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Special

The challenges of media and information literacy in the artificial intelligence ecology: deepfakes and misinformation

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Abstract

In the ecosystem of artificial intelligence (AI), generative models enable the creation of hyper-realistic manipulations that are extremely plausible due to the precision of the audiovisual objects. These deepfakes are undetectable thanks to their components, which heightens concerns about the distortion of reality in the information ecosystem and how the ability to distinguish between real and fake audiovisual content affects public trust and democratic systems. This is a major challenge for media and information literacy if it is to combat misinformation effectively. In this context, this study presents the results of a quasi-experiment conducted with 80 young people from the Community of Madrid (Spain) to assess their ability to detect deepfakes in immersive environments and to establish whether the context-identifying elements that enable detection of the reputation of the media source shape the credibility of the images. The results show that the images take precedence over the context identifiers, preventing a critical reading of the information that would make it possible to detect visual forgeries, something that is reinforced by their exceptional verisimilitude. It is concluded that the new post-humanist biome of virtual reality and artificial intelligence requires a reorientation of media and information literacy to raise the public's awareness and educate them to make them less susceptible to disinformation based on deepfakes created with generative models.

Keywords

Deepfake, artificial intelligence, misinformation, virtual worlds, quasi-experiment, quantitative analysis.

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1. Introduction

1.1. *An ecology of artificial intelligence (AI)*

All communication technologies establish new systemic contours, expanding the boundaries of media ecosystems. The germinal character of technology, with its protean value and its implicit philosophy (Islas, 2009, p. 29) become expansive, redrawing both the outline and the inner contours of the environment of relations, production, and communicative exchange. These technologies have an impact on people and societies because they create the matrix of possibilities in which they perform their communicative interactions and activate the roles to be adopted in the play of exchanges of this ecosystem; they condition and filter the view of reality because they fix its specifications and modify the ecological system itself (Postman, 1970). The media context not only bounds the construction of messages (McLuhan, 1964; McLuhan & Fiore, 1967) but it also predetermines the ontological, epistemological, and ethical universe in which interactions between the entities that comprise it will occur. Each new system expands the ecology of media, opening new frontiers that resignify relationships between individuals. These new systems reshape the experiential comprehension of reality (Islas-Carmona & Urrutia, 2023), establishing new frameworks in a progressive, intermediated remediation (Bolter & Grusin, 2011). In the context of digital communication in social media that vie for the limited commodity of attention (Bombaerts *et al.*, 2023), this understanding is shaped by a persuasive technology that, through its design, can predetermine subjects' behaviours (Fogg, 2003).

From an evolutionary dimension, as a process of transformation, communication technologies can take us further, but in the humanist vision asserted by Postman (2010), it is necessary to ask how much their advances offer us more valuable and meaningful information, or whether they can improve democratic processes. Whether the immense flow of data that they provide and the fast and indiscriminate access to these data do no more than generate a fiction of knowledge and skills lacking an ethical and moral basis that guides action. The fact is that the challenge and complexity, as Strate (2004, p. 38) observed, are significant. From a Rousseauian and romantic view of scientific progress, the speed, superficiality, appearance of knowledge, and the scopic of experience interacting with information have flattened imagination and *poiesis* as the framework of knowledge; as a reflexive and critical tool for facing reality. In the era of uncertainty, we seek simple solutions for complex problems, arrogantly remaining ignorant of the limits imposed by our own lack of knowledge (Innerarity, 2022).

The combination of virtual-reality technologies (Rubio-Tamayo *et al.*, 2017) and artificial intelligence (AI), their crystallisation in post-reality universes like the metaverse (Mystakidis, 2022), and the creation of alternative realities (Dincelli & Yaila, 2022) provide new discursive and technological, relational, informative, and communicational [TRIC] devices (Marta-Lazo & Gabelas-Barroso, 2022). They establish new horizons in the perceptive, cognitive, and emotional models, exploiting retention and the experience of flow (Csíkszentmihályi, 1990) as captological techniques (Voiskounsky *et al.*, 2020) and resignifying the spheres of interpretation of human values themselves. They de facto establish new epistemic ways of understanding and interacting with reality. Viewed from the transhumanist ideal (FM-2030, 1989), they instantiate a posthumanism in which subjects are able to transcend physical reality as the extropic principles imagined (More, 1998). In the digital order, the technological imaginary of the metaverse *defactifies* the existence of the human being (Han, 2021, p. 17), making it constantly available in its immersive virtuality.

This intensive and extensive nature of immersive technologies has revitalised the polarisation between apocalyptic and integrated viewpoints in a medium that is even colder, in the words of Eco (1968). Virtual reality, originally named by Artaud, already alluded to the alchemy of illusion, the existence of a fictional and illusory level (1938, p. 55). The science fiction of the second half of the twentieth century (*Neuromancer* by William Gibson, *Tron* by Steven Lisberger, *Snow Crash* by Neal Stephenson) and the first technological crystallisations such as

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the Sensorama wove the fabric of the rest of the symbolic principles of the metaverse: sensory immersion; hyper-realistic simulation; the technological singularity through AI; and technological transhumanism.

