HHAI 2024: Hybrid Human AI Systems for the Social Good
F. Lorig et al. (Eds.)

doi:10.3233/FAIA240180

In Search of Clarity: Discerning Between Human Replacement and Augmentation

Costanza ALFIERI [a,1], Martina DE SANCTIS [b] Donatella DONATI [a] and Paola INVERARDI [b]

[a] *University of L'Aquila, Italy*
[b] *Gran Sasso Science Institute (GSSI), Italy*

Abstract. As intelligent systems become more autonomous, humans increasingly delegate important tasks and decisions to them. On the one hand, this approach seems to be very supportive to humans, on the other it generates apprehension about a future dominated by machines. These contrasting viewpoints encapsulate what in literature is usually referred to as augmenting, enhancing or amplifying humans versus replacing them. However, these concepts lack clear and shared definitions.

To fill this gap, we conducted a semi-systematic literature review to elicit existing definitions, if any. We found out that replacement is generally negatively considered while a hybrid approach is often preferred, as there is a hesitancy to embrace complete automation, primarily driven by a lack of trust in AI systems. To make these concepts applicable, it is essential to identify shared and actionable definitions. Building on these insights, our upcoming research aims at developing a framework that fosters their measurement.

Keywords. Autonomous Systems, Replacement, Augmentation, AI

1. Introduction

In the realm of Artificial Intelligence (AI), numerous researchers have begun speaking of *replacing* and *augmenting* human roles in specific tasks [1,2,3]. To some extent, they seem to mirror the old terms of augmentation and automation [4,5]. While these terms have proven useful in describing the human-machine interaction thus far, in some current cases their applicability may be limited. For example, when it comes to experiencing a tour of a museum with virtual reality, can we speak of *automation* of a museum tour? It doesn't seem to be the case.

In general, as intelligent systems become more autonomous, humans increasingly delegate important tasks and decisions to them in both social and private contexts. This approach seems to be very supportive to humans, but it generates some apprehension about a future dominated by machines. Such duality might carry significant social implications and raise ethical concerns that go beyond privacy violations and data protection [6]. These contrasting viewpoints encapsulate what in literature is usually referred to as augmenting, enhancing or amplifying humans versus replacing them. Despite their intuitiveness, these concepts lack comprehensive definitions across various domains.

[1] Corresponding Author: Costanza Alfieri, costanza.alfieri@student.univaq.it.

We believe that to effectively apply these concepts, which encompass both conceptual and practical dimensions, it is essential to establish a shared definition. Therefore, we conducted an analysis of existing literature to extract definitions of the aforementioned notions. Initially, we conducted a semi-systematic literature review following well-established guidelines [7]. We identified the research questions guiding our study, focusing on exploring how terms such as enhance, replace, amplify, and augment, as applied to humans, are employed. We selected a final set of 24 relevant papers, for which we examined the use of these concepts at both the conceptual and application levels to tackle the lack of a comprehensive definition. Furthermore, we examined how the notions of augmentation and replacement of humans are perceived.

We found out that replacement is generally negatively considered while a hybrid approach of combining humans and AI systems is preferred. Indeed, augmentation involves using AI to support and assist human tasks, fostering a collaborative environment where humans and AI systems work together. In literature, this approach is preferred over fully replacing humans, as there is a hesitancy to embrace complete automation. However, beyond the absence of a comprehensive definition, we identified two different perceptions of replacement scenarios: positive and negative. We then propose future research directions towards evaluating the impact of intelligent systems.

2. Semi-systematic analysis of the existing literature

In this section, we describe the methodology we followed for the semi-systematic literature review, in Section 2.1, and the analysis of selected papers, in Section 2.2.

2.1. Methodology

To investigate the state of the art about definitions, usage and application of the terms *augment* and *replace* in AI, we started by conducting a semi-systematic literature review, following well-established guidelines [7]. We aim to conduct an analysis encompassing diverse fields ranging from Philosophy to Computer Science, including Life Science, Law and beyond. Thus, to prevent an unfair bias toward any specific field, we searched for suitable publications in the *Scopus* digital library[2], which includes multi-disciplinary fields. The Research Questions (RQs) we aim to answer are the following:

RQ1: Does a comprehensive and shared definition among disciplines for the terms *augment* and *replace* humans exist?

