User Experience Design Professionals' Perceptions of Generative Artificial Intelligence

JIE LI, Global Research Institute, EPAM, Netherlands

HANCHENG CAO, Stanford University, United States

LAURA LIN, Google, United States

YOUYANG HOU, Notion Labs, United States

RUIHAO ZHU, Cornell University, United States

ABDALLAH EL ALI, Centrum Wiskunde & Informatica (CWI), Netherlands

Among creative professionals, Generative Artificial Intelligence (GenAI) has sparked excitement over its capabilities and fear over unanticipated consequences. How does GenAI impact User Experience Design (UXD) practice, and are fears warranted? We interviewed 20 UX Designers, with diverse experience and across companies (startups to large enterprises). We probed them to characterize their practices, and sample their attitudes, concerns, and expectations. We found that experienced designers are confident in their originality, creativity, and empathic skills, and find GenAI's role as assistive. They emphasized the unique human factors of "enjoyment" and "agency", where humans remain the arbiters of "AI alignment". However, skill degradation, job replacement, and creativity exhaustion can adversely impact junior designers. We discuss implications for human-GenAI collaboration, specifically copyright and ownership, human creativity and agency, and AI literacy and access. Through the lens of responsible and participatory AI, we contribute a deeper understanding of GenAI fears and opportunities for UXD.

CCS Concepts: • **Human-centered computing** → **Empirical studies in HCI**.

Additional Key Words and Phrases: Generative AI, UX Designers, responsible AI, user experience, human-AI collaboration

1 INTRODUCTION

The landscape of Artificial Intelligence (AI) is rapidly evolving as versatile foundation models, built on deep neural networks and self-supervised learning, have gained widespread adoption [6]. These span transformer-based large language models (e.g., GPT-3, BERT), visual (e.g., DALL-E, Florence), or multimodal (e.g., UniLM) models. The power of these models has recently been harnessed, exemplified by the launch of Generative AI (GenAI) tools, such as ChatGPT [1], DALL-E 2 [2], Stable Diffusion [3], and Midjourney [4]. These models have dramatically pushed forward the edge of AI capabilities, where GenAI tools are capable of processing extensive data and learning statistical patterns, enabling them to generate novel multimodal output based on natural-language

---

[1]ChatGPT: https://chat.openai.com

[2]DALLÂ·E 2: https://openai.com/dall-e-2

[3]Stable Diffusion: https://stablediffusionweb.com

[4]Midjourney: https://www.midjourney.com

Authors' addresses: Jie Li, Global Research Institute, EPAM, Netherlands, jie_li@epam.com; Hancheng Cao, Computer Science, Stanford University, California, United States, hanchcao@stanford.edu; Laura Lin, Google, United States; Youyang Hou, Notion Labs, United States; Ruihao Zhu, Cornell University, United States, ruihao.zhu@cornell.edu; Abdallah El Ali, Centrum Wiskunde & Informatica (CWI), Netherlands, aea@cwi.nl.

inputs (*i.e.*, prompts). They have demonstrated the ability to produce diverse types of content, including text [68], images [78], video [40], and audio [7]. For example, ChatGPT is viewed as the finest chatbot ever [34] with over a million people signed up to use it in only five days [75]. Enthusiastic fans posted examples of ChatGPT producing computer code, essays, and poems; while others type in surreal prompts to Midjourney or DALL-E 2, ranging from requests like "paint a portrait of your boss patting a tiger in the style of Rembrandt", to "depict a gathering of middle aged dinosaurs sipping coffee and contemplating the meaning of life", and these tools will return a startlingly accurate depiction in an instant. On the one hand, the widespread adoption of GenAI tools has sparked excitement within society due to their remarkable advancements; on the other hand, it results in anxiety about unanticipated consequences that may be implicitly induced and beyond human control [4]. Moreover, concerns arise regarding homogenization, as any weaknesses in these models have can propagate to downstream applications [6].

The expanding capabilities of GenAI have the potential to revolutionize various aspects of modern life, and significantly impacting individuals who earn their living by creating content, including designers, copywriters, journalists, and tenured professors. Among those professionals, there is a growing recognition of potential harms, such as reputation damage, economic and job loss, plagiarism, and copyright infringement [21, 24, 47, 71]. In the context of participatory AI, it is of utmost importance to recognize that creative professionals and content creators, not just technical experts, possess valuable knowledge, expertise, and interests crucial for the responsible development of AI [5]. Several efforts are underway to explore the impact of AI on UX (e.g., AI in UX Research report [10]). As a step to better understand and address such growing concerns, in this paper, we specifically explore the potential impact of GenAI tools on User Experience Design (UXD) practice, by involving UX Designers, important creative professionals, in our conversations. In contemporary UX Design, the goal is to align with both user needs and business values. Unlike other creative professions, UX Design is not purely artistic work, but revolves around meeting end users' demands. This entails not only designing the overall look and feel of a digital product [91], but also involves crafting effective navigation systems, labels, and content categorization to ensure that users can effortlessly locate and access the information they require [38]. The UX Design process is an iterative, user-centered design process that requires designers to be creative and collaborative, possess a problem-solving and sense-making mindset, and exhibit empathy towards users [69]. Successful UX Design must go through several iterations and is often linked to how well designers manage to comprehend and translate users' requirements into corresponding functionality and pleasing aesthetics [85]. With the ability to automate repetitive design tasks, such as creating wireframes, generating layout variations, or producing design prototypes [43], GenAI tools can significantly speed up the UX Design process, allowing UX Designers to explore a wider range of design options and iterate quickly to create more effective and engaging user experiences [77]. While GenAI tools offer many opportunities for UX Designers, it also presents potential threats related to job displacement, ethical concerns, lack of human touch, data quality and bias, and intellectual property issues [44].

