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Jornalismo em um novo ambiente informativo estruturado por Sistemas Cognitivos Artificiais

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Resumo:
O jornalismo evoluiu ao longo dos séculos, adaptando-se para captar a atenção do público. Com o surgimento de sistemas inteligentes como chatbots e softwares que transformam dados em narrativas de notícias, dando origem à Mídia Artificial, sistemas computacionais com viés cognitivo criam conteúdo em tempo real por meio de relacionamento interativo com a audiência. Esse novo ecossistema de informações turva as fronteiras entre conteúdo humano e o produzido por máquinas. A introdução de Sistemas Cognitivos Artificiais estabelece uma parceria simbiótica entre agentes biológicos e artificiais, transformando a forma como a informação é consumida. Essa Interação de Informação Humana substitui a relação mestre-escravo anterior, da Revolução Industrial. O artigo aponta para a hipótese da consolidação da Mídia Artificial, na qual é possível a máquina processar eventos, contextos e ações, lidando inicialmente com situações imediatas e adquirindo cada vez mais uma capacidade preditiva ou prospectiva, assim remodelando a produção, distribuição e consumo de notícias.

Palavras-chave: Jornalismo. Sistemas Cognitivos Artificiais. Relevância Social.

Journalism in a new informative environment structured by Artificial Cognitive Systems

Abstract:
Journalism has evolved over the centuries, adapting to capture the audience's attention. With the emergence of intelligent systems such as chatbots and software that transform data into news narratives, giving rise to Artificial Media, computational systems with cognitive bias create content in real-time through interactive engagement with the audience. This new information ecosystem blurs the boundaries between human-generated content and that produced by machines. The introduction of Artificial Cognitive Systems establishes a symbiotic partnership between biological and artificial agents, transforming the way information is consumed. This Human Information Interaction replaces the previous master-slave relationship from the Industrial Revolution. The article suggests the hypothesis of the consolidation of Artificial Media, in which the machine can process events, contexts, and actions, initially dealing with immediate situations and increasingly acquiring predictive or prospective capabilities, thus reshaping the production, distribution, and consumption of news.

Keywords: Journalism. Artificial Cognitive Systems. Social relevance.

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Introdução

Journalism has been forged by a substantial technological influence since the 1st Industrial Revolution (1760). This landmark was fundamental to transform the handmade journalistic activities into production with industrial characteristics. According to Lev Manovich (2002), it is more likely the "reason why modern media has discrete levels is because it emerges during Industrial Revolution, because in the nineteenth century, a new organization of production known as factory system gradually replaced artisan labor". The physical locale of journalism work, the "fabric" of Journalism, was denominated "the newsroom". For centuries, the form of production of consumer goods has had an impact and, also, has shaped the production and distribution of immaterial goods, such as information of social relevance by print and electronic platforms. A discursive format, named journalism, has been embedded in those communication devices. Two centuries after these technological developments, another major technological impact affected the ways of producing and distribution of journalism.

This milestone occurred when computer machines and telematic networks were introduced in newsrooms, most strongly in the USA, from the '60s of the last century. Thenceforth, Journalism has been adapting the insertion of new connected digital technologies in your production processes, a factor that has radically altered the processes of capturing, analyzing, editing and distributing informative contents of social relevance. In spite of the transition from the industrial revolution to the digital revolution, inherited for the design of computer machines, the journalism business has always followed the formula: the relationship between informative content and the audience characterized by the availability of socially relevant informative content.

This relationship has been kept in all technological development processes in the communication field. According to a definition provided by Saracevic (2007), "on a fundamental level, relevance is understood as a relation". The relationship between the public and the journalistic content is very important to understand that this type of information carries an important component: social relevance. It was modeled to be shown by an interface, such as a newspaper or digital display, with the aim of ensuring public attention. Saracevic (2007) writes that the relevance information is strongly related to communication efficiency, because "relevance is also considered as a measure of relatedness. If we consider communication, then our intuitive understanding is that relevance has also something to do with the effectiveness of communication".

Then, relevance is an important component to convey the information efficiently. With uses of mediatic techniques, the information relevance is cognitively obtained through the relationship between the media language (discourse and format) and its audience. Thus, this relationship provides individual elements for a person to compose their scenario of reality, because according to Sperber and Wilson (1995), "the relevance of new information to an individual is to be assessed in terms of the improvements it brings to his representation of the world".

