Rethinking Generative AI in Human-Computer Interaction: Review of Affordances, Constraints, and Implications

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Abstract: Generative Artificial Intelligence (GAI) transforms our technological interactions, including new capabilities and concerns about biases and misuse. In the field of human-computer interaction (HCI), previous research has investigated generative AI in relation to human-centred AI, user trust, user experience, design work, co-creativity, and user personas. This study applies the theoretical lens of affordances and constraints to ask the question: Which affordances and constraints of generative AI can be identified in human-computer interaction research? The study employs a scoping literature review approach to collect data from the Web of Science Core Collection databases. The query string combined keywords, such as "generative", "artificial intelligence", and "human computer interaction", with Boolean operators AND and OR. Inclusion and exclusion criteria were used in the screening of 156 identified articles, from which a total of 37 were selected for inclusion in the study. An initial categorization matrix, based on the theory of affordances, was used to conduct a deductive thematic analysis. The analysis followed the guidelines for thematic analysis suggested by Braun and Clarke. The investigation identified seven key themes, with included sub-themes, illustrating the varied applications and potential effects of generative AI. The seven key themes are: 1) improving algorithms, 2) collaborative work, 3) education support, 4) truth issues, 5) biases, 6) ethical considerations, and 7) consequences for job market. The study further highlights the importance of considering contextual differences and short-term and long-term consequences when applying GAI technologies, as well as ethical considerations, such as ethical and legal accountability. The paper concludes with a novel conceptual model for affordances and constraints of generative AI, informing future research, guiding stakeholders' use and implementation, and providing design recommendations for generative AI systems across various sectors.

Keywords: Generative Artificial Intelligence, Human-Computer Interaction, Affordances, Literature Review

1. Introduction

In Human-Computer Interaction (HCI) research, the birth of Generative Artificial Intelligence (GAI) marks a transformative phase, broadening the horizon of possibilities for how humans to engage with digital systems. GAI, which includes several models for generating images, videos, text and so on, could be divided into Natural Language Processing (NLP) and Image Processing (Kim et al., 2024). Viewed from the perspective of NLP, Deep Neural Networks mark an important milestone (Kim et al., 2024). For example, deep learning architectures such as the transformer in ChatGPT includes attention mechanisms which allows for focus on the most important parts in the inputs, necessary for processing and comprehending large amount of data (Hashana, Brundha & Ayoobkhan, 2023). In relation to Image Processing, Generative Adversarial Network (GAN) could be mentioned as an important technology (Kim et al., 2024). Another technology related to Image Processing is Variational Auto-Encoder (VAE), which is often compared to, and combined with, GAN (Li et al., 2025; Akkem et al., 2024). Studies have shown that combining VAE and GAN allows for drawing on the strengths from both technologies, such as easier training with VAE and higher quality output with GAN (Akkem et al., 2024; Qiang et al., 2023).

As a technology, GAI has begun reshaping the industry and work landscapes (Chui et al., 2023), such as user experience (UX) design processes (Stige et al., 2024) and effectiveness in sales performances (Liao et al., 2024). Artificial Intelligence (AI) also offers opportunities for education, such as personalized and AI driven tutoring (Zhang et al., 2024), novel approaches for prototyping (Rapp, 2019), and enhanced teaching and learning practices (Giannakos et al., 2024). Additionally, GAI integration has consequences. It presents challenges such as ethical considerations (Farina, Yu & Lavazza, 2025; Cong-Lem et al., 2024; Hagendorff, 2024; Sison et al., 2023), data biases (Ali & Aysan, 2025; Hagendorff, 2024; Oppenlaender, 2023; Yu, Ma & Zhu, 2023), sustainability impact (Hosseini, Gao & Vivas-Valencia, 2025; Humble & Mozelius, 2024), and the potential for misuse (Ali & Aysan, 2025; Duong et al., 2024; Triantafyllopoulos et al., 2023), raising essential questions about the future of work, the nature of creativity, and the role of humans in a machine-driven landscape.