1.2. *Literacy for virtual environments and AI*

Every territory has its own map and requires interpretation. We know from analysis of the most recent past that the technological framework that has shaped the social web and the semantic web, their structurally persuasive design (Anderson, 2011), has significantly modified the media diet, the media repertoire (Hasebrink & Domeyer, 2012), and the forms of appropriation and participation (Tapscott & Williams, 2011). A systematic understanding of the digital diet (Sieberg, 2011) in its qualitative and quantitative aspects and as part of a post-digital dialogue (Marta-Lazo & Gabelas-Barroso, 2022, p. 145) involves understanding young people's models of information consumption and their relationship to information, and also understanding the need to work on a digital reculturisation and retemporalisation (Fullan, 2002) that will boost the virtues of the new immersive biomes, reducing their risks. And will close the gap of disaffection and mistrust towards the usefulness and trustworthiness of information and the media (García *et al.*, 2014). The interest and processes of information have been lost (Reuters, 2023) and re-establishing this connection will be difficult.

There is a need for a digital humanism (Arrubia, 2022) that strengthens the skills that are vital for an active and critical citizenship (European Commission, 2020; Marta Lazo, 2020), especially for the youngest citizens who will inhabit ever more immersive environments. A specific approach to the functioning and performance of these technologies in the framework of comprehensive media and information literacy actions is one of the keys to anticipating the relationship of appropriation of immersive technology to boost its advantages and minimise its difficulties.

Many of the warnings that were made a decade ago regarding the need to work on new literacies (Area & Pessoa, 2012) have turned out to be prescient. Virtual environments and AI offer numerous educational opportunities (Kaddoura & Al Husseiny, 2023; Prakash *et al.*, 2023) but a scenario also emerges of risks that we can anticipate in the threats that other technologies, prior to the mediasphere of hypermediations (Scolari, 2008), have revealed, such as the conditional nature of media devices themselves, in which it is necessary to distinguish between ethical designs and persuasive dark patterns (Nyström & Stibe, 2020). Communication is a process of symbolic exchange of meanings (Lustig, Koester & Halualani, 2006), a dynamic transition that affects the behaviour of the subjects who communicate by means of mechanisms that are usually intentional. And, in this game, we have seen how fraudulent manipulation has had psychological impacts (Grachev & Melnik, 1999), has promoted campaigns using AI systems (Bradshaw & Howard, 2018) or has made disinformation actions go viral by exploiting psychological, social, legal or technological vulnerabilities (Pennycook & Rand, 2018); therefore, a strong professional ethics that warns about fakes is important (Koch *et al.*, 2023).

The fact that young people's primary information sources are social media, especially ones based on the all-encompassing value of the image (Fuentes, 2003) and the addictive culture of infinite scrolling (Alter, 2017; Rixen *et al.*, 2023), such as Instagram, TikTok or YouTube (Catalina-García *et al.*, 2019), and that reading habits have become simplified to the extreme, eliding accumulations of information in favour of superficial and often decontextualised readings of headlines and lead paragraphs, decisively affects the comprehension of an ever more complex, inter-related, and dynamic reality, which requires in-depth, connective, and analytic pathways for its understanding. As mentioned above, young people have a clear disconnection from traditional media (AIMC, 2023). They have eschewed the dominant informational biome of the mass media of the second half of the last century and, on the frontier of the digital ecotone, they have colonised a new rich and profuse biotope that is populated by new species but is bewildering and has unclear rules that leave them vulnerable to informational predators. In the expectation of an integral prostheticity (Echeverría, 1999), on the frontier of the transhuman

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being that can break the limits and bonds of its physicality, in the anthropomorphising of the computer as substitute of the human (Roszak, 2005), the shadows from Plato's cave appear to confound what can be sensed and what is intelligible. The technology that expands us to what we could not dream of, that projects us in the intangible and ethereal realities of the digital, is capable, as in systems of extended reality, of modifying perception and leading us to parallel universes where identity is multiplied and the old axiom of "seeing is believing" (Shin & Lee, 2022) stops having contrast value. In them, we confront the risk of staring into the abyss. Rethinking Carr (2010), if we do not understand and train ourselves about how these new environments shape how we perceive and understand, we risk becoming –even– more superficial.