To harness the power of GenAI in supporting UX Designers and to ensure the responsible disclosure of further AI advancements, our objective is threefold. First, we aim to gain an overview of current UX Design practices, including the tools used, their limitations, as well as the existing workflows and challenges. Additionally, we seek to comprehend UX Designers' perceptions toward GenAI. Furthermore, we intend to explore how UX Designers can leverage the potential of GenAI to overcome the existing limitations in tools and challenges in workflows, allowing them to ultimately craft impactful and meaningful user experiences now and in the future. Relatedly, we seek to understand how and in what capacity GenAI impacts User Experience Design (UXD) practice, and whether fears that may arise are warranted. To this end, we pose the following research questions (RQs):

- **RQ1:** How do UX Designers perceive GenAI tools, and how is this reflected in their current workflows and practices?

- **RQ2:** What opportunities and risks do UX Designers envision for the future of human-AI collaboration in UX Design practice?

To address these questions, we conducted one-on-one in-depth interviews with 20 UX Designers who have diverse years of experience and currently work in companies ranging from startups to large enterprises with over 10,000 employees. These companies mainly located in four countries in the Europe and United States. We probed them to characterize their practices, and sample their attitudes, concerns, and expectations.

We find that overall, experienced UX designers are confident in their skills in terms of originality, creativity, and user empathy skills. They believe that GenAI can serve as an assistive tool to help with repetitive and general tasks, and for enhancing productivity – however, only for those who are already skilled designers. They emphasized the unique human factors of "enjoyment" and "agency", where humans will remain as the final arbiters of "AI alignment" despite anticipations of future emergent AI abilities. However, they expressed serious concerns about skill degradation and unemployment, especially for junior designers, who may lose opportunities to systematically study design, and may instead end up being trained as prompters. Furthermore, they emphasized the importance of society paying sufficient attention to potential problems that may arise with such GenAI advancements, such as copyright and ownership issues, adverse impacts on human creativity ("creativity exhaustion") through GenAI output speed and homogenization, and concerns over promoting AI literacy and ensuring equal access to stay relevant. Ultimately, while UX Design practice may constantly be in flux, we believe GenAI's impact on this profession requires immediate adaptation. We discuss the implications of these findings, within the lens of ensuring responsible AI development and human-AI collaboration within UX Design practice.

2 BACKGROUND AND RELATED WORK

2.1 AI's Impact on (Creative) Work

A key line of related literature studies the impact of AI on work. Felton et al. [26] suggest that the top occupations exposed to language modeling include telemarketers and a variety of post-secondary teachers such as English language and literature, foreign language and literature, and history teachers. Eloundou et al. suggests [22] around 80% of the U.S. workforce could have at least 10% of their work tasks affected by the introduction of large language models, while approximately 19% of workers may see at least 50% of their tasks impacted. Solaiman et al. [84] describe specific social impact GenAI systems may have over society – the framework defines seven categories of social impact: bias, stereotypes, and representational harms; cultural values and sensitive content; disparate performance; privacy and data protection; financial costs; environmental costs; and data and content moderation labor costs. Other works have empirically shown the considerable productivity gains through the use of state of AI tools such as ChatGPT [67, 73].

A number of works have discussed the impacts of AI on creative works, which are closely relevant to UX design and research [30]. Pearson [72] delves into the role of modern creative AI technologies as potential muses for artists and creators, highlighting their capacity to enable novel forms of image creation, music composition, animation, and video production. Kulkarni et al. [52] investigates the use of text-to-image models (TTIs) in collaborative design through involving 14 non-professional designers. They reveal that TTIs facilitate rapid exploration of design spaces and support fluid collaboration, with text prompts acting as reflective design aids that facilitates exploration, iteration, and reflection in pair design. Ning et al.[66] investigate the design space of Artificial Intelligence technology-driven Creativity Support Tools (AI-CSTs), highlighting AI-CSTs' impact on workflows, their potential as co-creators, and strategies for handling AI errors, providing insights into AI-CSTs' design and technology requirements. Epstein et al. [24] examine the impact of generative AI tools on traditional artistic practices, addressing questions of authorship, ownership, and the potential transformation of creative work and employment. Chang et al. [15] studied the perception of artists who leveraged text-to-image AI models

for artwork, finding that 1) artists hold the text prompt and the resulting image can be considered collectively as a form of artistic expression (prompts as art), and 2) prompt templates (prompts with "slots" for others to fill in with their own words) are developed to create generative art styles. Vinchon et al. [93] proposed four potential futures of AI human relationship for creative work, namely "Co-Cre-AI-tion", "Organic", "Plagiarism 3.0", and "Shut down". More closely related to the present work, Inie et al. [44] discussed creative professionals' worries and expectations about generative AI, concluding that creative professionals should better understand, cope with, adapt to as well as exploit AI. Long and Magerko [60] provided a concrete definition of AI literacy by identifying 16 core competencies (e.g., recognizing AI, human role in AI, ethics) that humans need to effectively interact with and critically evaluate AI, along with 15 recommended design considerations that foster increased user understanding of AI (e.g., explainability, promote transparency, low barrier to entry). Complementary to the foregoing, we focus and conduct in-depth analysis dedicated to understand how AI impacts one specific occupation closely related to the HCI community – UX Design practice.