RQ2: What is the perception of *augmentation* and *replacement* of humans in literature?

From the RQs we identified the keywords to be employed in the search query within the Scopus digital library. The generic query is as follow:

("augment human" **OR** "enhanc* human" **OR** "amplif* human" **OR** "replac* human") **AND** ("Artificial Intelligence" **OR** AI).*

[2] https://www.scopus.com/

It includes the terms *amplify* and *enhance* as synonyms of the term augment. The search was performed by considering publications' title and abstract. Moreover, we limit our query to works published within the past 5 years, namely from 2019 to (November) 2023, considering journal, conference, workshop papers, and book chapters. As a result, we get a total of **511** papers. Subsequently, we performed a screening of publications according to the inclusion and exclusion criteria, reported in Table 1, that we defined to identify the set of potentially relevant papers. The assessment phase undergo through multiple iterations among the authors. A first keywording using abstracts phase allowed us to detect out of scope papers, by means of an analysis focused on title, abstract, and keywords. It was expected that the results contained a considerable number of papers whose contributions were beyond the scope of this work. During the subsequent assessment iterations, we considered papers that explore the concepts of augmentation and replacement (and similar terms). We excluded papers that solely discuss specific applications of AI systems (i.e., medical technologies for diagnosis) without engaging in a thorough discussion of these concepts. For instance, papers that merely conclude that these technologies augment humans without delving into defining the term were excluded. Furthermore, we excluded papers that focus on evaluating the *interaction* between humans and intelligent systems, specifically those exploring the enhancement, amplification, or augmentation of this interaction. Instead, our focus lies on examining the enhancement of human capabilities or the potential replacement of humans by intelligent systems. This way, we get a set of **168** papers. At this stage of the assessment, we delved deeper into this set of papers, and distributed them among us for further examination. Those articles that posed more challenging evaluations were discussed in greater depth. Eventually, we get a set of **24** relevant papers. Details on the semi-systematic literature review can be found in the online replication package [8]. Those papers that fulfilled the criteria, were evaluated and are discussed in the following.

Table 1. Inclusion and Exclusion Criteria.

Inclusion criteria	**Exclusion criteria**
Papers in journals, conferences, workshops, books.	Papers not written in English.
Publication stage final.	Short papers, posters and tutorials ($\leq$ 5 pages).
Papers discussing replacement and/or augmentation.	Survey and out of scope papers.

2.2. Analysis of selected papers

In this section, we analyze the selected papers to examine any existing definitions and perceptions regarding the concepts of replacing and augmenting humans.

Bankins and Formosa [1] analyze the ethical implications of AI for meaningful work, defined as the perception that one's work holds worth, significance, or a higher purpose. Their analysis explores how meaningful work is influenced by three aspects of AI deployment: replacement, 'tending the machine', and amplifying humans' skills. Replacement occurs when AI takes over certain tasks; 'tending the machine' refers to AI assuming a set of tasks that involve new human work in managing the machine; amplifying refers to the scenario in which AI "assist/augment" workers in their tasks, enhancing human abilities. This is a case of collaboration, where the AI system supports workers in performing their jobs more effectively. The authours provide a qualitative analysis considering the various dimension of meaningful work and how these are positively or

negatively impacted by AI replacement. However, the definition of amplifying humans' skills remains somewhat vague, described as "improving something that humans were already doing in that process, leading to better outcomes for beneficiaries."

Formosa [9] explores the concept of human autonomy and its relationship with the autonomy of intelligent systems, examining how these systems can either enhance or erode human autonomy. While there are instances of beneficial replacements (e.g., robots performing tasks to enhance autonomy), there are also negative examples about these systems (diminishment of human competencies and autonomy). However, comprehensive definitions for enhancement or replacement are absent.

