passage from the mechanical image to the complex involves a transformation in fundamentals, a shift that occurred in

> the very foundations of the construction of our understanding of the beings of the world. This titanic movement can be presented as the dethronement of the conceptual pair *substantial-individual* in favor of the *process-information* one[9]. (p. 154, highlights by the author)

[9] In original: "a transformação de paradigmas correspondente à passagem da imagem mecânica para a complexa envolve uma deriva de fundamentos, um deslocamento ocorrido nas próprias bases da construção de nosso entendimento sobre os seres do mundo. Essa movimentação titânica pode ser apresentada como o destronamento do par conceitual substância-indivíduo em favor do par processo-informação".

Such theories do not bring ready-made solutions to prefabricated problems, like the search for the origin of life or the fundamental particle of matter. On the contrary: they have contributed to the invention of new problems based on entirely new terms. In short, they have built new worlds, as well as new ways of inhabiting, thinking and altering these worlds. Varela et al. (2001), in turn, reiterate the role of the cellular constitution in the perception of colors by living organisms (bi, tri or polychromatic) that bring different ways of seeing the same world, to speak of only one sense. Physics and Biology are full of examples of perceptual flaws or cognitive dissociations that sound like imperfections of the sensorial-motor apparatus, but that can also be interpreted as traces left by the process of invention that forge the connection between the organism and the world that surrounds it: a reflection of the virtual in the real. The very optical effect that allowed the appearance of cinema is one of these examples, thanks to which slightly different static images being alternated above a certain frequency give us the impression of a continuous movement.

For Yuk Hui (2016b), a solution to understand "the reality of technique" in this context would be to trace different accounts regarding the genesis of technicality, reinforcing the primacy of the perspective of locality and the production of radical otherness as an epistemology, of which technicality must be an integral part. According to the author:

> Scientific and technical thinking emerges under cosmological conditions that are expressed in the relations between humans and their milieus, which are never static. For this reason I would like to call this conception of technics "cosmotechnics". (p. 18)

The *gambiarra* as mediation does not consist of a form of resistance exclusive to a precarious place – as if one or more subjects were overcoming adverse conditions to reach a higher level of technical production. It is, in fact, a decolonial cosmotechnique (Mignolo, 2011) that emerges from precariousness. In this sense, not everything is *gambiarra*: but it can be the key to understanding the encounter between the real and its virtual. Even in the process of evolution of the species, we can see some kind of a bricolage: "the joining of parts and items in complicated sets, not because they fill any ideal project, but simply because they are possible"[10]. (Varela et al., 2001, p. 255).

[10] In original: "a junção de partes e itens em conjuntos complicados, não porque preencham qualquer projeto ideal, mas simplesmente porque são possíveis".

However, Hui (2016b) has reservations about what he understands as post-colonial theory:

> The strength of postcolonial theory, it seems to me, is that it effectively reformulates the question of power dynamics as narratives, and consequently argues for other, or different, narratives. However, this might also be regarded as one of its weaknesses, since it tends to ignore the question of technology – a question which, I would argue, cannot be reduced to one of narratives. (p. 56)

The option to seek a postcolonial cosmotechnique, however, is in the understanding of similar initiatives, such as that of Kavita Philip (2015) and the Indian notion of *Jugaad* and other terms mapped out by Bruno (2017), such as *shanzhai* in China. A common condition of precariousness – a precarious becoming – underlies this postcolonial cosmology of the Global South, inseparable from cosmotechnique.

This cosmotechnique is empirically made possible by the detection of limited actions, or rather, restricted by the agency of the various vectors of the system. The need for this direction consists of a form of restriction, but also of an improvised irruption – and therefore shameless, in the words of Bruno (2017) – which expresses what we mean by *gambiarra*: an emergent process, an overlapping of contingent phases (mediated in different orders of magnitude), which materialize in a precarious manner.

IRRATIONAL LOGICS AND ABERRANT MOVEMENTS IN THE HARDWARE, SOFTWARE AND GRAPHIC USER INTERFACES OF VIDEO GAMES

In fact, there is no rigid separation that prevents communication between those orders of magnitude – on the contrary, the understanding of such interrelatedness is exactly what differentiates the epistemology of complexity from those based on deterministic rationalism and immutable laws of positivism. However, it is undeniable that they can be analyzed in separate scales, which is evidenced by digital culture itself. Regarding the *gambiarra* as a kind of knowledge, we see the nuances of its mode of existence in at least three scales: the hardware and its manipulations; the software and its extension in the graphic interface and, finally, the sensorial connection between these interfaces and users (or players, in the case of video games).