The relationship among the individual and media technologies, including traditional media (TV, Radio, Press) and connected digital technology, which is more powerful in terms of interactivity, and the audience, is achieved through the provision of predetermined content.

Thus, it is a characteristic that provides a kind of relationship in the same way, in both analogical and digital platforms, because they all have the same origin, they are a mode of production based on the model belonging to the industrial revolution.

Journalism has been using the same winning formats to continue to seduce audiences. But, it has cleverly innovated, not at the desired speed, introducing in its narrative structure and production process, for example, a new automatic

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technology to follow the new tendencies in the use of intelligent systems of information, as Artificial Intelligence. This tendency is exemplified in the work undertaken by C. Lewis, Guzman, and R. Schmidt (2019), which claims that "devices and programs that utilize artificial intelligence, such as software that turns structured data into news narratives, are playing a growing role in media work, shaping how news is made, how it moves, and how users make sense of it".

The article suggests the hypotheses of a scenario where Artificial Media becomes more established. In this environment, computational machines have the ability to process events, contexts, and actions. They start by addressing immediate situations and gradually develop predictive and prospective capabilities. This transformation, in turn, alters the way news is produced, distributed, and consumed within a complex communication landscape.

To transform the traditional journalism environment, it's essential to consider foundational concepts such as the relationship and the information of social relevance, which play a crucial role in the decision-making processes of individuals. This socially relevant information, produced by journalism, is now presented on content platforms structured through Human-Computer Interaction (HCI) principles. However, with the emergence of new intelligent technologies that foster a symbiotic relationship between computational machines and humans, novel forms of interaction are emerging. These include Human-Machine Communication (HMC), Human-Centered Computing (HCC), and Human Interaction Information (HII), all of which utilize Natural Language Understanding (NLU) techniques. In this context, Artificial Cognitive Systems are poised to represent the next phase in the relationship between humans and computational machines.

Moving forward to exemplify the theoretical framework described above, "media companies continue to bet on artificial intelligence as a way of delivering more personalised experiences and greater production efficiency", as stated in *Oxford Report* titled *Journalism, media, and technology trends and predictions 2022* (Newman, 2022). One significant aspect of this technological landscape is the Language Model GPT. In the thesis titled *Self-supervised language models in journalism: quality perception of GPT-3-written articles*, researcher Lasse Häufglöckner conducted an experimental study to investigate how readers perceived text quality and their trust in journalistic opinion pieces written by the language model GPT-3. In this experiment, 192 participants analyzed the content generated by GPT-3, which was "rated slightly better in terms of text quality as well as the trust placed in the content" (Häufglöckner, 2023).

Information of social relevance

In the current world, where there are infinite possibilities of connection via telematic networks, the struggle for the audience's attention. Maintaining informative relevance in contemporary society is of utmost importance for journalism. This maintenance of relevance will only be possible if journalism establishes new forms of relationship with its audience. The intelligent systems also are looking for this connection with the audience. And it is in this relationship that relevance is built with the audience, because "relevance is not given, it is established" (Saracevic, 2007).

To make this base of the connection stable, Journalism has created context by formats, like newspapers, magazines, portals, telejournalism, radio journalism and so on. All these vehicles have their own language processes with specific discursive elements. This strategy of communication, in creating platforms and discursive formats, aims to provide the audience an informative context. And in it, are inserted techniques to create informational relevance by discursive elements, forming the specific language for each media. Thus, the creation of context is important because "the intention in the expression of relevance always comes from

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a context and is directed toward that context. Relevance cannot be considered without a context" (Saracevic, 2007).

Thereby, Journalism has been continually adapted to continue building audience-sensitive languages through informative relevance, having as the main vector in this process, the dynamic changes of society. The dynamic of society, a set of actions that influences ideas and beliefs of his time (Zeitgeist), is fundamental to establish what is relevant or not at that time. Fidel (2012) holds the view that relevance judgment is dynamic, being the evaluation "a cognitive process; therefore, the argument goes, any new information, or even thinking, can change the view a person has on the information problem at hand, and the view of what is relevant as a consequence".

In this new informative ecosystem, which is structured by connected digital technologies, the understanding of complex information, having at its base the good journalism, depends on understanding that relationships, in potential, are essentially infinite, because in the technological universe there are many kinds of connections, and many ways of language.

In journalism, the connection is established when people mentally integrate the news with their view of the situation that is reported. According to Albers (2015), the information integration lies not in a text element itself, but the relationship between all discursive elements. For him, the audience needs to figure out what kind of information is relevant and how it is connected to its current problems.