Immersive technologies assisted by generative AI make it possible to create hyper-realistic manipulations in which the detail and precision of visual objects (images, videos, sound etc.), their degree of iconicity (Villafañe, 2001), and their "pernicious" intense realism (Ahmed, 2023) make detecting these fakes an increasingly unachievable task (Chesney & Citron, 2019). In addition to this problem, there is a tendency for people to overestimate their competence and ability to do this (Köbis *et al.*, 2021), something that offers a fertile ground for the propagation of disinformation narratives or for crimes to be committed using AI applications (Caldwell *et al.*, 2020). The difficulty of understanding this phenomenon can be seen in the results of studies that show, for example, the conditioning that the multimodal nature of messages produces in the perception of fake news (Lee & Shin, 2022).

1.3. *The importance of educommunication for detecting deepfakes created using generative AI models*

Media and information literacy will not solve this problem, but it is an inherent part of the solution from the dimension of the media ecology (Islas, Gutiérrez & Arribas, 2022) because it can help subjects reflect on how they consume information, make them aware of how their media consumption works, how they relate to each other in this new informational biome, and help them introduce habits that reduce the impact of disinformation (Hwang *et al.*, 2021). Research such as that by Shin and Lee (2022) for example has shown the efficacy of training people in how to produce deepfakes as a way of reducing their propensity to be taken in by them and halt behaviour patterns that help them go viral. Ultimately, it is a matter of teaching and learning how to discern between what is verisimilar and what is real (Pombo, 2004) in complex informational contexts.

We are facing a disruptive scalar and logarithmic scenario of disinformation that goes beyond the cognitive and emotional and passes into the sphere of risking manipulation of perception (Tolosana *et al.*, 2020) that transcends the boundaries of traditional mechanisms of technological persuasion (Foog, 2003). Artificial intelligence-based applications facilitate the creation of realistic original audiovisual representations that simulate the appearance and speech of human beings (García-Ull, 2021) and can be deployed in immersive settings.

This has created a breeding ground for deepfakes (Temir, 2020), a sophisticated form of disinformation (Rodríguez Pérez, 2019) based on the manipulation of existing media (images, video, and/or audio) or the creation of new media using focuses based on deep-learning (Altuncu *et al.*, 2022) resulting in artificial creations that are indistinguishable from reality (Espacio Telefónica, 2023) in which it is difficult to trace the manipulation that has been carried out (Chawla, 2019). Photographic manipulation is nothing new; there are even records of it from the First World War (Lavín & Chivite, 2015) when photographers could develop their films and superimpose several negatives to create an image with more impact on the viewer (Caballo, 2005). But we are now speaking about automated processes based on powerful AI systems that can instantly design alternatives with a greater informational load (Doménech Fabregat, 2013).

AI and virtual reality are technologies that make the viewer part of the story. There is a growing concern that virtual reality environments might serve as a scenario for possible psychological and emotional manipulation of their users (Waltzman, 2022). Therefore, they must be

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adequately analysed and efforts must be made to train users to understand the new dynamics of the immersive digital era (Kremidas-Courtney, 2022) and detect this manipulated content (Cerdán-Martínez *et al.*, 2020) created in the productive spheres of an intelligence that will be ever more expansive.

1.4. *Objectives and hypothesis*

This research tackles the challenge of recognising deepfakes based on the parameters that have conventionally been used as identifying elements (McDonald, 2018).

In view of the current capacity of generative artificial intelligence to create high quality images with a high degree of verisimilitude: What elements make it possible to recognise and identify that something is a fake? Do the contextual elements of the information relating to the information source, its identification and the features of its reputation enable analysis and detection?

Given the importance of visual communication for young people, especially in the distribution and consumption of content on social networks, the current state of technology requires the focus of media and informational literacy to be shifted onto the recognition of fake audiovisual images and content and knowing the key areas on which to act.

In this context, our research establishes the following objectives:

O1. To evaluate the capacity to recognise deepfakes (fixed images created by generative artificial intelligence) within immersive environments.

O2. To analyse whether the contextual information that accompanies an image influences the ability to recognise deepfakes.

And the following hypotheses are set:

H1. The contextual identifying elements (reference to the source and headline of a news story) that make it possible to identify a media source's reputation shape the credibility of the images.

- H1a. Images from information sources regarded as having the best reputations are the ones that are recognised as real images.
- H1b. Images from information sources regarded as having the worst reputations are the ones recognised as deepfakes.

The reputation of the media sources is considered on the basis of the methodology established in the Global Ranking of Media Web Reputation (SCImago Lab, 2022).

2. Methodology

2.1. *Methodological approach*

To assess the capacity to identify deepfakes (Ramachandran *et al.*, 2021), a quasi-experimental model was developed comparing a control group with an experimental group (Ramos-Galarza, 2021). The experimental stimulus was a virtual environment in which participants accessed an immersive room with eight recreations of newspaper front pages comprising an information source, a headline and an image. From the educommunicative perspective (Cicalese *et al.*, 2022), a virtual environment is an opportunity to accompany learning by considering principles such as recognition of people's diversity of knowledges and experiences as well as other principles of educational communication (Prieto Castillo, 2010).