Haefner *et al.* [10] present a framework that shows the extent to which AI may replace human in innovation management. The study unfolds in two main stages: an examination of how AI systems can augment human contributions to the innovation process, and an analysis of the "information processing capabilities levels" for AI systems, indicating the likelihood of replacing human decision-making. From this framework emerges a definition of replacement as the scenario where humans no longer engage in a specific task. However, a definition for augmentation is entirely absent from this paper.

Fritts and Cabrera [11] explore the ethical implications of what they call "dehumanization"—the absence of humans in certain tasks or processes. They argue that while there are instances where replacing humans with autonomous systems is morally acceptable (e.g., using a robot to vacuum the floor), there are cases where this replacement raises ethical concerns, particularly in processes involving human interaction, such as hiring. The authors suggest that the use of recruitment algorithms may harm the employee-employer relationship, for example. However, a precise definition of "replacement", extending beyond the intuitive notion of dehumanization, is missing.

The papers outlined below can be classified into three main categories (see Table 2). While the boundaries between these categories may not be sharply distinct, they serve as a helpful guide for the reader. For this reason, each paper may belong to multiple categories, which represent the main approaches towards augmentation and replacement adopted by the papers. These categories are:

1. Augmentation: includes papers considering the notions and describing cases of augmentation, enhancement or amplification;
2. Replacement: includes papers focusing on task replacement in human activities, or advocating for replacement in repetitive tasks.;
3. Against Replacement: includes papers advocating against replacement.

Table 2. Panoramic on the literature review.

1. Augmentation	[1,9,12,13,14,15,16,17,18,19,20,21,22]
2. Replacement	[1,3,9,10,11,23]
3. Against Replacement	[2,3,11,13,17,18,19,20,21,22,24,25,26,27,28,29]

Augmentation and Replacement. For the sake of clarity, in this paragraph, we discuss papers falling into the first two categories together. A preliminary definition of augmentation is explored in various studies. Madni [15] elucidates the concept of augmented intelligence (AugI) in the context of systems engineering. AugI is characterized as a design paradigm that fosters a human-centered collaboration with artificial intelligence to improve human decision-making and learning in domains where human limitations

are evident. It is synonymous with terms such as "intelligence amplification, cognitive augmentation, and machine augmented intelligence".

Campbell *et al.* [16] articulate it as "augmented decision-making that necessitates human expertise and knowledge to effectively manage intelligent machines." Dengel *et al.* [17] use the term "augmented human" to describe the incorporation of cognitive and physical enhancements as integral components of the human body. Maiuri *et al.* [12] conceptualize augmentation as the extension of "human faculties in some way."

Brynjolfsson [13] explores the comparison between human-like AI and humans augmentation, namely mimicking humans vs. augmenting them. He highlights that while augmentation offers new capabilities and generates more value with respect to merely developing human-like AI, there is a prevailing trend of encouraging automation over augmentation. The author emphasizes that the promise of automation might hide a trap: when AI replicates and automates existing human capabilities, machines become increasingly capable substitutes for human labor, resulting in a decrease in economic and political negotiating power for workers, namely the *Turing Trap*. Despite both automation and augmentation have the potential to increase labor productivity, they differ in terms of who benefits. The owners, inventors and architects of new systems, when technologies automate human labor, human workers when technologies augment human capabilities. While the author advocates for replacing purely repetitive tasks, he discusses how augmenting human capabilities with technology opens up a realm of new opportunities.

Marino *et al.* [14] advocate for prioritizing AI augmentation over replacement as a means to establish Trustworthy AI. Specifically, the authors highlight the reluctance to adopt fully automated AI systems and completely exclude humans from the process due to the lack of human trust in AI systems. To address this challenge, they propose leveraging AI augmentation, which utilizes AI to enhance and support human activities and this ultimately diminishes distrust. The authors argue as AI augmentation introduces *shared-autonomy*, allowing to relegate high-level decisions.