In the case of journalism, the audience is related to a specific kind of information. In other words, the audience recognizes that journalism is connected to information of social relevance. Information on social relevance is very important in shaping the decision-making scenario as well as in producing an opinion of who is consuming the news. Albers (2015) claims that "without relationships, information exists as a bunch of interesting Informatics factoids which do not help a person form an adequate mental picture of the situation".

The type of format and narrative style contextualizes the perception of the audience and also sets out the form of their relationship with the information. "We would rather say that style is the relationship", said Sperber and Wilson (1995). With respect to the platform, journalism has, over the decades, consolidated formats such as print newspapers, TV news and web portals, whose forms and narrative styles differ from other kinds of content such as flyers, soap operas, and blogs, for example.

According to the researcher Shapiro (2014), "journalism comprises the activities involved in an independent pursuit of accurate information about current or recent events and its original presentation for public edification". Over the past decades, News (facts) and Articles (Opinion) formats have encapsulated and strengthened the relationship by these discursive styles. The main objective of this strategy was to bring the reader closer, to attract the reader's attention and to reinforce the relationship through the transmission of credible information. Sperber and Wilson (1995) established the view that "from the style of a communication it is possible to infer such things as what the speaker takes to be the hearer's cognitive capacities and level of attention".

In the case of journalism, this type of public communication has had a long process of shaping and adapting its language during the last 400 years, since the invention of the newspaper as a journalistic format. Old discursive formats and narrative styles have been adapted and transformed into new discursive languages in accordance with technological developments, starting "from a relational perspective, news-writing programs reprise the role of a journalist in older representations of mass communication in which a message is produced by a journalist within an organization and then transmitted via a medium to an audience, with little, if any, feedback conveyed from the audience" (Lewis et al., 2019).

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Information and Decision-making process

The relationship reached among the journalistic content and diverse audience by the most varied media platforms, via the production and conveyance of socially relevant information, has achieved success in the last decades. However, there is the current drop in newsprint sales and broadcasting TV audience, besides the exponential growth of digital social networks. Facebook, Twitter and Instagram have been competing in the attention economy, such as the traditional or native media vehicles born on the Internet. Despite this fierce struggle for society's attention, journalistic content is very important for composing decision-making in various fields of human activity yet, Journalism, with its inherent elements, ensures the proper production of socially relevant information, thereby contributing to a more informed decision-making process for its audience.

The development and exponential expansion of connected digital media in the last decade, especially mobile devices, has provided emerging immeasurable information sources, constituting a new mediatic ecosystem. This informative architecture has been structured because information spreads in many ways, and this configuration has affected the formation of the link of relevance between Journalism and its audience. Several studies "indicate that information overload affects decision-making negatively" (Gynnild, 2014). Then, efforts must be addressed to establish, once again, the relationship between Journalism and audience, in order to provide information of social relevance. An important process for supporting decision-making of individuals and formation of public opinion. Today, this is not an easy task, because billions of people are connected, via the Internet, to infinite information services, and they generate an incalculable volume of information every second, creating an "information overload" for each person. Hence, which technology will assist users in navigating the intricate digital landscape to find socially relevant information to aid in decision-making? How can journalism reestablish its relationship with the audience to fulfill this crucial role?

HCI as method to understand relationship

According to Marchionini (2008), the fields of computer science and psychology have adopted the information-processing model of cognition and developed a new field known as Human–Computer Interaction (HCI). This field has been scientifically studied over the last sixty years. The first academic mention of the word came only in 1975 was made by Carlisle (1976). HCI is a concept derived from other theories about human behavior while using computational machines, mainly in studies on hyperlinks and screen attention zones. Thus, the main concern of the researchers, in the field of HCI, was to establish methods and metrics to measure the relationship between the human being and the computing machine, for instance, through video interfaces. HCI is an interdisciplinary field that focuses on the multi-faceted interactions, beyond communication issues, with technologies designed to mediate and communicate (Grudin, 2012).

Through HCI, in recent decades, many digital interfaces have been created for the Journalism's field, such as Web Portal. It's a visual metaphor from the newspaper front page. Thus, this process is always an ongoing adaptation in order to build the relationship between journalistic content and its audience by style, content and format.