The pre-experiment and design and development of the quasi-experiment process were done in the first half of 2023.

2.2. *Pre-experiment*

To ensure the construction of a homogeneous environment and systematise the information-collection process, two pilot tests were first carried out in which participants had to distinguish between real and deepfake images in a virtual extended-reality environment (Bay, 2023) with an ad hoc design. The virtual environment in both tests was designed with the A-Frame framework

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and the deepfake images using the synthesia.io app. As the item for both environments, six images were included, four of real people and two deepfakes.

The first pilot trial took place in March 2023. In this test, carried out at the Aula Madrid es Ciencia fair at IFEMA, students from the first and second cycles of secondary education (n = 24) were exposed to a virtual environment (Sanchez-Acedo *et al.*, 2023a) in which they had to identify which of the people shown were real and which were generated by AI. On completion, the participants evaluated the quality of the virtual environment, the degree of immersion and the experience with a self-administered online form. Based on these results, a new virtual environment was designed (Sanchez-Acedo *et al.*, 2023b) adjusting some parameters of the images to achieve a homogeneous viewing environment, such as the lighting, colour, and sharpness, homogenising the backdrops and the facial expressions of the deepfake subjects to isolate the compositional variables of the image.

The second trial was carried out during the Jornadas de Cultura Libre of the Universidad Rey Juan Carlos (OfiLibre, 2023). Forty-six university teachers and researchers participated in it. Through non-participant observation, the aspects on which the participants focussed in the course of the experiment to determine whether a person was real or fake (such as composition, colour, lighting, definition, and sharpness of the image, or the facial features of the person) were collected in a file (Blaxter *et al.*, 2000). It was concluded that the participants' perception of the veracity of the images matched independently of whether their responses were correct.

Based on these results, the quasi-experiment was developed using uniform environments in which the variables of composition, colour, lighting, definition, and sharpness of the image and the facial features of the people were isolated so that they were not included in the recognition of the image. The results of the pre-experiment showed that it is practically impossible to distinguish whether an image is real or has been generated with artificial intelligence (Sanchez-Acedo *et al.*, 2023c).

2.3. *Design, construction and validation of the quasi-experiment*

To carry out the quasi-experiment, two virtual environments were created (control group and experimental group). Each included as items eight recreations of front pages of newspapers in two virtual environments. In the control group's virtual environment, all of the images were real. In the experimental group's environment, all of the images were fakes created using artificial intelligence. In both environments, the headlines and the information sources were real.

The eight information sources used for preparing the items (newspaper front pages) were selected in accordance with the reputation criteria set out in the Global Ranking of Media Web Reputation of SCImago Media Ranking (SCImago Lab, 2022). Taking the 100 highest-ranking Spanish media sources for 2022 from this map of media sources, the four with the best reputation indicators and the four with the lowest classification were selected.

As for the choice of headlines, eight real news stories were retrieved from the selected media sources that fulfilled the criterion of having the image of the person in the forefront. To homogenise the images, the background was eliminated from all of them. In the experimental group, the images were replaced by eight others created by an artificial intelligence system, maintaining the established homogenisation criteria. The selection featured an equal distribution of men and women.

For information collection in the quasi-experiment, a form comprising eleven questions was designed and it was subjected to validation by experts in virtual reality following criteria of importance, unambiguousness, and relevance (Sanchez & Revuelta, 2005). All of the instruments, including the quasi-experiment guide are available in Sanchez-Acedo *et al.* (2023d).

The study population comprised young people from the Community of Madrid, aged between 20 and 29 (INE, 2023). Purposive non-probability sampling was used (n = 80). The participants, who were volunteers, were assigned at random to the control group and

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experimental group. Information gathering was done simultaneously and in-person by several previously trained researchers. Both groups had the same number of participants (n = 40).

Given that the objective of the study is to obtain an overview to describe trends and patterns, descriptive analysis of frequencies and percentages for each of the variables was performed. Considering this and the sample size, no approximate inferential statistical techniques were applied.

The data collected and the results of the analytic process are included in Sanchez-Acedo *et al.* (2023e).