Focusing on theoretical concepts, the concepts of affordances and constraints provide a nuanced lens to explore the research on GAI in HCI. Affordances, initially coined by psychologist James J. Gibson, refers to the possibilities for actions offered by objects and environments to an organism (Gibson, 2014). As later stated by Donald A. Norman (2008), affordances according to Gibson's definition do not need to be perceivable or even knowable by the organism, "they simply existed". Norman's (1999) own definition, which is commonly applied in HCI,

encompasses affordances that are perceivable by a user, therefore 'perceived affordances'. For example, users perceives that they can interact with a computer system. Similarly, constraints are about what users cannot do or perceive that they cannot do. For example, clicking outside the computer screen or navigating a computer system in a way that seems illogical or breaks conventions (Norman, 1999). In the context of the literature review, affordances denote the actionable capabilities of GAI systems found in the HCI literature, and constraints refer to the limitations or boundaries within which these systems operate, encompassing technical, ethical, and practical barriers that may hinder their effective use.

Moreover, recent literature reviews in the field of HCI have investigated GAI concerning, for example, human-centred AI (Schmager, Pappas & Vassilakopoulou, 2025), user trust (Bach et al., 2024), user experience (UX) design (Stige et al., 2024), design work (Shi et al., 2023), and quantitative user personas (Salminen et al., 2023). Complementing these, Liu et al. (2023) provide a systematic overview of how AI and machine learning foster human-computer co-creativity, underscoring a gap in design-oriented research within HCI. However, no prior literature review has, to the authors' knowledge, explored GAI in HCI through the theoretical lens of affordances and constraints. This study aims to address that specific research gap. Since affordances is an influential and widely applied theoretical lens in HCI, adding this perspective to the body of knowledge would constitute a contribution to the field. Further, compared with previous research that has explored GAI in technical implementation, this study can more comprehensively reveal GAI mechanism in HCI through the use of affordances theory, and thus provide new directions for future research.

This study aims to identify the affordances and constraints of generative AI in human-computer interaction research. The following research question has guided the study: *Which affordances and constraints of generative AI can be identified in human-computer interaction research?*

2. Materials and Methods

This literature study was conducted with a scoping review approach. Further details on the conducted steps for collecting and analysing data are described below.

2.1 Data Collection

Data were collected by two searches in the Web of Science (WoS) Core Collection databases, which include six online indexing databases. The searches were conducted in early 2024, to collect data on research of generative AI in HCI conducted up to that date, and in late 2024, to complement the previous search with more recently published research. The query string used in both searches:

> *((ALL=("generative")) AND ALL=("artificial intelligence")) AND ALL=("human computer interaction" OR "human-computer interaction" OR "HCI")*

The first search was set with no time frame and identified 84 potentially relevant papers. As a basis for deciding whether papers would be included or excluded in the study, inclusion and exclusion criteria were applied (Table 1).

Table 1: Inclusion and exclusion criteria

Inclusion	Exclusion
Is a proceedings paper or a journal article	Is NOT a proceedings paper or a journal article
Is written in English	Is NOT written in English
Is published as Open Access	Is NOT published as Open Access

After the initial search, filters were applied in WoS, based on the inclusion and exclusion criteria (Table 1). This reduced the number to 21 potentially relevant papers published between 2008 and 2024 (excluding 63). The 21 selected papers underwent manual screening of the title, abstract and keywords based on the inclusion and exclusion criteria presented in Table 1 to detect papers that were not excluded through the filters applied in Web of Science. To the previous inclusion and exclusion criteria additional criteria were added for the manual screening: address a topic related to GAI in the HCI field. After the manual screening process, all 21 papers were deemed relevant for addressing the aim and research question of the study and included in the study.

To extend the list of included papers and capture more recent research, a second search was conducted in WoS for research published in 2024. The search used the same query string, which resulted in identifying 72

potentially relevant papers published in 2024. Filters, based on Table 1, were then applied in WoS. This reduced the number to 16 potentially relevant papers published in 2024 (excluding 56). The 16 selected papers underwent manual screening of the title, abstract and keywords based on the updated inclusion and exclusion criteria, for detecting papers that were not excluded through the filters applied in WoS. After the manual screening process, all 16 papers were deemed relevant for addressing the aim and research question of the study and included in the study. This increased the total of included papers in the study to 37.