Journalism itself has learned how to remain relevant to society, testing countless ways to understand what is the best form of relationship with the audience across different media environments. According to Lev Manovich (2002), this process can be termed as Cultural Interfaces, because the "cultural interfaces predictably use elements of a general-purpose HCI such as scrollable windows containing text and other data types, hierarchical menus, dialogue boxes, and command-line input".

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Journalism's language has been developed in the last 400 years. Then, since print media, performing metaphors among a type of content and the communication technologies that have emerged over time, such as radio, film, TV, and the web, and now the mobile platform. According to Lev Manovich (2002), "the history of human-computer interface is that of borrowing and reformulating, or, to use new media lingo, reformatting other media, both past and present: the printed page, film, television". However, despite the transition from analog devices and platforms to digital and connected tools, another technological transition has not been widely recognized: the symmetrical and cognitive relationship between computational machines and their users.

New scientific branch

In 1960, the interdisciplinary researcher, Joseph Carl Robnet Lickider, wrote a seminal paper entitled *Man-computer Symbiosis*. This essay envisioned a relationship between human beings and computational machines in the way differently proposed by Nobert Wiener and his cybernetics colleagues. Cybernetics is a scientific movement launched in the 1950s. The movement initiated and consolidated a computational scientific branch in which a single cognitive agent interacts with a replicating machine (computational). For this kind of relationship between the human being and the computing machine was coined a term called "master-slave", when the computational technology is subordinated to human intentions, because "typically, computers are thought of as tools to make people more productive in their jobs" (Griffith, 2005). The Licklider's vision proposes a rupture with the vision that was developed by cybernetics. Licklider pointed that "the hope is that in not too many years, human brains and computing machines will be coupled together very tightly, and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today" (Licklider, 1960).

For this computational design, machines will need to be able to provide a relationship on a cognitive level. In contrast to Wiener and his colleagues, Licklider envisioned that there would not be only a single cognitive agent, but two in this relationship, one biological and one artificial. Therefore, either biologically or computationally, both are considered cognitive agents. In this scenario outlined in Licklider's *Man-computer Symbiosis*, human beings and computational machines will be mutually dependent in their relationship.

Nowadays, the current technological advances in the field of intelligent computer systems with cognitive bias. They are precursors to the conceptions of man-machine symbiosis, "because they emulate conditions of information exchange in a symmetric way, thus, although computerized machines remain technologically subservient to human intentions, they could jump to a more symmetric relationship also pushed by market demands" (Silva; Lima Junior, 2017). This technological basis would be formed by procognitive technologies (Licklider, 1965). Licklider's conceptual evolution that claimed emulates the human-machine relationship by accomplishing it in a complementary way. In his book *Libraries of the Future*, Licklider described how the system would work the procognitive system conceptually. In this system, the Natural Language Processing tools are used and vast repositories of information are archived in machine-readable format. They would be connected to real-time computer networks with large processing capacity. Today, this scientific vision is closely similar to the scientific branch named Cognitive Computing.

The technologies that involve Cognitive Computing "will be able to 'think for themselves', reaching decisions on actions in a variety of ways, some which is considered a tremendous advancement to provide computers with cognitive capacity similar to those we use. They should be flexible and adaptive, able to learn from their

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past and that of others around them. They may even be close to ourselves in some (although not necessarily all) ways" (Taylor, 2009).

Although the field of the Cognitive Computing is more scintillating, because large companies like Amazon, IBM, Apple, and Microsoft are using this term to refer to products that have inserted this system on devices and sell it in the market, however, there is another scientific field that is being structured and that it also uses intelligent computing systems with cognitive bias: Artificial Cognitive Systems.

These intelligent computing systems, with cognitive bias, are evolving technologically and being used in various areas of human activity. From a communication point of view, in Human Interaction Information (HII) and Journalism, the key point is that the process of symbiosis depends on the capacity of communication between human beings and computational machines in the way of an informative collaboration of social relevance. This process should have strong cognitive content Silva and Lima Junior (2017). Pavlik (2016a) claims that for journalism practices it will be considered a tremendous advancement to provide computers with cognitive capacity, but "cognitive computing-based systems like it (SyNAPSE), IBM has a cognitive computing chip inspired by the human brain, may represent only the tip of the digital iceberg for journalistic transformation" (Pavlik, 2016a).