3. Results of the quasi-experiment

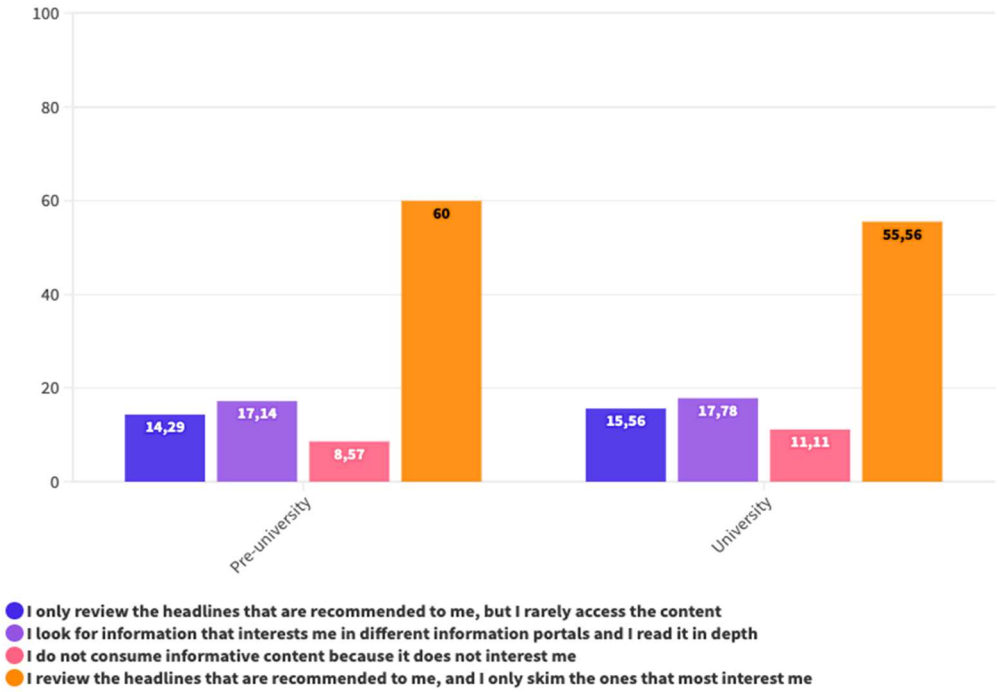
3.1. *Contextualisation of the participants*

The participants' mean age is 25 years (55% female and 44% male). With regards to the level of studies, 43.75% have pre-university education (Obligatory Secondary Education, n = 6, Baccalaureate, n = 15, and Professional Training, n = 14), while 56.25% have university education (licentiate or bachelor's degree, n = 33, master's, n = 10, and doctorate, n = 2). Of them, 26.25% are currently studying at public universities in the Community of Madrid.

With regards to how the participants inform themselves, it is striking that 57.5% review the recommended headlines and only superficially read the ones that most interest them, 17.5% seek information in different information portals, reading it in depth, 15% review the headlines that are recommended to them, rarely accessing the information content, and finally 10% do not consume content of an informative nature.

Comparing educational level with how participants find information shows that most of them, independently of their level of studies, review the headlines that are recommended to them and only superficially read the ones that most interest them (Figure 1).

Figure 1. Comparison of the level of studies and information access method variables.



Source: Own elaboration.

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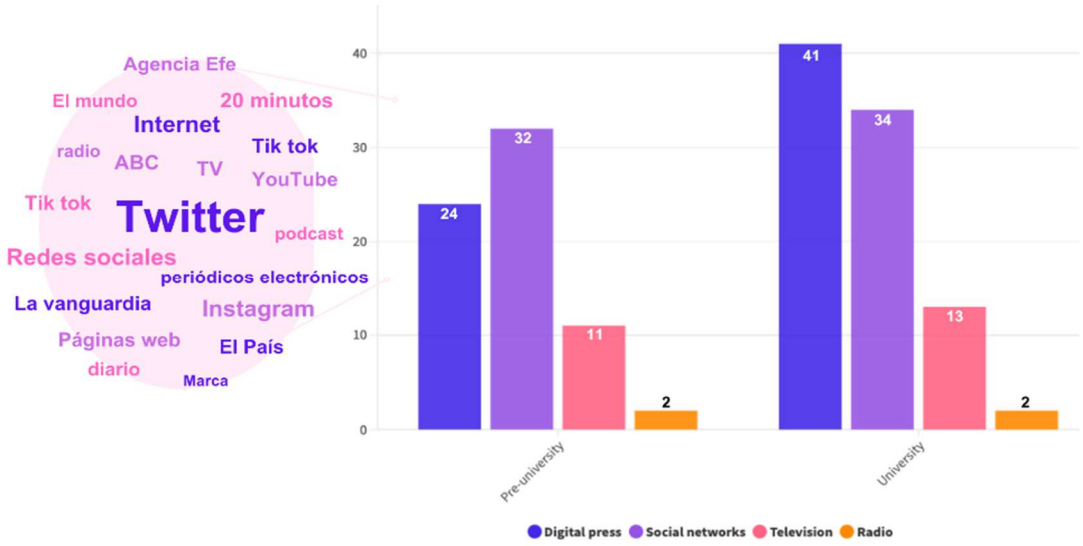
The principal sources of access to information are social networks and digital press. Conventional media such as television and radio appear to a lesser extent. When considering the results in greater depth and comparing the level of studies variable with the options for accessing information variable (Figure 2), it is apparent that social networks are used more than the digital press at pre-university levels and that participants with university education make greater use of digital press than social networks. Furthermore, the results show that Twitter is the most-used social network for accessing information.