Flores-Vivar and García-Peñalvo [18] shed light on a crucial aspect within the domain of education, emphasizing the role of augmentation over replacement when integrating AI systems. They advocate for a collaborative approach where AI tools serve to enhance rather than replace human capabilities, recognizing that certain professions demand the irreplaceablility of the human. They caution against expecting AI to fulfill inspirational roles in education, as empathy is not replaceble.

Lai *et al.* [19] advocate for the integration of AI tools to support human capabilities. They focus on the potential of AI systems to enhance certain aspects of human performance, in the realm of decision-making. On their view, AI tools can complement and augment human decision-making abilities by providing predictive insights or recommendations for consideration. So, the authors advocate for a collaborative approach where AI aids humans in making more informed and better decisions, aligning with the principle of prioritizing augmentation over replacement. Also, Adomavicius G. and Yang M. [20] assert that AI systems can improve the decision-making process. Their focus lies on leveraging AI tools to promote fairness and mitigate human biases inherent in decision-making. However, they emphasize the indispensable role of humans in critically examining the origins of biases and potential instances of discrimination. Thus, their perspective aligns with the overarching principle of augmenting human capabilities through AI while recognizing the need for human involvement in the process of making decisions.

Additionally, many authors agree that replacement is advisable when a specific repetitive task can be automated [1,3,13,23].

Against Replacement. Several papers emphasize the importance of not replacing humans, although they often lack a clear definition of replacement. In these instances, the authors generally advocate for human-machine collaboration. Xu *et al.* [25] analyze the pros and cons of incorporating AI into justice systems, asserting that AI should only serve as a supportive tool rather than a replacement for humans. Analogous considerations within the realm of justice are explored by Greenstein [24], who raises concerns about AI systems being 'black boxes' whose decisions may not align with fundamental human principles. Bertolini *et al.* [2] delve into the role of care robots, stating that they should not replace human caregivers. Dengel *et al.* [17] discuss the consideration of replacements, asserting that the most valuable AI systems in the future are those that collaborate rather than replace. This viewpoint aligns with the concept of mutually reinforcing collaboration, supported by [3,26,27,28]. Brynjolfsson [13] suggests that as technology increasingly replaces rather than enhancing labor, the resulting disparity may become more pronounced. Therefore, it is imperative to reverse the trend of incentivizing automation at the expense of augmentation.

Goldfarb and Lindsay [29] question the assumptions regarding AI substitution and delve into the implications of AI complements, within the international security domain and with a specific focus on machine learning. Despite machine learning improved statistical *prediction*, decision-making further includes *data* and *judgment*, as complementary to prediction. The authors argue that if AI renders prediction more cost-effective for military organizations, the value and contested nature of both data and judgment will increase. Therefore, the authors conclude that assuming AI will replace human beings in either warfare or any other competitive endeavor is premature, since functions like judgment and moral leadership cannot be automated with AI technology.

Fortes [21] argues against the assumption that intelligent systems outperform humans in decision-making, emphasizing that these tools are "task-oriented" and lack the broad cognitive abilities associated with general intelligence that pertains to humans. While acknowledging the potential for these tools to augment human capabilities, Fortes highlights their role as supportive aids rather than replacements for human judgment. Koeszegi [22] explores the impact of automated decision systems on human autonomy and the necessary safeguards to protect individuals and society. The author argues that automated decision systems are not always efficient and objective, but are often vulnerable to the same decision-making issues as humans. To foster decision support systems that uphold human dignity and enhance autonomy and well-being, we must view these systems within their contextual applications as socio-technical entities.

3. Findings, Future Research and Conclusions

Missing definitions. Augmentation is often referred to with the notions of "improving", "facilitating", "supporting" and "enhancing" human faculties, activities, decisions and tasks with the aim of "achieving superior outcomes" [12,14,15]. For instance, [1] posits that a better outcome entails the experience of meaningful work, while [15] suggests it involves leveraging the strengths of both humans and machines to overcome respective limitations. However, while these discussions hold some merit, they fail to ad-

dress the crucial question of: *who benefits from it?* In [1], the authors tackle this question by analyzing how the introduction of these technologies can either enhance or undermine the meaningfulness of work. However, their analysis falls short in providing examples that align with their proposed notion of augmentation.