HCM, HCC, and (HII)

In this new communication environment, where computational machines are enabled by intelligent systems endowed with cognitive bias, new kinds of interaction begin to emerge and, probably, new kinds of platforms too. In the journalism area, some researchers are debating about the concept named Human-Machine Communication (HMC), which is an area of study that, according to these researchers, may be considered as a broad term that includes all forms of communication and how they interact with other connected digital technology. Spence (2019) thinks that "HMC does so with a specific focus on aspects of people's interactions with technologies designed as communicative subjects (i.e. algorithms etc). A person can study and be in the field of HMC as one is in communication". This point of view distinguishes from HCI, because the interaction focuses on the system and not with the platform. According to Guzman and Lewis (2019), "HMC research could offer important insights for the study of chatbots, socialbots, and newswriting technologies within journalism. Here, we broaden the scope of the application of HMC scholarship from technologies of automated journalism to communicative AI more generally". Thus, the interaction process between the content and the audience is being carried out directly by the computer program which was designed to simulate conversation with human users, instead of platforms designed to establish the relationship between information and audience. Thus, there are related and correlated databases through algorithms that provide socially relevant information in conversation format. This content is "Human-Machine Communication (HMC), an emerging conceptual framework and empirically grounded research domain, as a way of approaching the study of technology based on its function as communicator (message source) rather than merely as the mediator (message channel)", said Lewis et al. (2019). Thus, as illustrated by Guzman and Lewis (2019), from this point of view, the concept is based in conversation, because "sets HMC apart is its focus on people's interactions with technologies designed as communicative subjects, instead of mere interactive objects" (Guzman and Lewis, 2019).

The perception that another method, besides HCI, is needed to understand this new process of relationship between man and the computational machine, it is opening new fields and concepts, such as Human-Centered Computing (HCI). HCC also has established on focus in the interactions, "while HCI focuses technology, to understand humans and ties together the threads to establish on the boundary (the

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interactions) between and humans, Human-Centered Computing places humans (as individuals and in societies) at the center of the research HCC might lead to designs for new software, but it can also help us to understand what emerges from the world that Licklider predicted, according to Guzdial (2013). In the meantime, another conceptual aspect begins to consolidate, Human Information Interaction (HII).

According to Fidel (2012), the researchers in Human Information Interaction field investigate the interaction between people and information with its multiple forms and purposes, "that is, they focus on the relationships between people and information, rather than on those between people and technology (as in human--computer interaction) or between people and the information agency (as in librarianship)" (Fidel, 2012). This difference is crucial to understanding that there is a new level in this relationship, which cannot be detected by methods based on the master--slave relationship, because the central object of the HCI study is the computer interface. That way, HII researchers have developed models and theories of interaction as well as methodologies and processes for designing interfaces for implementing and evaluating them Fidel (2012).

One of the leading researchers in the HII field, Gary Marchonini, explains that the human–information interaction is a core phenomenon for the information field. The works of Marchionini (2008) describes "that humans are moving toward a potentially more symmetrical meaning of human–information interaction, where both humans and information objects evolve as a result of and throughout interaction". As said by Licklider, this new kind of relationship is necessary as if they were two cognitive entities. In the symbiotic case, between the biological system (human being) and the artificial system (computational machine), the interaction causes the changing of state in both entities through a process of adaptation by conversation. For Marchionini (2008), the "interaction is a special kind of action that involves two or more entities and a set of reciprocities that effect changes to each entity".

The changing of information between cognitive entities (biological and artificial) will be only feasible if the interaction is established the symmetrical way. In other words, by creating the condition for the evolution of both as well as with the result and through the process of interaction itself.

For that to happen, the human being will have to interact with the cognitive artificial entity by the perception that one is another human being (immersion). Thus, it is not a computational machine supporting a media platform. This relationship can't be carried out by an intermediated interaction through navigation in a visual interface, because it is not appropriate to establish a relationship in the symbiotic way. This concept is closer to Licklider's vision about the relationship between human beings and computational machines with cognitive bias.