2.2 Data Analysis

The data analysis utilized a deductive theoretical thematic analysis approach to investigate GAI in HCI research, following Braun and Clarke's thematic analysis guidelines (Braun & Clarke, 2006). Initially a categorization matrix was created in a spreadsheet document, containing the categories “affordances”, “constraints” and “unclear”. After that, the analysis applied the six phases of Braun and Clarke's thematic analysis (Braun & Clarke, 2006): Data familiarizing, Code generating, Searching for themes, Reviewing themes, Defining and naming themes, and Producing the report. Identified themes (n=25) where combined to create super-themes (n=7), which are presented in Table 2.

Table 2: Identified super-themes

Affordances	Constraints
Improving algorithms	Truth issues
Collaborative work	Biases
Education support	Ethical considerations
	Consequences for job market

3. Results

The analysis of the included papers identified seven super-themes relating to affordances or constraints (Table 2). These are presented in subheadings below according to which central concept in the theory of affordances they address, affordances or constraints.

3.1 Affordances

The analysis of included papers identified eleven themes and three super-themes related to affordances. The theme of improving algorithms is supported in 12 of the 37 included papers (Dembinsky et al., 2024; Kucukler et al., 2024; Kurtoğlu et al., 2024; Acien et al., 2021; Burrows et al., 2021; Liu et al., 2021; Numan et al., 2021; van Rijn et al., 2021; Bergmanis et al., 2020; Forbes, 2020; Yin et al., 2019 Ma et al., 2018). These highlight, for example, the possibilities of GAI technologies to improve bot detection (Acien et al., 2021), image colour and depth accuracy (Numan et al., 2021). Papers compare generated synthetic data to ‘real’ data for training (Kurtoğlu et al., 2024) and in some studies note that generated data could be used in training to improve algorithms, for example in object recognition (Ma et al., 2018) and machine translation (Bergmanis et al., 2020).

Collaborative work is supported in 15 of the 37 included papers (Elagroudy et al., 2024; Ford et al., 2024; Geyer et al., 2024; Ibarrola, Lawton & Grace, 2024; Muller et al., 2024; Nacke, 2024; Newman, 2024; Sivertsen et al., 2024; Maican et al., 2023; Oppenlaender, 2023; Sarkar, 2023; Sison et al., 2023; Forbes, 2020; Liikkanen, 2019; Romero et al., 2008). These highlight that GAI systems can be used in collaboration with human intelligence as a companion to work on design and creativity (Sivertsen et al., 2024; Forbes, 2020; Liikkanen, 2019), improve and assist mundane writing tasks (Sison et al., 2023), and analyse and visualize large amount of data to inform quick and efficient decision making (Maican et al., 2023). Collaborative work could be essential for understanding complex risks and threats, such as environmental challenges and criminal activities, where GAI could support in identifying patterns and forecast trends in the future (Maican et al., 2023). It is further highlighted that the integration of GAI in human work to complement or support human decision-making rather than replace it (Maican et al., 2023), as well as in creative work, could be labelled as critical integration (Sarkar, 2023).

GAI as education support is supported by 5 of the 37 papers selected for inclusion in this study (Li et al., 2024; Newman et al., 2024; Zheng et al., 2024; Maican et al., 2023; Sison et al., 2023). These highlight that GAI technologies can be used both as a teaching tool and a learning tool, for example, by assisting assessments (Zheng et al., 2024), by supporting teachers in preparing engaging lessons (Li et al., 2024; Sison et al., 2023) and

by providing students visual explanations that can support the understanding of complex theoretical concepts (Maican et al., 2023). It is further noted that GAI systems are often trained on English texts and could, therefore, serve as English tutors for improving students' grammar and spelling, but that this should be done under supervision to limit the risks of both cheating and bad accuracy in the responses (Sison et al., 2023). Lastly, it is highlighted that proficiency in utilizing GAI will be a competitive advantage for students and that efforts should be made to upgrade GAI skills in the existing workforce and support them in staying relevant, for example, through lifelong learning programs (Maican et al., 2023).