The first level is that of hardware. Regarding its material characteristics, most of the devices we use are structured with relatively high levels of enclosure.

In short, they are designed to make it difficult and, if possible, impossible to deconstruct the pieces that make them, precisely to avoid the redirection of their functions. Even so, these redirections happen, largely due to what Douglas Hofstadter (1979) calls "levels of description" (p. 285).

Even if programmers and computer engineers architect their work with an intention in mind, this intention exists only as a linguistic statement. In paradoxical contrast to this statement, lies a structure based on computational language. Those two kinds of languages, although they communicate, are based on separate parameters and have divergent aspects. This is the origin of the misunderstandings commonly referred as bugs and glitches, "defects" that are called in a pejorative way only because they displease the human side of human-machine communication. However, from the computer point of view, every one of those effects are completely normal: defects, bugs and glitches are, therefore, nothing more than symptoms of noise, a necessary aspect of the emergence of variability, difference and, finally, communication (Krapp, 2011).

The potential for misunderstandings increases as more levels of description are added to the process. The greater the distance covered by this route, "you know less and less precisely what you've told the computer to do! Layers and layers of translation may separate the 'front end' of a complex program from the actual machine language instructions". (Hofstadter, 1979, p. 312). In other words, what we call a defect, bug, or glitch is nothing more than the often inevitable result of the inherent instability of computers and the creative noise generated by the contradictions between their way of functioning and the human way of thinking.

These contradictions allow, in a concrete way, the redirection of the vectors driven by interactions between levels of description, even in the case of the most advanced hardware. The Playstation 3 video game console, for example, has sometimes been used in large quantities by organizations, which connect them in networks to function as supercomputers (two examples: "The PlayStation powered", 2010; Zyga, 2010). What happens in cases like these is an expensive and large-scale form of *gambiarra*, but still based on improvisation and a kind of precariousness: Playstation 3 was not built for this purpose, but the fact that it is the result of complex networks of production and circulation makes it a more economical, fast and as efficient as a supercomputer built from scratch for the project.

One degree below, we highlight the phenomenon of the use of video cards, such as those manufactured by Nvidia and AMD, whose original purpose is to fill a commercial niche of gaming PCs for home and personal use. They are usually bought individually, and are meant to be coupled to systems assembled by the consumers themselves, especially those who want greater graphic fidelity

and capacity on monitors and high-resolution TVs (Full HD or up to 4k) and high frame rate in their games.

These video cards have recently been subject to their own function redirection, when they were suddenly hit by a demand from amateur cryptocurrency miners. Their complex agglomeration of chips and processors, which is designed to enable a series of complex processing functions, had their power reversed to operate raw calculations in a repetitive and exhaustive manner – a process called "mining", by configuring: a) the mode of verifying the value of cryptocurrencies and b) rewarding computers that calculate the packages with more currency. Thanks to this function deviation, the video card manufacturing industry found problems to supply the demand of miners, and gamers suffered from high prices and diminished supply of cards[11].

[11] This demand fluctuates and, at the moment, is in decline due to the volatile value of cryptocurrencies (De, 2019).

It is important to note that the raw processing power of the cards is the strength that miners are seeking. This processing power grows in an almost predictable and uniform manner, which is informally postulated by Moore's Law, the prediction that the maximum number of transistors that fit into a single microchip would double every two years, increasing the processing speed on devices *such* as computers and smartphones. Postulated in 1965, this forecast remains relatively consistent several decades later[12]. The predictable evolution of raw processing power, however, is always accompanied by more unpredictable and intermittent innovations in the way it is applied in software and graphical interfaces. And while the uniform progression of Moore's Law is leveraged by the ordered and rational march of the semiconductor industrial conglomerate, the field of software and graphical interface development comes up with innovations whose origins are much more humble – but equally powerful.

[12] Still, the eletronics industry lives under the constant paranoia of a "post-Moore's Law" era ("Nvidia plays," 2019).

A great example that illustrates the presence of *gambiarra*'s mode of existence in software engineering and graphical interfaces is the invention of bit mapping and the mouse (cf. Johnson, 2001). Until those inventions came to be, Moore's Law advanced undisturbed, conditioned only by new demands of tasks usually performed on mouseless and keyboardless computers: text processing, image exhibition, spreadsheet editing, calculations and so on. However, in 1963 the first mouse was invented by Douglas Engelbart. Its conception is based on two *gambiarras*: on the hardware side, Engelbart reconfigured an object called a planimeter, used in the field of engineering and technical drawing to measure flat surfaces.