HII and NPU techniques

If Human-Computer Interaction is the main method to understand the interaction process between human beings and media platforms by an interface, a Natural Language Processing (NLP) is also the technology that allows the current systems advance for an automatic communication. But, both were evolved with orientation from the master-slave concept. To jump to another technological level, based on Licklider's symbiotic relationship, it is necessary to pay attention in another emergent technique, as Natural Language Understanding (NPU), besides adopting the HII method, that is inserting us to experiment another informative ecosystem. For Singh (2018), "there are lot many processes involved in the pipeline of NLP. At the syntactic level, statements are segmented into words, punctuation (i.e. tokens) and each token is assigned with its label in the form of noun, verb, adjective, adverb and so on (Part of Speech Tagging). At the semantic level, each word is analyzed to obtain the meaningful representation of the sentence. Hence,

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the basic task of NLP is to process the unstructured text and to produce a representation of its meaning". According to Sciforce (2019), NLP is a well-established tool because it has been operating for decades at the cross-section of computer science, artificial intelligence, and increasing data mining. This approach is allowing "to read, decipher, understand, and make sense of the human languages by machines, taking certain tasks off the humans and allowing for a machine to handle them instead", according to Sciforce (2019). Giving some examples of its use, can be mentioned the accomplishment of tasks like online chatbots, text summarizers, auto-generated keyword tabs, as well as tools analyzing the sentiment of a given text. In this way, the NPL has accomplished a great job today. But, so that we can have computational machines with cognitive bias, it is necessary that they can "understand" before processing language.

These tasks are still very difficult to be accomplished by computational machines, because utterances regularly contain ambiguities, ellipses, production errors, implicatures, and many other types of complexities (Mcshane, 2017). For the researcher, it is necessary for the development of artificial cognitive agents that the modeling will be inspired by human cognition.

Artificial Cognitive Systems

A new era in the relationship between human beings and computational machines, in the field of cognitive communication, is taking place in the area of technological development called Artificial Cognitive Systems. This technological line of interaction with cognitive-semantic bias is part of a new scientific branch originating from Cognitive Sciences supporting a popularly known area, Cognitive Computing. According to E. Kelly III and Hamm (2013), "with cognitive computing, we will be able to harvest insights from huge quantities of data to handle complex situations, make more predictions about the future, and better anticipate the unintended consequences of actions". Due to the speed in the development of technologies, in this field, executed by big companies like IBM, Amazon, Microsoft, and Apple, is emerging other nomenclatures that scientifically embrace this developing field, such as Cognitive Systems Engineering and Symbiotic Cognitive Systems. The emerging field of Artificial Cognitive Systems is inspired by the artificial intelligence area. According to Vernon (2014), this scientific conception has "the aim is to build systems that can act on their own to achieve goals: perceiving their environment, anticipating the need to act, learning from experience, and adapting to changing circumstances". These systems can be built, by cognitive architectures, based on four lines of inspiration, claims Vernon (2014): modular decomposition of a hypothetical model of the mind; cognitive system modeled on a macroscopic brain organization; cognitive system based on statistical learning of a specific domain; cognitive system based on artificial neural networks.

An Artificial Cognitive System refers to a variety of software products that use plausible computational models of cognitive processes, being like a basis for symmetrical interactions in the computational and human being relationship. The intention is to reproduce cognitive mechanisms responsible for the effectiveness of human-human interaction. Then, the computational human-machine interaction becomes more like an interaction between a human being and a human cognitive entity. In short, a cognitive system consists of software that helps a machine interact with people in the way people interact with one another (both cognitive entities). For Forsythe, Bernard, and Goldsmith (2006), "we further assert that the objective in creating a machine-based cognitive system is to emulate the properties of human cognition that enable people to effectively engage the world and interact with other humans as fellow cognitive entities".

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This vision is very similar to Licklider. Thus, it can be noticed that several fronts are being researched, including with emphasis on bio-inspired systems, aiming to simulate abstract thoughts, a cognitive task that only human beings can accomplish. However, the formalization of computer systems for abstract thinking is one of the greatest challenges for scientists in the coming decades.

New adaptation for journalism?

One of the main attributes of journalism is to provide to the audience the structured information of social relevance, with intention of helping them to compose their representation of the world. Besides another roles, this function aims to support the decision making the process of those who consume journalistic information, overcoming limitations of understanding complex subjects, for example. In the last decades, journalism has experimented with new formats and languages according to technological development, like the Internet, which aims to continue its mission. The Journalism has technologically adapted in production and diffusion of information of social relevance with the public interest. In this period, the professional activity advanced in the use of computational technologies in a master-slave way, improve many journalistic internal processes, as in the publication of content. One of the main researchers in the intersection between journalism and digital technologies, John Pavlik claims that digital technologies have provided a pool of tools for journalists, "far from deterministic, these technological changes have given innovative journalists new tools that can be used to improve the quality of news coverage, gain efficiencies in production, and enable new techniques for reporting and storytelling" (Pavlik, 2016b).