3.2 Constraints

The analysis of included papers identified fourteen themes and four super-themes related to constraints. The theme of 'Truth issues' is supported in 10 of the 37 included papers (Mim et al., 2024; Muller et al., 2024; Bryan-Kinns et al., 2024; Plohl et al., 2024; Bryan-Kinns et al., 2023; Maican et al., 2023; Sarkar, 2023; Sison et al., 2023; Triantafyllopoulos et al., 2023; Zhu et al., 2021). It is highlighted that GAI problematizes our old beliefs regarding ownership, plagiarism, copyright, originality, and creativity when anyone can use and transform their work with generative tools (Sarkar, 2023). On the other hand, many of these tools require a specific skill set and personality to fully utilize them, such as the English language and creativity, which could make them more accessible to some people (Maican et al., 2023). Many of the tools provide little to no information about how to fully utilize them or how they affect, for example, the environment (Bryan-Kinns et al., 2024). It is noted that there is still limited research on how GAI can be more explainable and user centred (Bryan-Kinns et al., 2023). Research further notes the problem of hallucinations when interacting with GAI, false information that sounds confident, and that outputs need to be validated and verified (Sison et al., 2023). False outputs can also be produced with ill intent by users. Papers note the potential use of GAI to spread disinformation and defame individuals through deepfakes (Plohl et al., 2024; Triantafyllopoulos et al., 2023), which could threaten politics and economics (Zhu et al., 2021). GAI tools, such as ChatGPT, have therefore been labelled as a potential "weapon of mass deception" because of the dangers of massive deceit and criminal activities through their use (Sison et al., 2023).

Potential biases associated with GAI are supported in 8 of the 37 included papers (Bryan-Kinns et al., 2024; Mim et al., 2024; Muller et al., 2024; Liikkanen, 2019; Oppenlaender, 2023; Ragot et al., 2020; Sison et al., 2023; Triantafyllopoulos et al., 2023). It is highlighted that biases in training data for GAI models can have a cultural effect on the outputs, for example affect the skin-color of people in AI-generated images (Oppenlaender, 2023). However, this could also be a result from data availability, which makes some cultures more dominant in the training data, which could still be problematic (Triantafyllopoulos et al., 2023). The black box nature of GAI is related to potential biases. The models are often uninterpretable and unexplainable to those who use them (Bryan-Kinns et al., 2024; Muller et al., 2024), which must be addressed if improving fairness and reducing biases in GAI is a goal (Sison et al., 2023). One paper also notes the potential negative biases of humans towards AI-created content, such as paintings, if they know that AI has produced it (Ragot et al., 2020).

Ethical concerns related to GAI are supported in 8 of the 37 included papers (Constantinides et al., 2024; Zheng et al., 2024; Maican et al., 2023; Sison et al., 2023; Triantafyllopoulos et al., 2023; Alfrink et al., 2022; Forbes, 2020; Liikkanen, 2019). Papers highlight that GAI does not sufficiently respect personal rights (Sison et al., 2023), for example with the possibility of creating deepfakes (Forbes, 2020) and limitations of cultural representation (Triantafyllopoulos et al., 2023), which can cause concerns for discrimination, biases, and privacy (Maican et al., 2023). A potential problem is that machines are not typically accountable for their actions or outputs (Constantinides et al., 2024). Therefore, humans should be kept in the loop (Sison et al., 2023) for the possibility of human intervention and protection against unjust, illegitimate and fallible automated decisions (Alfrink et al., 2022). Papers highlight that more attention should be placed on the users of GAI to preserve their dignity and agency while still enhancing the experience of using these models (Zheng et al., 2024; Sison et al., 2023). It is further noted that a potential problem with technology development, as it is driven, is that users, like designers, can typically only adjust their choices and actions in accordance with new technology but not affect them on a fundamental level (Liikkanen, 2019).

The theme of potential consequences for the job market with GAI is supported in 5 of the 37 included papers (Mim et al., 2024; Maican et al., 2023; Oppenlaender, 2023; Sison et al., 2023; Liikkanen, 2019). Papers highlight that human jobs can be lost or changed due to the introduction of GAI (Mim et al., 2024; Maican et al., 2023; Sison et al., 2023). For example, it is noted that GAI will transform both the content and agency in human work and how we work and interact with computers (Oppenlaender, 2023). Skills and knowledge related to GAI are also expected to increase as demands on the future job market, which would pressure universities to provide what future specialists need to remain relevant in the job market (Maican et al., 2023). Lastly, it is highlighted

that GAI can potentially transform society on a larger scale by, for example, disrupting the economy and creating whole new worlds, such as games, through prompt engineering (Oppenlaender, 2023).