On the software side, Engelbart used a *gambiarra* materialized in code, which linked the movement of the mouse sensors to programmed changes of how pixels were displayed on the screen. After that, it was a question of programming a pointer that could obey a coordinated system, which in turn would be modified according to the user's manipulation. Thanks to this, the

entire language of human-computer interaction was reconfigured: windows, menus, icons and cursors redesigned the destinations to which the processing power of transistors would direct its forces.

One can see in the invention of the mouse a kind of knowledge that is clearly logical, but could never be called rational. It is, in fact, an irrational logic, as David Lapoujade (2016) seeks to describe from the thought of Gilles Deleuze:

> For this reason, from beginning to end, the interesting logics are those that escape from all rationality, the logic of masochism, the logic of sense and nonsense in Lewis Carroll, the logic of the schizophrenic process and, also, the logic of certain philosophers which, under the guise of rationality, came up with not very rational logics (Hume, Bergson, Spinoza and Lebniz). Logics always have a touch of schizophrenia in Deleuze[13]. (p. 15)

[13] In original: "Por eso, desde el comienzo hasta el final, las lógicas que interesan son aquellas que escapan a toda razón, lógica del masoquismo, lógica del sentido y del sinsentido en Lewis Carroll, lógica del proceso esquizofrénico o incluso lógica de ciertos filósofos que, bajo manto de razón, inventaron lógicas en verdad muy poco racionales (Hume, Bergson, Spinoza o incluso Leibniz). La lógica tiene siempre algo de esquizofrénico en Deleuze".

From these irrational logics emerge what Lapoujade (2016) calls aberrant movements. Such movements can emerge in a spontaneous way – like the images that appear to us in dreams or even the inexplicable thoughts that attack us for no apparent reason during our daily lives. But they can also be invented, in the cognitive sense of the term.

The kinds of expression images and movements in cinema are aberrant movements (Lapoujade, 2016, p. 29). They invent impossible spatial logics, like the paradoxical corridors filmed by Stanley Kubrick in *The Shining*; or irrational temporalities such as Alan Resnais' amalgam of past, present and future in *Last Year at Marienbad*. In digital culture, the manipulation of graphic processing generates, through an aberrant movement, the irrational logic of the graphic interface. In turn, this processing is intensified by multiple strategies of characterization of space and time in video games, strongly reinforced by the double concept of precariousness/improvisation.

The incremental invention of three-dimensional space in video games, for example, occurred at several key moments. The vast majority of them came from unlikely places such as the room divided by two English college students, David Braben and Ian Bell. It was their mission to enter the race for the creation of the very first game in three dimensions. Many ways of fabricating the sensation of traveling through a three-dimensional space were attempted. The first of these was in 1973, with Maze War, which ran on a mainframe installed at NASA's research center in California. In 1982, 3D Monster Maze would be the first example of three-dimensional space in a home computer game. The result, however, was a small, labyrinthine space with fixed perspective. The player could

walk in turns, like a chess piece jumping from tile to tile, without the ability to look sideways or down/up.

Less than two years later, in 1984, Braben and Bell would launch their joint creation: Elite. The game proved itself so far ahead of the competition that their creators could be accused of using magic instead of programming. The player flies a ship through deep space, directing the vessel at any angle and variable speed. The gamespace is not only three-dimensional, but continuous and expansive, explorable in all directions. To crown their achievement, Elite did not consist of a simple labyrinth, but of a micro-universe boasting eight galaxies, each with 256 solar systems – these, in their turn, with different alien characters, spacecrafts, economic systems: an extremely wide circuit of processes, unfolded by algorithms. All this was developed by the two students in a modest home computer – the BBC Micro – with no more than 22kb of memory.

Such precariousness required improvisation: the game was programmed by saving literally every bit of memory. It was necessary to resort to mathematical processes hitherto unused in video games, such as the Fibonacci sequence – discovered several centuries ago[14]. The technical result surpassed what any major corporation or research center had been able to achieve so far. Future innovations in graphics processing would continue to demonstrate that abundance of resources is less important than the propulsion of irrational logics. Likewise, with id Software, a company formed by two beginner programmers: John Carmack and John Romero. The duo, especially Carmack, would be responsible for enabling the mapping of textures in the three-dimensional worlds of video games in such a fashion never seen before. The first game to demonstrate ray casting technology was Wolfenstein 3D (1992), also responsible for effectively inaugurating the genre of computer games known as first-person shooters. Carmack's genius was not due to the fact that he could project textures on three-dimensional objects, but rather to process these textures' spatial transformation almost instantly: a speed hitherto considered impossible. This allowed not only a better performance of the game, but an accelerated rhythm of movement on the part of the player, which would characterize even more the successor of Wolfesntein 3D: the influential Doom (1993).