The current information ecosystem has also been formed from informational structures generated by Artificial Intelligence when using Natural Language Processing (chatbots), big data (machine learning, deep learning), and image recognition. These technologies have aimed at producing socially relevant content.

Nowadays, the audience has many forms to reach information in order to balize its thoughts and decisions, as recommendation systems. But, the current digital communication environment is being compounded too by primordia of Artificial Cognitive Systems, like chatbots. As foregoing, chatbots are only the start of a new cognitive era of computational machines.

In this moment, the technological cybernetic model (master-slave) drives how communication must work, relationship to information by portals, social networks, blogs, etc, but "various human-centered smart systems are proposed to provide services with higher quality, such as smart healthcare, affective interaction, and autonomous driving", according to Chen, Herrera, and Hwang (2018).

Conclusion

Since 1760, the 1st Industrial Revolution has influenced all production processes, including the journalistic procedures. The newsroom has worked as a production line. In the last 30 years, journalism has adopted the innovations from new connected digital technologies in production processes, having the main objective to maintain the relationship with the audience through socially relevant informative content. For that, it has been using many platforms, with its discursive forms (factual and opinion) to aim to produce varied media languages and products.

However, this scenario was established based on the creation of technologies to improve work tasks. Same in the computational era, this conception persists, due to the cybernetic influence, in which the structure is based on the master-s-

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lave paradigm. In the light of the description of technological changing paradigma from master-slave to the symbiotic relationship between human beings and computational machines, being these artificial entities endowed with cognitive computational bias, will journalism be able to transform itself? To abdicate the formats and practices that enshrined it as a way of representing reality in the field of information of social relevance? How can you transfer the credibility (which falls around the world) gained, since the creation of the newspaper, as the main provider of information of social relevance? These questions will only be answered in the next few years. However, some trends are beginning to come up, such as the emergence of artificial cognitive systems to support decision processes. Providing information on social relevance is one of the main epistemic functions of journalism and one of the attributes that make it possible is related to the audience in the attention economy.

Journalism has suffered the competition of countless informational flows, digital repositories, and social networks. It will also have that dispute with the artificial cognitive systems in the economy of attention. This kind of intelligent systems will exchange information with the audience, in a symbiotic relationship, with each cognitive agent (biological and artificial) establishing a relationship in the form of partnership. According to Deuze (2019), "no longer believe that the news industry as it has traditionally been organized is necessary for journalism as an ideology to survive and remain relevant to people's lives".

Thus, the communicational environment structured by artificial cognitive systems, based on HII and using Artificial Cognitive Systems will be the next stage of the relationship between human beings and computational machines? Therefore, very different from the master-slave relationship model, based on the studied usability, HCI line has been surviving for the last decades.

This process of technological disruption will lead, primarily, to the impossibility of making innovations in communication products in a metaphorical way, because the relationship platform model with journalism content will not exist. Finding other possibilities for communicating news or organizational information, for example, using the level of communication between man and machine in symbiotic informational relationship, will be one of the biggest challenges for media companies and start-ups, because communication will occur in a personalized, effective way, contextualized and will focus on relevant information so that the human being who uses it can improve their decision making about important actions in his or he life.

Bibliography

ALBERS, M. Human-Information Interaction with Complex Information for Decision-Making. **Informatics**, v. 2, n. 2, p. 4–19, 2015.

C. LEWIS, S.; GUZMAN, A.; R. SCHMIDT, T. Automation, Journalism, and Human-Machine Communication: Rethinking Roles and Relationships of Humans and Machines in News. **Digital Journalism**, p. 1–19, 2019.

CARLISLE, J. H. Evaluating the impact of office automation on top management communication. Em: **Proceedings of the June 7-10, 1976, National Computer Conference and Exposition on - AFIPS**. Nova Iorque: ACM Press, 1976. Disponível em: http://dx.doi.org/10.1145/1499799.1499885. Acesso em: 10 jan. 2024.

CHEN, M.; HERRERA, F.; HWANG, K. Cognitive Computing: Architecture, Technologies and Intelligent Applications. **IEEE Access**, v. 6, p. 19774–19783, 2018.
DEUZE, M. What Journalism Is (Not). Social Media + Society, p. 1–4, 2019.

E. KELLY III, J.; HAMM, S. **Smart Machines: IBM's Watson and the Era of Cognitive Computing**. New York: Columbia Business School, 2013.