On the other hand, the notion of replacement is often used or implicitly referred to as the substitution of humans in a task, [1,2,25,29]. While this idea of replacement applies to many scenarios commonly described as "automation" [14], it may not encompass all instances and replacement types. For example, when considering the use of virtual reality for visiting a museum, can we accurately label it as the "replacement" of a museum tour? Here, the use of a system results in a replacement of an experience, rather than a task.

Answer to RQ$_1$: We observed that, in the analyzed literature, a comprehensive definition of augmentation and replacement that encompasses all cases, ways, and nuances in which the two concepts are used is lacking.

Positive and negative forms of replacement. The literature we analyzed reveals an implicit distinction between positive and negative forms of replacement. Indeed, many authors advocate against what they believe to be cases of "bad" replacement. Brynjolfsson highlights concerns about the diminishing power of workers [14], Bankins *et al.* focus on the proliferation of repetitive and mundane jobs [1], and Bertolini *et al.* warn of the risk of social isolation when humans are solely assisted by care robots instead of human caregivers [2]. The very same authors provide examples of "good" replacement: "Bestic", for example, is a device designed to assist people with disabilities in feeding themselves autonomously, or "AlphaFold", in the field of disease treatment, can determine protein structures, a laborious and long work previously done by humans [1,2]. Similar considerations can be made regarding the apparent agreement on replacing humans in repetitive tasks, which is considered a positive form of replacement [1,3,13,23]. We noticed that the absence of a clear distinction between positive and negative replacement leads many authors to have a positive attitude towards augmentation, and to advocate for augmentation rather than replacement of humans [1,12,13,14]. Contrary to what is held in the analyzed literature, we believe that the concepts of augmentation and replacement are not intrinsically good or bad: the evaluation of cases of augmentation or replacement seems to depend on the specific context of application, the stakeholders involved, and the socio-economic interests at play. Considering, who benefits from the introduction of an AI system is crucial when assessing its effectiveness in augmenting or positively replacing humans, as there might be contrasting interests at stake that need to be taken into account. Beyond a simplistic dichotomy of augmentation versus replacement, framed as positive versus negative, we propose a nuanced perspective as in Table 3.

Table 3. Cases of positive and negative augmentation and replacement from the literature.

	Augmentation	**Replacement**
Positive	Robot teleoperation [14].	"Bestic" device for eating autonomously [1].
Negative	Nudging social robots disrespecting autonomy [9].	Human caregivers substituted by care robots [2].

Answer to RQ$_2$: We observed a predominant negative perception towards the replacement of humans, whereas there is a generally positive attitude towards augmenting them. However, it seems that distinguishing between beneficial and detrimental replacement scenarios is more accurate.

The problem of trust. In recent years, the public discourse on intelligent systems has intensified due to advancements in research, deployment, and application; and this heightened attention highlights the importance of trust and trustworthiness within AI ethics. Many of the papers we analyzed underscore its significance in the context of human augmentation or replacement. For example, transparency and accountability in decision-making processes are key factors in bolstering trust in intelligent systems, while blind reliance on algorithmic decisions is discouraged [21], critical evaluation of data processing, systemic calibration, and decision justifications is imperative for cultivating trust in systems that either augment or replace humans in tasks and decisions. Although, according to different authors [20] the adoption of intelligent systems is a promising avenue for fostering Trustworthy AI, it is important to have humans to maintain oversight and accountability over such systems [14].