Figure 2. Comparison of the level of studies and options for accessing information variables.



Source: Own elaboration.

The results from the quasi-experiment show, in relation to the reputation of the media, that 56.25% of the participants from the control group judged the images to be real in the media with the best reputation. While in media sources with worse reputations, 54.5% considered the people to be real.

On the other hand, in the experimental group, 46.87% consider that the images that appear in the media with the best reputation are deepfakes. In the media with the worst reputation, 58.12% identify the images as people generated by artificial intelligence.

3.2. *Importance of contextual elements*

In the control group, where all of the images are real, 55% of the subjects identify them as such while 45% believe they are deepfakes. When analysing the control group's results in depth, it is apparent that the contextual element that most influences participants' decisions, in the media with the best and worst reputations alike, is the image, which 52.81% of participants consider to be important or very important. Moreover, 53.59% consider the headline and the source of information to be not important or not very important.

The results from the experimental group, where the images were generated with artificial intelligence, show that 47.5% of the participants identified these images as real and 52.5% recognised them as deepfakes. Analysing the results of the experimental group shows that the image is the contextual element considered to be most important, with 47.5% of respondents saying this, both in the media with the best and the worst reputation. The headline and the information source are considered by 60.31% of respondents to be not very important or not important.

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Table 1 shows a control group –experimental group comparison and the percentage values of the contextual elements.

Table 1. Percentage values of the control group (C) and experimental group (E) contextual experiments.

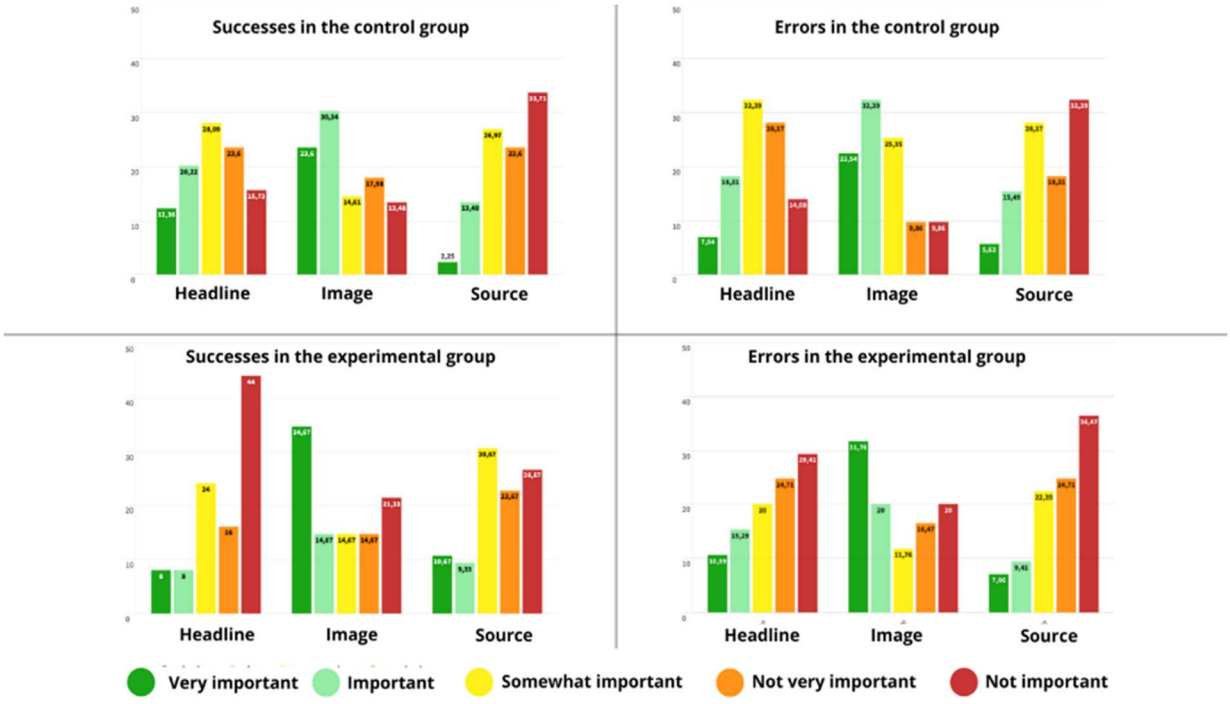
	Very important		Important		Somewhat important		Not very important		Not important	
	C	E	C	E	C	E	C	E	C	E
Image	21.25	30.31	31.56	17.19	18.13	15.31	14.06	17.19	15.00	20.00
Headline	10.00	8.44	16.88	10.00	28.75	23.75	30.31	22.50	14.06	35.31
Information source	2.19	6.25	11.25	6.56	23.75	24.36	26.88	24.69	35.94	38.12

Source: Own elaboration.