2.2 Human-AI Collaboration for Human Empowerment

The relationship between human and machine intelligence has been discussed since the early days of human computer interaction [42, 57]. Given the increasing performance and prevalence of AI in society, much attention have been drawn to study and design for effective and responsible human-AI collaboration in recent years. Amershi et al. [2] proposed design guidelines for human-AI interaction. Through multiple rounds of evaluation with practitioners, they condense over 150 AI-related design recommendations into 18 aspects concerning four different time phases, and test their guideline against 20 AI-fused products with various categories (e.g., e-commerce, web search) and features (e.g., recommendations, search). Yang et al. [97] investigated whether, why, and how human-AI interaction exerts unique difficulties in design. Through synthesizing prior research with their own design, research, and teaching experiences, they identified AI capability uncertainty and AI output complexity as two sources of unique design challenges of AI. Over two decades ago, Horvitz [42] presented a set of principles for building mixed-initiative user interfaces (UIs) that enable users and intelligent agents to collaborate efficiently. The proposed principles are still widely applicable to today's human-AI collaboration, such as *"providing mechanisms for efficient agent-user collaboration to refine results"* and *"employing socially appropriate behaviors for agent-user interaction"*. Lehman [55] also investigates mixed-initiative human-AI interactions and collaborative work with generative systems. The author focuses on designing and evaluating functional prototypes through web-based experiments, exploring concepts like initiative, intent, and control, showing that the levels of initiative and control afforded by the UIs influence perceived authorship when writing text.

Kim et al. [49] used computational methods to categorize ten different AI roles prevalent in our everyday life and compared laypeople's perceptions of them using online survey data, e.g., AI are considered with roles such as tools (low in both human involvement and AI autonomy), servants (high human involvement and low AI autonomy), assistants (low human involvement and high AI autonomy), and mediators (high in both dimensions). They found that people assessed AI mediators the most favorably, and AI tools the least. Relatedly, Scott et al. [80] studied whether lay people perceive AI as "conscious", finding dynamic tensions between denial and speculation, thinking and feeling, interaction and experience, control and independence, and rigidity and spontaneity. Capel and Brereton [14] explored the emerging field of Human-Centered Artificial Intelligence (HCAI) by reviewing the existing literature on the subject. Their work identifies established HCAI clusters, and highlights emerging areas, including Interaction with AI and Ethical AI. Additionally, they proposes a new definition of HCAI and encourage greater collaboration between AI and HCI research while suggesting new HCAI constructs. Similarly, Shneiderman [82] explored the concept of HCAI as a transformative approach to AI system design, emphasizing the importance of placing humans at the core of design thinking, offering three key ideas: (1) a two-dimensional HCAI framework that balances human control and automation, (2) a shift from emulating

humans to empowering people, and (3) a three-level governance structure for creating trustworthy HCAI systems. These ideas propose a reframe in design discussions with the potential to yield greater benefits for individuals, communities, and society, although they will require validation and refinement through further research and development. Indeed, such HCAI methods [81] aim to ultimately produce Reliable, Safe & Trustworthy (RST) designs, fostering human self-efficacy, creativity, and responsibility while significantly improving performance. Birhane et al. [5] reviewed participatory methods and practices within the AI and Machine Learning pipeline and acknowledged that wider publics beyond technical experts have knowledge, expertise, and interests that are essential to the design, development, and deployment of AI. These prior works set the stage for ensuring, at both a research and policy level, for ensuring responsible human-AI collaboration that ultimately empower people and practices. We draw on these works to help interpret our findings on how UX Designers envision current and future human-AI collaboration.

2.3 Use of AI in UX Design and Research

Studying User Interface (UI) and corresponding User Experience (UX), and how to build tools to better support UX design and research has long been a focal subject in the HCI community [12, 30, 50]. As AI increasingly shows its potential in transforming work practices, researchers have started studying and discussing the implications of AI for UX design and research [48, 85]. So far research has demonstrated the immense potential of AI for UX Design, with prototypes and applications available at key processes, including understanding the context of use, uncovering user requirements, aiding problem solving, evaluating design, and for assisting development of solutions [1, 85]. Generally, most believe that AI will likely result in AI-augmented creativity support tools rather than a full transformative shift [58, 93]. Tholander et al. [87] investigated how generative machine learning and large language models may play a part in creative design processes of ideation, early prototyping and sketching, demonstrating practical usefulness and limitations of the system in design ideation processes, as well as how user interaction, and broader discourse around AI, shapes user expectation of AI's capabilities and potentials. Feng et al. [27] found that UX practitioners can be more hands off when designing prototypes since AI can provide support. They introduced in detail how UX practitioners communicate with AI and use AI as design materials for their daily work. Other works have also proposed specific prototypes to support better user experiences [36, 94]. Evaluations of such systems point to the potential of AI for augmenting human creativity, as AI often brings distinct perspective that opens up new avenues for artistic expression[16], and fosters a two-way exchange of ideas between users and AI [53]. Lin et al. [59] explored the design space of mixed-initiative co-creativity systems where humans and AI systems could communicate creative intent to each other.