Future research. Here are a few key points outlining what we believe should be addressed following this preliminary research. First, to make the notions of augmentation and replacement applicable is necessary to provide comprehensive and rigorous definitions that can be shared across disciplines. Second, further work on what are considered to be bad and good cases of replacement and augmentation needs to be done. This distinction, as revealed in our research, is crucial and cannot be drawn upon the intrinsic nature of the concept of augmentation and replacement. Determining whether a replacement is beneficial or detrimental remains an open challenge to face. Ultimately, an evaluation framework for measuring these concepts is needed to guide researchers and practitioners in distinguishing between augmentation and replacement. This framework must also consider who benefits from the introduction of AI systems. The evaluation framework endeavors to measure the impact of autonomous systems to determine their placement within one of the four situations illustrated in Table 3. One of the positive outcomes of using a framework like this could be that if replacement becomes quantifiable, it might be regarded with less suspicion, as quantification provides an objective basis for assessment and evaluation. Finally, the framework would additionally bolster explainability, thereby fostering trust. As evidenced in the literature, a prevalent argument suggests that humans should not blindly trust systems that operate as black boxes. By enhancing transparency, human agents can rely on the system more easily, understanding its role in given context, what it does and why it performs in a certain manner.

In this paper, we investigate the concepts of replacing and augmenting humans when an intelligent system is introduced into a given context. We initiated our exploration with a semi-systematic literature review, which yielded several key findings: augmentation is generally favored over replacement; replacement scenarios can vary in their outcomes, with some being beneficial and others detrimental; and the level of trust towards these systems can be influenced by their role (i.e., whether they are replacing or augmenting). Drawing from these findings, we emphasize the necessity for shared and comprehensive definitions that could serve as foundational elements for developing an evaluation framework for the application of intelligent systems.

Acknowledgements

This work has been partially funded by the MUR (Italy) Department of Excellence 2023-2027, and the PRIN project 2022JKA4SL - HALO: etHical-aware AdjustabLe autOnomous systems.

References

[1] S. Bankins and P. Formosa, "The ethical implications of artificial intelligence (AI) for meaningful work," *Journal of Business Ethics*, pp. 1–16, 2023.

[2] A. Bertolini and S. Arian, "Do robots care?: Towards an anthropocentric framework in the caring of frail individuals through assistive technology," in *Aging between Participation and Simulation: Ethical Dimensions of Social Assistive Technologies*, 2020, pp. 35–52.

[3] G. Sammour and L. Malas, *The Obvious Foreseen Effects of Machines Replacing Humans in Society*. Springer International Publishing, 2023, pp. 335–352.

[4] M. Spence, "Automation, Augmentation, Value Creation & the Distribution of Income & Wealth," *Daedalus*, vol. 151, no. 2, pp. 244–255, 05 2022.

[5] S. Raisch and S. Krakowski, "Artificial intelligence and management: The automation–augmentation paradox," *Academy of management review*, vol. 46, no. 1, pp. 192–210, 2021.

[6] P. Inverardi, "Ethics and privacy in autonomous systems: A software exoskeleton to empower the user," in *Software Engineering for Resilient Systems*, R. Calinescu and F. Di Giandomenico, Eds. Springer International Publishing, 2019, pp. 3–8.

[7] K. Petersen, S. Vakkalanka, and L. Kuzniarz, "Guidelines for conducting systematic mapping studies in software engineering: An update," *Information and Software Technology*, vol. 64, pp. 1–18, 2015.

[8] C. Alfieri, M. De Sanctis, D. Donati, and P. Inverardi, "Additional material for the paper titled "In Search of Clarity: Discerning Between Human Replacement and Augmentation"," 2024. [Online]. Available: https://anonymous.4open.science/r/HHAI2024-1CC7/README.md

[9] P. Formosa, "Robot autonomy vs. human autonomy: social robots, artificial intelligence (ai), and the nature of autonomy," *Minds and Machines*, vol. 31, no. 4, pp. 595–616, 2021.

[10] N. Haefner, J. Wincent, V. Parida, and O. Gassmann, "Artificial intelligence and innovation management: A review, framework, and research agenda," *Technological Forecasting and Social Change*, vol. 162, p. 120392, 2021.

[11] M. Fritts and F. Cabrera, "Ai recruitment algorithms and the dehumanization problem," *Ethics and Information Technology*, vol. 23, pp. 791–801, 2021.

[12] C. Maiuri, M. Karimshoushtari, F. Tango, and C. Novara, "Application of reinforcement learning for intelligent support decision system: A paradigm towards safety and explainability," in *Artificial Intelligence in HCI*. Springer Nature Switzerland, 2023, pp. 243–261.