3.3. *Success-error ratio and contextual elements*

After analysing the level of importance of contextual elements (headline, image, and information source) by the ratio of successes and errors of participants in the media with the best reputation (Figure 3), the results show that the image is the most important contextual element for 52.49% of participants when evaluating whether an image is real or fake, independently of whether their response is correct or incorrect. However, with 54.63%, the information source is the least important contextual element when it comes to recognising a deepfake.

Figure 3. Ratio of importance of the contextual elements by successes/errors in the media with the best reputation.



Source: Own elaboration.

When analysing the importance of contextual elements in media with the worst reputations, according to the successes and errors of the participants (Figure 4), 70.37% of participants report that the information source is the least important element when recognising a deepfake.

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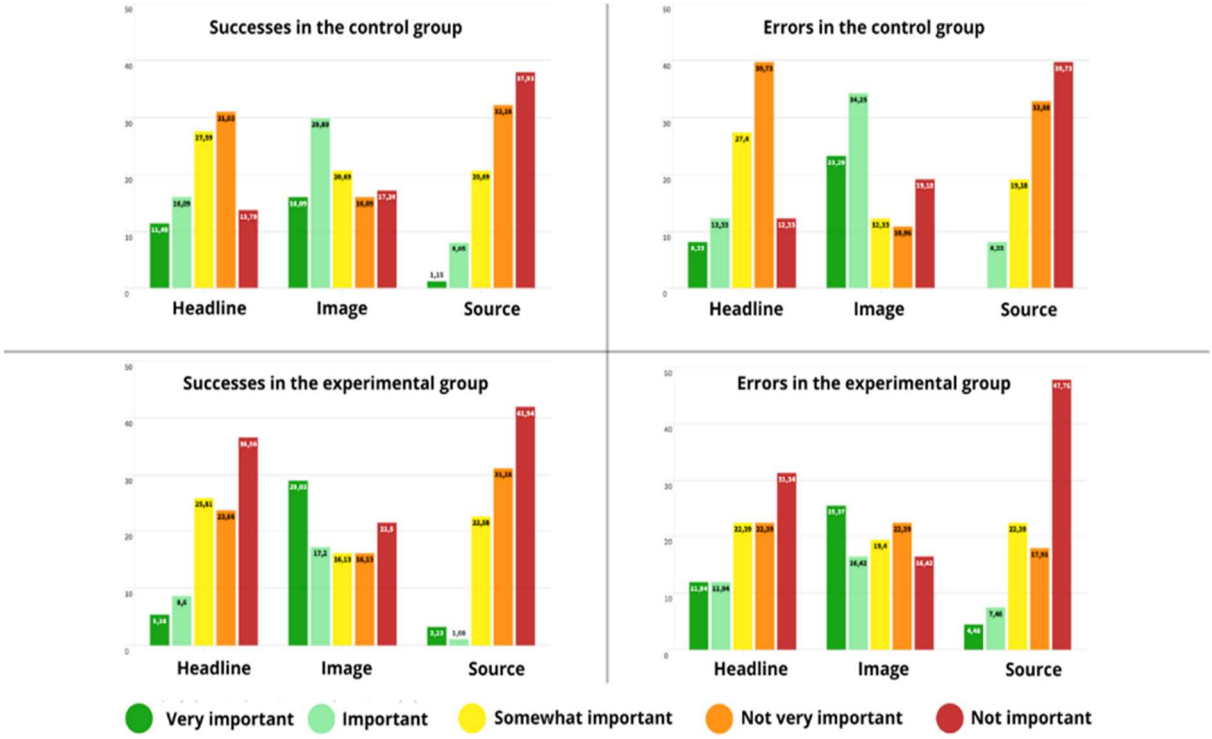
As in the media with the best reputations, the image is the element with most importance, with 47.89% of respondents stating it is important or very important.

Figure 4. Ratio of importance of the contextual elements by successes/errors in the media with the worst reputation.



Source: Own elaboration.

4. Discussion and conclusions

The most influential element for the participants was the image itself, contrasting with the contextual elements that make it possible to recognise the reputation of the of the media (information source or headline) which were valued as not important. This predominance of the image, identified by Fuentes (2003) among others, manifests how the ecology of social networks, especially those whose technological design favours visual discourses and a behaviour of addictive consumption based on technological persuasion techniques (Rixen *et al.*, 2023), has not only produced a remediation in the terms identified by Bolter and Grusin (2011) but that the generation of these new discursive devices establishes a new media ecology (Postman, 1970; Islas *et al.*, 2009) in which new reading frameworks are developed, in the sense of how a text is interpreted. In this way, the referential value, reputation, and intrinsic credibility of the media sources (SCImago Lab, 2022) are overshadowed by the empathetic and emotional relationship with the elements of verisimilitude of the image itself, which increases our ignorance of our own lack of knowledge, as identified by Innerarity (2022), and matches the results of Köbis *et al.* (2021) on how subjects overestimate their abilities to recognise elements of disinformation such as deepfakes.