Meanwhile, research has also revealed challenges of incorporating AI into the UX design process. Gmeiner et al. [33] showed designers face many challenges in learning to effectively co-create with current generative AI systems, including challenges in understanding and adjusting AI outputs and in communicating their design goals. For example, when expecting AI tools to provide them with project-relevant work examples, or exhibit more context awareness for the specific problem at hand. Zhang et al. [99] further demonstrated limitations of AI for architectural design, in that the AI tool "fails to understand the Architectural domain-specific terms" and "generates surreal images unsuitable for construction purposes". Other works demonstrate similar challenges of prompt engineering in using AI for product design [41]. On the other hand, Abbas et al. [1] found that while the majority of UX designers had no expertise with ML as a design tool, it holds great potential for improving productivity. Thoring et al. [88] define a research agenda for GenAI-enabled design, highlighting key areas include creating better guided prompts, better interfaces for output interpolation, and getting AI to think outside of the latent space box (i.e., extrapolation). With regard to the potential of AI in UX research, Yang et al. [96] proposed a methodology to simulate user experience by using AI-aided design technology in mobile application design. Hamalainen et al. [35] leveraged OpenAI's GPT-3 model to generate open-ended questionnaire responses about

user experiences over video games, where they find that GPT-3 can yield believable accounts of HCI experiences that is hard to be distinguished from real human responses. Park et al. [70] leveraged GPT-3 to simulate synthetic users and conversations over social computing platforms prototypes, where they find generated responses are hard to be differentiated from actual community behavior. By contrast to the majority of literature that focus on evaluating the use of AI for UX design and research in specific settings or technologies, our work contributes a deeper understanding of current practices, AI adoption, and perceptions of UX practitioners regarding emerging generative AI technologies, which sets the stage for envisioning how UX as a profession may evolve in the future with the ever increasing capabilities of AI.

3 METHOD

We employed a semi-structured interview methodology for this study [61]. We first sent out a screening questionnaire distributed through social media and emails, resulting in 38 responses. Subsequently, 20 participants willingly engaged in online one-on-one 60-minute interviews between April and July, 2023. 20 participants were deemed sufficient given saturation points exceeding 17 interviews in sociological research [39] and local sample size standards in HCI (remote interviews usually have M=15, SD=6) [13]. Each interview was conducted by an interviewer (author), while a second researcher (also author) was present to take notes. All interview sessions were additionally audio recorded. The interview process, data collection, and storage strictly adhered to the GDPR and ethical policy and data protection guidelines set forth by (anonymized) research institute.

3.1 Participants

Among the 20 participants, there were 12 females and 8 males. Three participants fell within the 18–25 age group, while 12 were in the 26–35 group. An additional five participants belonged to the 36–45 age group. 11 of them had over five years experience as UX Designers, two had three to five years, and seven had fewer than three years of experience. For their experience using GenAI tools, all 20 participants used *ChatGPT* regularly, and eight of them regularly used *GPT-4* (known as ChatGPT Plus). Thirteen participants tried *Midjourney* and occasionally used it for inspiration. Seven participants also mentioned their occasional use of *Notion AI*. Four tried *Miro AI*, and two used *Bard*.

The 20 participants were from 15 different companies, with ten participants located in Europe, including The Netherlands, Sweden, Romania, Hungary, and the other 10 participants located across the United States. Moreover, ten participants were employed by enterprises with over 10,000 employees (e.g., *Walmart, Microsoft, Google, IKEA, EPAM*), five worked in enterprises with 1,000 to 10,000 employees (e.g., *Miro, PlayStation, Cloudflare*), one was employed at a company with 500 to 1,000 employees, and four worked in small companies or startups with fewer than 50 employees. To ensure data privacy, we ensure that where participants work cannot be traced back to them.

3.2 Interview questions and procedure

The interview questions are scripted to gather answers for the research questions presented in Sec. 1, which are divided into four parts. **Part 1** begins with general questions that aim to gather information about participants' backgrounds, work experiences, common challenges in UX Design, and perceived limitations in their current tools. **Part 2** comprises a set of questions focused on understanding participants' current experiences and knowledge of GenAI tools, as well as their attitudes toward using GenAI in UX Design work. In **Part 3**, participants are shown a collection of videos consisting of four demonstrations from YouTube using various GenAI tools for UX Design, ideation, research data synthesis, and frontend development work (Table 1). Subsequent follow-up questions delve into their impressions of the GenAI tools shown in the videos, their envisioned roles for AI in human-AI collaboration, and their concerns regarding ethics and ownership. **Part 4** concludes the interview with

GenAI video demos	GenAI tools included	Date posted on YouTube
Crafting a mobile interface[5]	Midjourney (V4), Stability Photoshop Plugin (0.7.0) & ChatGPT (Jan. 30, 2023 version)	Feb. 20, 2023
Drafting a design proposal (only used the part of Notion AI: 4'18"-4'50")[6]	Notion AI (2.21)	Mar. 15, 2023
Creating UI components[7]	Prompt2Design (V3)	May. 6, 2023
Organizing ideation notes[8]	MiroAI (Beta)	Mar. 8, 2023

Table 1. GenAI video demonstrations used in the interview

questions soliciting further reflections, advice or recommendations for UX Designers interested in integrating GenAI into their work and identifying their most desired, innovative functionalities of current and future GenAI. The complete list of interview questions is available in the supplementary material.

The interview process lasted approximately 60 minutes and involved the following steps:

- **Step 1 (5 mins):** Introduction given by the interview facilitator to ensure participants understand the purpose of the interview, have read, comprehended, and signed the informed consent form;
- **Step 2 (10 mins):** General questions about background, workflows, and UX practice;
- **Step 3 (20 mins):** Attitudes, concerns, and expectations of GenAI Systems;
- **Step 4 (20 mins):** Envisioning GenAI's role in human-AI collaboration (including watching a video demonstration of a sample of current GenAI tools);
- **Step 5 (5 mins):** Concluding questions.