4. Discussion

In light of this literature review, a proposed conceptual model encapsulates the interplay of affordances and constraints of GAI in HCI research (Figure 1). This model serves as a visual representation, illustrating how various factors interact. The model highlights the role of contextual differences for affordances and constraints and the potential short-term and long-term consequences that these might have. Further, the model visually represents how affordances and constraints of GAI can overlap and be interchangeable in a dynamic relationship between the two, depending on the contextual circumstances.

For instance, the ability of GAI to support education (Li et al., 2024; Sison et al., 2023) showcases an affordance that can also pose constraints if not carefully managing concerns about privacy, biases, and potential discrimination (Maican et al., 2023). Similarly, the ability of GAI to support work through human-AI collaboration (Maican et al., 2023; Oppenlaender, 2023) showcases affordances that can also pose constraints if concerns regarding future jobs and job market (Maican et al., 2023; Oppenlaender, 2023) are not considered. The identified themes cover both short-term and long-term aspects of GAI, for example that it can support in preparing lessons (Li et al., 2024; Sison et al., 2023) but also potentially become an essential skill for staying relevant (Maican et al., 2023), that depend on contextual circumstances, likelihood, and if they are to be perceived as affordances or constraints. Putting all this together forms a potential conceptual model of GAI in HCI research based on the theory of affordances (Figure 1).

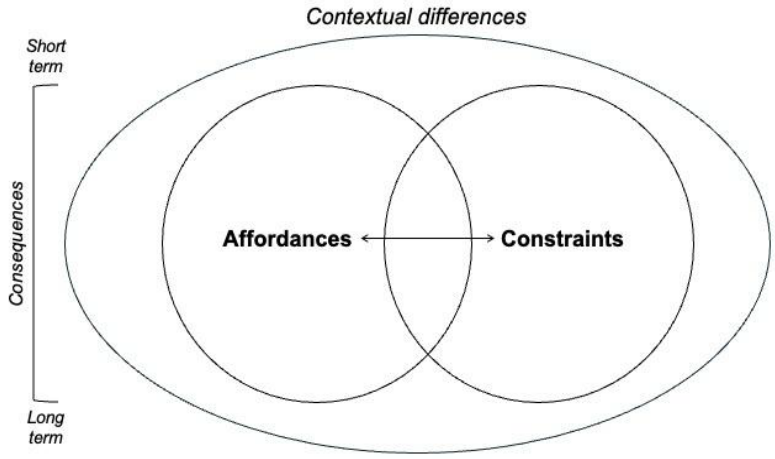

Figure 1: Conceptual Model of GAI affordances and constraints in HCI

5. Concluding Remarks

This study has charted the affordances and constraints of generative AI (GAI) within human-computer interaction research, highlighting a complex interplay influenced by various contextual factors and the potential short-term and long-term consequences that GAI might have. Results have highlighted GAI's future potential of forecasting trends and identifying patterns that can support in addressing societal challenges, such as climate change and criminal activities, which should be a prioritized area for future research. GAI marks a disruptive shift in human-computer interaction, by enabling natural and conversational interfaces that adopt to users rather than the other way around. Unlike traditional HCI technologies, GAI offers dynamic, context-aware, and creative collaborations, which position it not only as a tool, but also as a potential partner in digital work.

The study's proposed conceptual model provides a framework for understanding the dynamics between affordances and constraints, contextual factors, and short-term and long-term consequences when applying GAI. Which should be used to guide the design and development of adaptable and ethical GAI systems. Moving forward, the aim is to leverage the possibilities of GAI by ensuring that technological progress aligns with human values and societal benefits. For example, through research that develops and tests new ethical frameworks for GAI, ensuring alignment with societal values amidst rapid technological progression.

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Ethics and AI Declarations

Ethical clearance was not required for this research. AI tools have been used in this paper for proofreading and suggestions for improved language and clarity. The authors have conducted the research and written the paper and take full responsible for its content.

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