[13] E. Brynjolfsson, "The Turing Trap: The Promise and Peril of Human-Like Artificial Intelligence," *Daedalus*, vol. 151, no. 2, pp. 272–287, 05 2022.

[14] D. L. Marino, J. Grandio, C. S. Wickramasinghe, K. Schroeder, K. Bourne, A. V. Filippas, and M. Manic, "AI augmentation for trustworthy AI: Augmented robot teleoperation," in *2020 13th International Conference on Human System Interaction (HSI)*. IEEE, 2020, pp. 155–161.

[15] A. M. Madni, "Augmented intelligence: A human productivity and performance amplifier in systems engineering and engineered human–machine systems," *Systems Engineering for the Digital Age: Practitioner Perspectives*, pp. 375–391, 2023.

[16] C. A. Campbell and S. Ramamoorti, "Design thinking and cybernetics: The case for generative ai in ais pedagogy," *Advances in Accounting Education: Teaching and Curriculum Innovations*, vol. 27, pp. 101–123, 2023.

[17] A. Dengel, L. Devillers, and L. M. Schaal, "Augmented human and human-machine co-evolution: Efficiency and ethics," *Reflections on Artificial Intelligence for humanity*, pp. 203–227, 2021.

[18] J.-M. Flores-Vivar and F.-J. García-Peñalvo, "Reflections on the ethics, potential, and challenges of artificial intelligence in the framework of quality education (sdg4); [reflexiones sobre la ética, potencialidades y retos de la inteligencia artificial en el marco de la educación de calidad (ods4)]," *Comunicar*, vol. 30, no. 74, p. 35 – 44, 2023.

[19] V. Lai, C. Chen, A. Smith-Renner, Q. V. Liao, and C. Tan, "Towards a science of human-ai decision making: An overview of design space in empirical human-subject studies," in *Proceedings of the 2023 ACM Conference on Fairness, Accountability, and Transparency*, 2023, pp. 1369–1385.

[20] G. Adomavicius and M. Yang, "Integrating behavioral, economic, and technical insights to understand and address algorithmic bias: A human-centric perspective," *ACM Transactions on Management Information Systems (TMIS)*, vol. 13, no. 3, pp. 1–27, 2022.

[21] P. R. B. Fortes, "Paths to digital justice: Judicial robots, algorithmic decision-making, and due process," *Asian Journal of Law and Society*, vol. 7, no. 3, pp. 453–469, 2020.

[22] S. T. Koeszegi, *Automated Decision Systems: Why Human Autonomy is at Stake*. Springer International Publishing, 2022, pp. 155–169.
[23] J. Armour, R. Parnham, and M. Sako, "Augmented lawyering," *University of Illinois Law Review*, vol. 2022, no. 1, p. 71 – 138, 2022.
[24] S. Greenstein, "Preserving the rule of law in the era of artificial intelligence (ai)," *Artificial Intelligence and Law*, vol. 30, no. 3, p. 291 – 323, 2022.
[25] Z. Xu, "Human judges in the era of artificial intelligence: challenges and opportunities," *Applied Artificial Intelligence*, vol. 36, no. 1, p. 2013652, 2022.
[26] R. Galin and R. Meshcheryakov, "Collaborative robots: Development of robotic perception system, safety issues, and integration of ai to imitate human behavior," in *Proceedings of 15th International Conference on Electromechanics and Robotics" Zavalishin's Readings" ER (ZR) 2020*. Springer, 2021, pp. 175–185.
[27] L. Benichou and ChatGPT, "The role of using ChatGPT AI in writing medical scientific articles," *Journal of Stomatology, Oral and Maxillofacial Surgery*, vol. 124, no. 5, p. 101456, 2023.
[28] A. de Regt and E. Gagnon, "Rethinking how humans and machines make sense together," 2020.
[29] A. Goldfarb and J. R. Lindsay, "Prediction and judgment: Why artificial intelligence increases the importance of humans in war," *International Security*, vol. 46, no. 3, pp. 7–50, 2021.