3.3 Data Analysis

To ensure traceability in presenting the results, we labeled the 20 participants as P1-P20. We used Miro [9] for remote collaboration on data analysis. The audio recordings of the interviews were transcribed. We analyzed the data following an inductive thematic analysis approach [9, 17]: First, the transcripts were coded by five researchers and each researcher identified topics in their codes independently according to research questions. After the coding phase, the five researchers held a meeting to discuss the identified topics and converted the coded data into digital statement cards on Miro. Instead of calculating statistical inter-rater reliability (IRR) for the analysis, the consensus among the five researchers was reached through daily meetings and discussions [64]. Each statement card consists of the original quote from the participant, participant ID (P1-P20), and a one-sentence statement or summary of the quote on the card. Next, five researchers removed the repeated statement cards and sorted all the statement cards using the affinity diagramming technique [37], resulting in the emergence of six major themes: **(1) Limitations in current UX Design tools:** (a) frictional design handoff; (b) fragmented tools; and (c) lack of advanced design support. **(2) Challenges in current UX Design:** (a) managing stakeholders expectations; (b) understanding users; (c) satisfying both business and user needs; and (d) lacking domain knowledge. **(3) UX**

---

[5]Crafting a mobile interface: https://www.youtube.com/watch?v=_A_Jpr9HkGA
[6]Drafting a design proposal,: https://www.youtube.com/watch?v=R0gPrJsjsfU
[7]Creating UI components: https://www.youtube.com/watch?v=4Gt1NMfVlGQ
[8]Organizing ideation notes: https://www.youtube.com/watch?v=7u_EYv3ZXNw&t=3s

[9]Miro: https://miro.com

Designers' attitudes towards GenAI: (a) overall impression of the videos; and (b) shortcomings of GenAI tools in the videos. **(4) Human-AI collaboration:** (a) threats and collaboration with GenAI; (b) work replaceable by GenAI; and (c) work irreplaceable by GenAI. **(5) Ethical concerns and ownership:** (a) originality, copyright, and ownership; (b) skill degradation, and unemployment; (c) privacy, transparency, and equal access to GenAI. **(6) The future of GenAI in UX Design:** (a) envisioning collaboration with GenAI; (b) promoting AI literacy and accessibility for designers; (c) AI's desired role in enhancing design processes; and (d) challenges of defining AI-generated outcome metrics.

4 FINDINGS

This section illustrates the current UX Design tools and workflows, and provides a detailed presentation of the findings under the six themes identified in the data analysis (Sec. 3.3). Fig. 2 displays the activities in the UX Design workflow that UX Designers in our study stated can and cannot be completed by GenAI.

4.1 Current UX Design Tools and Workflow

We synthesized eight categories of frequently used tools that support UX Designers in their daily work (Fig. 1), as well as eight typical steps within UX Design practice – from gathering requirements from business stakeholders and users, to ideation, prototyping, user testing, iteration, and enabling the realization of solutions with the development team. Table 2 illustrates the main activities and tools used in each step.

We observe that Figma was mentioned by all 20 participants as a design tool to support high-fidelity prototyping and handoff to development teams. Miro was the most frequently mentioned tool (mentioned by 12 participants) for brainstorming and synthesizing user research data. In other categories of tools, participants had more diverse preferences, with many different tools mentioned that serve similar functions. For example, Teams, Slack, and Zoom were all mentioned as communication tools.

In terms of workflow, we observed that larger enterprises often have clear divisions of roles between UX Designers, Product Managers, and UX Researchers. In contrast, smaller companies, such as startups with fewer than 50 employees, often lack such clear divisions. UX Designers in smaller companies are responsible for conducting user research and may spend more time convincing stakeholders to prioritize UX. Furthermore, workflows in smaller companies tend to be shorter than those in larger enterprises (with over 10,000 employees) due to fewer people involved and lower communication costs. However, smaller companies may also omit or simplify some steps due to resource limitations, such as a limited budget for extensive user evaluations. One participant, P6, who has experience working in both small companies and large enterprises, explained, *"In large companies, our [UX Designers'] roles are well-defined. Although we also face a complex business landscape and stakeholders with different opinions, we have collaborators like UX Researchers and Product Managers to handle those aspects, and we can focus more on design. In small companies, we [UX Designers] must take on the roles of researchers, Product Managers, and designers."*

4.2 Theme 1: Limitations of Current UX Design Tools

4.2.1 ***Limitation 1: Frictional design handoff to development teams.*** Five participants pointed out that handing over design specifications, assets, and documentation to the development team is a rather frictional process. The current design tools do not support a seamless transition from design to development in a format accessible and understandable by the developers: *"[We need] more gateways between designers and the developers, improving prototyping workflows by enabling Figma prototypes to feed directly into the development coding workflow, to reduce the frictions in communication between design and development teams."[P14]; "Software engineers could not discern the nuanced differences in Figma designs - which one is the final design ready for development. The*
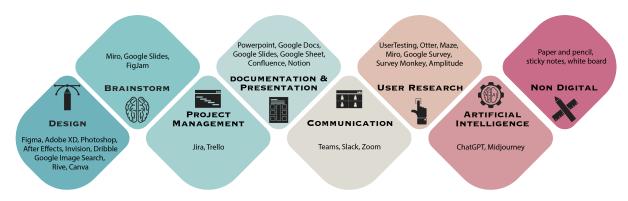
Fig. 1. Eight categories of tools commonly used in UX Design practices

information architecture, essentially how tons of screens are related to each other, is confusing for engineers as well. There is a lot of back-and-forth communication and manual work from both the design and development sides."[P5].