FIDEL, R. **Human Information Interaction : An ecological approach to information behavior**. London, England: MIT Press, 2012.

FORSYTHE, C.; BERNARD, M. L.; GOLDSMITH, T. E. C**ognitive System: human cognitive models in Systems Design**. Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc., Publishers, 2006.

GRIFFITH, D. Beyond Usability: The New Symbiosis. E**rgonomics in Design: The Quarterly of Human Factors Applications**, v. 13, n. 3, p. 30–34, jun. 2005.

GRUDIN, J. A moving target: the evolution of human-computer interaction. In: JACKO, J. A. (Ed.). **The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications**. 3rd. ed. [s.l: s.n.]. p. 2.

GYNNILD, A. Journalism innovation leads to innovation journalism: The impact of computational exploration on changing mindsets. **Journalism**, v. 15, n. 6, p. 713–730, 2014.

HÄUFGLÖCKNER, L. **Self-supervised language models in journalism**: quality perception of GPT-3-written articles. Thesis in the degree programme Media, Technology and Society to obtain the academic degree Master of Science (M.Sc.), Hochshule Darmstadt, University of Appied Sciences, 2003.

MANOVICH, L. **The Language of New Media**. Cambridge, MA, USA: MIT Press, 2002.

LICKLIDER, J. C. R. Man-Computer Symbiosis. **IRE Transactions on Human Factors in Eletronics**, p. 4–11, 1960.

LICKLIDER, J. C. R. **Libraries of the future**. [s.l.] MIT PRESS, 1965.

MARCHIONINI, G. Human-information interaction research and development. **Library {\&} Information Science Research**, v. 30, p. 165–174, 2008.

MCSHANE, M. Natural Language Understanding (NLU, not NLP) in Cognitive Systems. **AI Magazine**, v. 38, n. 4, p. 43–56, 2017.

NEWMAN, N. **Journalism, Media, and Technology Trends and Preditions 2022**. Reuters Institute for The Sudy of Journalism and University of Oxford Report, 2022.

PAVLIK, J. V. Computing, Algorithms and Data: Transforming Journalism and Media. **II Encontro Internacional de Tecnologia, Comunicação e Ciência Cognitiva (EITCCC)**, 2016a.

PAVLIK, J. V. Cognitive computing and journalism: implications of algorithms, artificial intelligence and data for the news media and society. **Brazilian Journal of Technology, Communication, and Cognitive Science**, v. 4, n. December 2016, p. 1–14, 2016b.

SARACEVIC, T. Relevance: A Review of the Literature and a Framework for Thinking on the Notion in information Science. Part II: Nature and Manifestations of Relevance. **Journal of the American Society for Information Science and Technology**, v. 58, n. 13, p. 1915–1933, 2007.

DOI: https://doi.org/10.5007/1984-6924.2023.95083

SCIFORCE. NLP vs. NLU: from Understanding a Language to Its Processing. **Sciforce Blog**, [s.l.], 18 de abril. 2019. Disponível em: https://medium.com/sciforce/nlp-vs-nlu-from-understanding-a-language-to-its-processing-1bf1f62453c1. Acesso em: 10 jan. 2024.

SHAPIRO, I. Why democracies need a functional definition of journalism now more than ever. **Journalism Studies**, v. 15, n. 5, p. 555–565, 2014.

SILVA, J. R.; LIMA JUNIOR, W. T. From Licklider to cognitive service systems. **Brazilian Journal of Technology, Communication, and Cognitive Science**, v. 5, n. 1, p. 13, 2017.

SINGH, S. **Natural Language Processing for Information Extraction**. Preprint, submetido em 6 de julho de 2018. Disponível em: https://arxiv.org/abs/1807.02383. Acesso em: 10 jan. 2024.

SPENCE, P. R. Searching for questions, original thoughts, or advancing theory: Human-machine communication. **Computers in Human Behavior**, v. 90, p. 285–287, 2019.

SPERBER, D.; WILSON, D. **Relevance**: Communication and Cognition. 2ª ed. Cambridge, MA, USA: Blackwell, 1995.

TAYLOR, J. G. **Cognitive computation**. Cognitive Computation, v. 1, n. 1, p. 4–16, 2009.

VERNON, D. **Artificial Cognitive Systems**: a primer. Cambridge, Massachusetts: MIT Press, 2014.

DOI: https://doi.org/10.5007/1984-6924.2023.95083