The speed with which colors and shapes appeared and changed in the screen connected with the players' eyes, creating an unprecedented (and irrational) temporal and rhythmic logic, in the sense defended by Lapoujade, inoculating them with a new kind of sensoriality, skills and ways of playing. In fact, what Carmack and Romero did with Wolfenstein 3D and Doom resembles what Engelbart did with the mouse: from inversions and reversions of processing power, a new kind of sensory platform was coined for user enjoyment. This

[14] It has been acknowledged for some years that the famous sequence popularized by the Italian mathematician would have originated in India at least 500 years earlier (Singh, 1985).

is what Kristine Jørgensen (2013) defines as "gameworld": when the human sensory capacity meets the stimuli resulting from computer's internal work.

CLOSING REMARKS: *GAMBIARRA* AS MULTIPLICITY

The levels of description involved in this phenomenon – the manipulation of hardware processes, software algorithms, the creation of new kinds of visual and motor functions of the graphical interface – consist of a set of vectors that Manuel Delanda (2002/2005), mixing Deleuzian Mathematics and Philosophy, will call "degrees of freedom", that is, the different dimensions within which a system can reorganize itself. Each of these layers mobilizes several sub-layers, composed by other degrees of freedom. The joint action of these vectors is not a result of a mathematical calculation, but rather an expression conditioned by the divergent and ever-mutating force that Delanda (2002/2005), reading from Deleuze, understands as multiplicity:

> Multiplicities are, by design, *obscure* and *distinct*: the singularities which define a multiplicity come in sets, and these sets are not given all at once but are structured in such a way that they progressively specify the nature of a multiplicity as they unfold following recurrent sequences. (p. 16)

In an even more complex way, these degrees can be manipulated in order to create irrational logics. However, this process does not emerge, to use Kastrup's allegory (2007, p. 27), as a puzzle, whose image is already established from the start. Instead, it emerges from vectors whose power is obscure and contingent. In fact, the precariousness-improvisation duo, as well as its political, aesthetic and post-colonial dimensions, points to a set of singularities – a concept that Delanda (2002/2005) understands as the magnitudes that design the tendencies that unfold a phenomenon. In the case of *gambiarra*, these singularities would unfold a kind of technical thought.

Distancing itself from Essentialism, the *gambiarra* as multiplicity points to a kind of knowledge free from the bonds of immutable laws and the pre-conceived paths of rational logic. Therefore, it cannot be constrained to geographic and socioeconomic positions – which does not prevent us from understanding how the postcolonial perspective conditions its appearance in diverse contexts. Finally, we believe that there are enough examples in the history of digital culture to justify an approach that understands the invention of knowledge as a paradoxical and dissonant process. M

REFERENCES

Bruno, F. (2017). Objetos técnicos sem pudor: Gambiarra e tecnicidade. *Revista Eco-Pós*, *20*(1), 136-149. doi: 10.29146/eco-pos.v20i1.10407

Clark, A. (2001). *Mindware: An introduction to the philosophy of cognitive science*. New York, NY: Oxford University Press.

De, N. (2019, January 29). AMD cites 'absence' of GPU sales to crypto miners in Q1 estimate. *Coindesk.* Retrieved from https://bit.ly/34iZUdr

Delanda, M. (2005). *Intensive science and virtual philosophy.* London, England: Continuum. (Original work published 2002)

Galloway, A. (2012). *The interface effect*. Cambridge, England: Polity Press.

Grusin, R. (2015). Radical mediation. *Critical Inquiry*, *42*(1), 124-148. doi: 10.1086/682998

Guattari, F. (2006). *Caosmose: Um novo paradigma estético.* São Paulo, SP: Editora 34.

Hardt, M., & Negri, A. (2001). *Império*. Rio de Janeiro, RJ: Record.

Hardt, M., & Negri, A. (2005). *Multidão: Guerra e democracia na era do Império*. Rio de Janeiro, RJ: Record.

Hardt, M., & Negri, A. (2016). *Bem-estar comum*. Rio de Janeiro, RJ: Record.

Hennion, A. (2010). Loving music: From a sociology of mediation to a pragmatics of taste. *Comunicar*, *17*(34), 25-33. doi: 10.3916/C34-2010-02-02

Hofstadter, D. (1979). *Gödel, Escher, Bach: An eternal golden braid*. New York, NY: Basic Books, Inc.