4.2.2 **Limitation 2: Fragmented Tools.** Eight participants emphasized that the current UX Design tools are scattered. Each tool has specific strengths or functionalities, but transitioning seamlessly between them is challenging: "*We use Miro for brainstorming and creating low-fidelity prototypes, and Figma for high-fidelity ones. However, transferring wireframes from Miro to Figma isn't straightforward."[P10]; "The current UX Design tools are disjointed. I yearn for an all-in-one solution with a dashboard-like interface."[P19]* Among these eight participants, three specifically noted that the current design tools lack support for user research: "*Something valuable would be the ability to conduct usability testing and generate data within the design tool itself, similar to the tool called Maze that I've used before."[P17].*

4.2.3 **Limitation 3: Lack of Advanced Design Support.** Nine participants expressed dissatisfaction with the current design tools due to their lack of advanced support for complex animations, cross-platform designs, graphic design, and more intelligent design systems: "*There are micro animation-type things that you don't get from Figma, like the timelines that you would use in After Effects or Principle to fine-tune your animations."[P17]; "Designs aren't easily transferable between different devices."[P4]; "I don't have much background in graphic design, so I often face obstacles when trying to sketch things that match my initial vision. I have the image in my mind, but struggle to translate it onto paper."[P3]; "Design systems lack intelligence. I'd appreciate a design system that recommends suitable design components and automatically adjusts these components to fit various screens."[P5].*

4.3 Theme 2: Challenges in Current UX Design

4.3.1 **Challenge 1: Managing stakeholder expectations and gaining buy-ins for UX**. The most frequently mentioned challenge (9 participants) is that UX Designers often spend over half of their time communicating and collaborating with a variety of stakeholders. This includes working with external vendors who take time to adapt to the work culture and style (P13), spending excessive time keeping stakeholders in sync, coordinating across time zones, and convincing them of the necessity of UX and gaining buy-in from management-level stakeholders (P1, P8, P12). Additionally, they must balance the expectations of stakeholders and clients with user needs to come up with an ideal solution (P18).

As P13 complained, *"The e-commerce side hired Deloitte to be responsible for a part. We cannot collaborate with them since the codebase and the design system are different. It is very difficult for engineers [to implement]."*; P12 mentioned, *"I have to convince others that UX is necessary and do a lot of work with developers to ensure the design is appropriately implemented. Some organizations take UX as lightly as a window dressing task and give more buy-in to the backend. So, we need to constantly educate them about the importance of scaling up UX."*; Similarly, P8 told

us, *"I am not designing as much as I would love to; I spend 50% of my time syncing and convincing stakeholders, coordinating colleagues across time zones, and arguing for buy-in."*.

4.3.2 **Challenge 2: Understanding end-users.** Eight out of 20 participants mentioned that conducting research to understand user needs is challenging: *"At the early stage, it is challenging to truly understand our users, find out their right pain points, and know if it is the right thing to build."[P10]*; *"I think the challenge always lies in trying to understand who I'm designing for, what their needs, goals, and problems are, and whether the product or service that I'm working on fits into the broader landscape."[P17]*.

4.3.3 **Challenge 3: Designing solutions that satisfy both business value and user needs.** Eight participants pointed out that coming up with good design solutions that balance clients' needs, users' needs, business value, and visual novelty is challenging: *"The UX field is quite mature, with existing design references and design systems aiding the work. The challenge is to come up with new ideas constantly and find a balance when considering both established design references, internal stakeholders' expectations, user needs, and incorporating them into the new design."[P18]*; *"[It is challenging to] find the bridge between business requirements, users' perspectives, and the UX maturity level of the client, which is often reflected by how clients value the importance of user testing and user requirements."[P14]*.

4.3.4 **Challenge 4: Lacking domain knowledge and resources.** Five participants mentioned that lacking domain knowledge and resources to access knowledge is a significant challenge: *"One of the challenges for UX Designers is acquiring extensive domain knowledge, such as creating designs customized for specialized fields like medical, automotive, fintech, and so on."[P1]*; *"In a startup, we often face resource constraints that limit our access to experts, conducting user research or usability testing on a larger scale, which is crucial to ensure the feasibility and desirability of the products."[P6]*.

4.4 Theme 3: UX Designers' Attitudes toward GenAI

All participants agreed that GenAI tools can be powerful and convenient in supporting general tasks such as early-stage design ideation, basic UX writing, and basic coding. These tools provide a starting point for human designers to build upon, helping them overcome the fear of beginning from scratch. Half of the participants were optimistic about the potential of GenAI tools, envisioning these tools as a means to enhance design efficiency. The other half expressed mixed feelings towards GenAI. On one hand, they acknowledged that AI could assist with repetitive tasks, but they underscored that UX Design is inherently user-centered. The reliability of AI-generated designs is questionable, as they may not always align with user needs and goals. Relying too heavily on AI to design products or interfaces without human input was seen as risky. All participants emphasized that the current quality of AI outputs, such as text accuracy, image resolution, and design details and functionalities, still requires significant human input and review, which may not necessarily save time.

All participants believed that human designers possess unique abilities, as they exhibit empathy towards users and derive enjoyment from the design process, even when starting ideation from scratch: *"We have tried AI tools during the ideation phase, but the outputs need human validation. They are not 100% accurate. I can use them to gather common knowledge in a certain field, but they are not very useful for design tasks or user studies."[P10]*; *"GenAI tools can help nowadays in generating basic ideas to help us populate the blank canvas, thereby aiding in overcoming the fear of the 'empty canvas'. It's similar to when we need to write reports; you can start with a basic structure generated by ChatGPT and then build upon it. However, I fear that in the long run, I might become more of an editor, gradually losing my design superpower to fill in the blank canvas."[P8]*.