The informational overload that young people face is not only quantitative, but it is also the result of the design of the media devices in the sense expressed by McLuhan and Fiore (1967). The technological modelling of social networks favours superficiality owing to the enormous and constant flow of information (Parra-Medina & Álvarez-Cervera, 2021), with the result that the images alone capture the attention of the participants. The speed with which they continuously consume information shaped by the underlying technological design, which studies on captology have been evaluating for two decades (Foog, 2003), prevents the pause and profundity

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that analytical and critical processing of information require, as Strate (2004) argues, something that inhibits behaviours that are vital for a healthy media ecosystem such as verifying sources or comparing information (Blanco-Alfonso *et al.*, 2021). So, it is highly important to promote verifying agencies and bodies that solidify the reliability of the media we consume and that also contribute to training in design patterns, especially dark patterns, which through persuasive technological models and recommendation algorithms facilitate the propagation and appeal of disinformation.

Another of the findings is that having isolated the variables of the composition of the image, the capacity of generative artificial intelligence to create hyper-realistic manipulations makes it all but impossible to recognise a deepfake based on the image's constituent elements, something that agrees with the results of Ahmed (2023), Temir (2020), and Chesney and Citron (2019). In other words, we are already unable to tell whether images are false or true because their verisimilitude is such that the identifying elements conventionally used to train in prevention no longer work (McDonald, 2018). As Fray Hortensio Félix Paravicino ventured centuries ago: "The truth does not, in my opinion, have any greater enemy than verisimilitude" (RAE, 1739), a position that is brought up to date in the recent results of Shin and Lee (2022), which affirm that the old axiom of "seeing is believing" is now no longer valid for detecting these sophisticated fakes.

Therefore, in this new medial ecosystem, in the biome of a posthumanism experienced in the post-realist and alternative environments of virtual reality (Dincelli & Yaila, 2022) and AI (Lorenz *et al.*, 2023), refocussing media and information literacy processes is key. More than ever, training must be provided about the complexity of multimodal media systems, the addictive nature of the designs of a persuasive and seductive technology that keeps us in a constant state of flux, and the ease with which perceptive, cognitive, and emotional components can be adapted to alter our values and, with them, individual and social behaviours and responses. Therefore, we must demand the highest standards of verification of facts to offer quality information to users (Suárez-Roca & Vélez-Bermello, 2022), of comparison of information with other sources and with one's own personal judgement (Belloch, 2012), of content curation (Guallar *et al.*, 2020), and of taking advantage of the assistance of AI technology (Iqbal *et al.*, 2023) to distinguish between what is true and what is false.

The comparative analysis by level of studies (pre-university or university education) shows a homogeneous digital media diet, despite the wide age range and range of studies pursued. The fact that the formative level does not affect how people access and consume information shows the shortfall in media literacy. Specialist knowledge seemingly does not result in better comprehension of the social and informational reality, something that requires rethinking of media and information literacy from more comprehensive models as Marta-Lazo and Gabelas-Barroso (2022) have noted. It is also necessary to establish new communicative strategies, as Morejón-Llamas (2020) notes, as well as to go further with policies to combat disinformation in the new media ecosystem (Sábada-Chalezquer & Salaverría-Aliaga, 2023). Moreover, we need new tools to achieve a moral digital education (Cerdán-Martínez *et al.*, 2020), especially when facing a disruptive scenario of disinformation –both scalar and logarithmic– like the one prompted by immersive technologies (Escobar-Álvarez & Álvarez-Zapata, 2018) and generative artificial intelligence in all of their dimensions, including their impact on professional journalistic activity (Ufarte-Ruiz *et al.*, 2023).

The results of the quasi-experiment allow the working hypothesis to be confirmed. In any case, it is important to highlight that the sample size and the descriptive statistical analysis make it possible to describe these patterns or trends, but there is a need for studies with larger samples and ones that apply inferential statistical analyses to estimate population parameters and be able to make predictions about the hypothesis.

The results of the research have an applied value (Ivan *et al.*, 2023). The ecology of the metaverse has barely started its journey. As Gartner's hype cycle (2023) has shown us, the emergence of technologies is multi-stage; they require adjustments, but they arrive, impact and

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modify media ecosystems. We are passing through the ecotone of a *defactified* transhumanism in which it is essential to analyse, comprehend, investigate and generate instruments for the literacy of an ever more complex world in which advanced practices for intervening in and improving media and information literacy processes will be vital. We must not miss this opportunity.

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