Hui, Y. (2016a). *On the existence of digital objects*. Minneapolis, MN: University of Minnesota Press.

Hui, Y. (2016b). *The question concerning technology in China: An essay in Cosmotechnics.* Falmouth, England: Urbanomic Media.

Johnson, S. (2001). *Cultura da interface: Como o computador transforma nossa maneira de criar e comunicar.* Rio de Janeiro, RJ: Zahar.

Jørgensen, K. (2013). *Gameworld interfaces.* Cambridge, MA: MIT Press.

Kastrup, V. (2007). *A invenção de si e do mundo: Uma introdução do tempo e do coletivo no estudo da cognição.* Belo Horizonte, MG: Autêntica.

Kastrup, V. (2008a). A cognição contemporânea e a aprendizagem inventiva. In V. Kastrup, S. Tedesco, & E. Passos, *Políticas da cognição* (pp. 93-112). Porto Alegre, RS: Sulina.

Kastrup, V. (2008b). Autopoiese e subjetividade: Sobre o uso da noção de autopoiese por G. Deleuze e F. Guattari. In V. Kastrup, S. Tedesco, & E. Passos, *Políticas da cognição* (pp. 46-63). Porto Alegre, RS: Sulina.

Krapp, P. (2011) *Noise channels: Glitch and error in digital culture*. Minneapolis, MN: University of Minnesota Press.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to Western thought*. New York, NY: Basic Books.

Lapoujade, D. (2016). *Deleuze: Los movimientos aberrantes.* Buenos Aires, Argentina: Cactus.

Massumi, B. (2002). *Parables for the virtual: Movement, affect, sensation*. Durham, NC: Duke University Press.

Mbembe, A. (2017). *Critique of black reason*. Durham, NC: Duke University Press.

Mignolo, W. (2011). *The darker side of Western Modernity: Global futures, decolonial options*. Durham, NC: Duke University Press.

Norman, D. (1993). *Things that make us smart*. Cambridge, MA: Perseus Books.

Nvidia plays the diversification game. (2019, February 23). *The Economist*. Retrieved from https://econ.st/2wl7KXJ

Oliveira, L. A. (2003). Biontes, bioides e borgues. In A. Novaes (Org.), *O homem máquina: A ciência manipula o corpo* (pp. 139-173). São Paulo, SP: Companhia das Letras.

Pelbart, P. P. (2017). *O avesso do niilismo: Cartografias do esgotamento*. São Paulo, SP: n-1 edições.

Philip, K. (2015, March 12). *Pirate copying, Jugaad economics: Postcolonial tech and developmental leapfrogging* [video file]. Retrieved from https://bit.ly/2RjAvLx

Rosas, R. (2007). Gambiarra: Alguns pontos para se pensar uma tecnologia recombinante. *Caderno Videobrasil*, *2*(2), 36-52. doi: 10.22409/gambiarra.v1i1.29620

Simondon, G. (2009). The position of the problem of ontogenesis (G. Flanders, Trans.). *Parrhesia Journal*, (7), 4-16.

Simondon, G. (2017). *On the mode of existence of technical objects*. Minneapolis, MN: Univocal.

Singh, P. (1985). The so-called Fibonacci numbers in ancient and medieval India. *Historia Mathematica, 12*(3), 229-244. doi: 10.1016/0315-0860(85)90021-7

Sodré, M. (2014). A ciência do comum. Petrópolis, RJ: Vozes.

Souriau, É. (2015). *The different modes of existence*. Minneapolis, MN: Univocal.

Stengers, I., & Latour, B. (2015). The sphinx of the work. In É. Souriau. *The different modes of existence* (pp. 11-94). Minneapolis, MN: Univocal.

The PlayStation powered super-computer. (2010, September 4). *BBC*. Retrieved from https://bbc.in/2JMLb0Y

Varela, F., Thompson, E. T., & Rosch, E. (2001). *A mente corpórea: Ciência cognitiva e experiência humana.* Lisbon, Portugal: Instituto Piaget.

Viveiros de Castro, E. (2013). *A inconstância da alma selvagem e outros ensaios de antropologia* (5th ed.). São Paulo, SP: Cosac Naify.

Zyga, L. (2010, December 2). US Air Force connects 1,760 PlayStation 3's to build supercomputer. *Phys.org*. Retrieved from https://bit.ly/34eghYY

Article received on April 29, 2019 and approved on March 24, 2020.