4.4.1 **Overall impressions of the GenAI video demo.** Seven participants commented that the GenAI demos are aligned with their expectations. They have seen or used similar functionalities shown in the demos, so they

are not surprised. As P18 commented, *"I've seen everything in the demo. Miro AI and Notion AI are very similar, both bringing external AI resources to their own tools, not really offering anything new.".* Two participants (P17 and P20) mentioned that the demos are underwhelming and fell below their expectations. They found that the demo videos failed to present the context and purpose behind the designs, and lacked an explanation who the target audience for the designs is: "*The demos feel like an expert trying to showcase ways of combining various GenAI tools for design, for the sake of demonstrating, without giving much thought to who will be using the product they've created and what this product is for. I missed an explanation of the 'why', the context and purpose of the designs*"[P17]. Only one participant (P2) mentioned that the demos exceeded her expectations, particularly in terms of the speed at which an interface could be crafted based on Midjourney graphics. The demos created a sense of urgency for her, leaving her with the feeling that *"If I don't learn about the GenAI tools, I am going to lose my competency."*

4.4.2 ***Perceived shortcomings of GenAI tools shown in the demo.*** There were two shortcomings perceived to be key amongst participants:

(1) Practicality and efficiency. 13 participants highlighted that the GenAI tools showcased in the demos are quite generic, and the design process still requires a substantial amount of manual work. This includes tasks such as redrawing icons and buttons and inputting accurate text-based prompts. As noted by P12 and P18: "*Designers are trained to think visually. Our design process involves trial and error on sketchbooks. Designs emerge from numerous sketch trials, not from text-based prompts. [In the demo], you're required to switch between various GenAI tools, Photoshop plugins, and perform a substantial amount of manual work, including redrawing and regenerating high-resolution images. I question whether these GenAI tools truly enhance the design workflow.*"[P12]; "*I am skeptical about the first demo [Midjouyney+Figma AI+ChatGPT]. It appears to be an expert trying to convince others of the usefulness of GenAI in design, but it does not align with the reality of development and design processes. [In the demo], it still takes a long time to make the interface, not quicker if a designer starts from scratch in Figma.*"[P18]

(2) Accuracy and reliability. Eight participants questioned the overall accuracy and reliability of outcomes generated by AI tools. They hold the belief that human inputs are necessary to validate the AI-generated outcomes. P16 shared: "*For visual design, GenAI tools are still quite limited in capturing nuances and intricate details. Regarding ideation, AI tools like Miro AI may fall short in adequately representing the insights of stakeholders who possess extensive experience, say, 20 years in a specialized field like healthcare.*"[P16]. P19 described her negative experience using GenAI tools: "*My experiences with GenAI tools have not been very positive. For Midjourney, I often found myself spending hours adjusting my prompts, yet still unable to achieve the envisioned results. As for Miro, the cards are only clustered based on keywords, requiring manual effort to create coherent clusters.*"[P19]; "*Miro AI is fun, however, generating mind maps automatically seems not very convincing. I can ask Miro AI to give basic cards or to generate basic structures, but further ideation needs human inputs, needs to involve stakeholders and users.*"[P14] Furthermore, P3 expressed doubts about the reliability of AI's code generation capability: "*I'm a bit skeptical about ChatGPT's ability to generate code. It can generate basic code and assist in facilitating communication between designers and developers. I've actually attempted to have ChatGPT generate code for certain features or functionalities, but it didn't quite produce the results I was looking for.*"[P3].

4.5 Theme 4: Human-AI Collaboration

All participants described GenAI tools as helpers or assistants and recommended that "augmentation" and "enhancement" are good words to describe the assistance provided by GenAI in UX Design.

4.5.1 ***Perceptions of threats and collaboration with GenAI.*** P10 described when or when not they feel threatened by GenAI "*If GenAI is a more generic tool, like a personal assistant that I have full control over, I wouldn't feel threatened by it, like I don't feel threatened by my phone or laptop. However, if it becomes a work tool, a design*
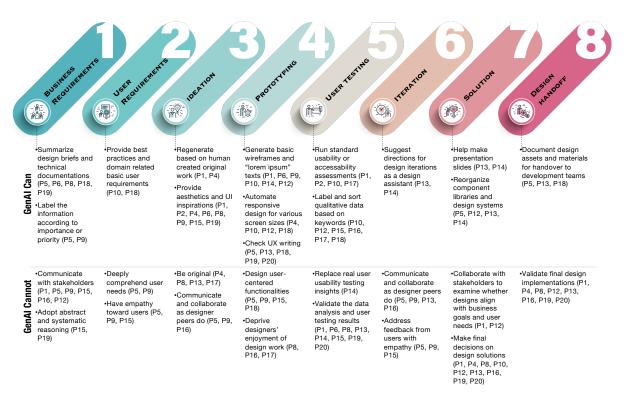
	1 BUSINESS REQUIREMENTS	2 USER REQUIREMENTS	3 IDEATION	4 PROTOTYPING	5 USER TESTING	6 ITERATION	7 SOLUTION	8 DESIGN HANDOFF
GenAI Can	•Summarize design briefs and technical documentations (P5, P6, P8, P18, P19) •Label the information according to importance or priority (P5, P9)	•Provide best practices and domain related basic user requirements (P10, P18)	•Regenerate based on human created original work (P1, P4) •Provide aesthetics and UI inspirations (P1, P2, P4, P6, P8, P9, P15, P19)	•Generate basic wireframes and "lorem ipsum" texts (P1, P6, P9, P10, P14, P12) •Automate responsive design for various screen sizes (P4, P10, P12, P18) •Check UX writing (P5, P13, P18, P19, P20)	•Run standard usability or accessability assessments (P1, P2, P10, P17) •Label and sort qualitative data based on keywords (P10, P12, P15, P16, P17, P18)	•Suggest directions for design iterations as a design assistant (P13, P14)	•Help make presentation slides (P13, P14) •Reorganize component libraries and design systems (P5, P12, P13, P14)	•Document design assets and materials for handover to development teams (P5, P13, P18)
GenAI Cannot	•Communicate with stakeholders (P1, P5, P9, P15, P16, P12) •Adopt abstract and systematic reasoning (P15, P19)	•Deeply comprehend user needs (P5, P9) •Have empathy toward users (P5, P9, P15)	•Be original (P4, P8, P13, P17) •Communicate and collaborate as designer peers do (P5, P9, P16)	•Design user-centered functionalities (P5, P9, P15, P18) •Deprive designers' enjoyment of design work (P8, P16, P17)	•Replace real user usability testing insights (P14) •Validate the data analysis and user testing results (P1, P6, P8, P13, P14, P15, P19, P20)	•Communicate and collaborate as designer peers do (P5, P9, P13, P16) •Address feedback from users with empathy (P5, P9, P15)	•Collaborate with stakeholders to examine whether designs align with business goals and user needs (P1, P12) •Make final decisions on design solutions (P1, P4, P8, P10, P12, P13, P16, P19, P20)	•Validate final design implementations (P1, P4, P8, P12, P13, P16, P19, P20)

Fig. 2. Activities that can and cannot be completed by GenAI in the UX Design workflow

tool that not only replaces the mundane aspects of our work but also takes over the enjoyable parts, I will become concerned."*[P10]* Similarly, P18 commented: "*If the technology does eventually reach a point where it can accurately simulate designers' rationales, then I might start worrying about it.*"*[P18]*. P12 and P19 recommended treating GenAI as a team member. P12 suggested, "*We can carve out a distinct role for GenAI, similar to ChatGPT, treating it like a person, a collaborator, and a team member.*"*[P12]*; "*I would envision AI as part of the team, contributing to the overall process, but not solely responsible for the final outcome.*"*[P19]*. P8 stressed that humans should have the ultimate decision-making power in human-AI collaboration: "*It should depend on people to choose which part I want AI assistance, for the purpose of expediting tasks. I don't like the word 'replace'. I very much enjoy the UI and UX Design parts, I want to do them myself. I don't want AI to take over. It is similar to hiring an assistant for administrative tasks, but not design work. I want AI to be my apprentices. Humans do the creative and complex parts, and AI apprentices fill in the colors or draw lines.*"*[P8]*.

*4.5.2 **General and repetitive work can be replaced by GenAI.*** All participants shared the belief that GenAI has the potential to replace repetitive tasks, such as generating "lorem ipsum" texts for design mockups, condensing design briefs and technical documentation, crafting repetitive design components, creating responsive designs for various screens, automatically documenting visual design elements into design systems, generating low-fidelity prototypes, and generating design variations for inspiration. As P8 said, "*I envision AI functioning as a productivity tool that quickly aids me in concrete tasks. For instance, AI could summarize PRDs [Product Requirement Documents] or explain technical backgrounds in plain language. Currently, these aspects require substantial effort from PMs [Product Managers] and engineers to convey to us designers.*"*[P8]*. P12 expressed their wish, "*I'm hopeful that GenAI can assist with tasks like responsive design for different screens and suggesting user flows across pages,*

not just on a single page."[P12] Many other participants expressed their desire for GenAI support in various tasks, including providing design inspiration (P2, P4, and P8), as well as facilitating efficient UX writing (P18 and P19). P2 remarked "*Midjourney could function as an inspirational guide for both 2D and 3D design, potentially shaping trends for AR and VR development.*"[P2]. P19 also shared their perspective: "*In our startup, we don't have a dedicated UX writing role. Our designers often use ChatGPT to assess the appropriateness of the UX content in our design.*"[P19].

4.5.3 UX Design work cannot be replaced by GenAI. Several participants made it clear that UX Design work simply cannot be replaced by AI:

(1) User inputs and human-human communication or collaboration. Many (13 participants) confidently expressed that they do not currently perceive GenAI as a competitor, since human designers serve as ambassadors for user needs and continue to be the ultimate decision-makers and arbiters of AI alignment. They emphasized that GenAI cannot replace work that requires user inputs, and human-human collaborations, as noted by P7: "*AI can create eye-catching UIs, but not user-centered functionalities.*"[P7]. Similarly, P6 commented, "*GenAI might be capable of taking over basic, repetitive, and straightforward tasks, but it cannot replace service design and collaborative efforts that demand more systematic and abstract thinking.*"[P6]. P14 additionally pointed out, "*UX Design is not just about aesthetics, but also usability and the accessibility of elements. Therefore, real human users are essential for improving designs through actual user testing, which AI cannot achieve.*"[P14]. Similarly, P12 shared, "*Aspects like vision, purpose, alignment with organizations, inspirations, the ability to think innovatively, and the research component should remain within the domain of human involvement.*"[P12]. P16 believed that human communication is not replaceable by AI, stating "*The value lies in human communication. I value insights from human colleagues, their experiences, ideas, and the knowledge they bring to the table. This does not have to be flawless, but it aids us in charting directions together. I do not believe AI can perform this aspect of work.*"[P16].

(2) Human creativity and decision making. Some participants (P4, P8, and P10) pointed out that human creativity and originality are strong human qualities that are difficult to be replaced by AI. AI outcomes heavily rely on past data, potentially leading to recurring results due to the limited data pool. Human designers remain the driving force capable of deeply comprehending design contexts, empathizing with users, and innovating based on the latest knowledge: "*The creative work that humans enjoy doing should not be replaced by AI. AI is a trained model that is based on the past, while human creativity and originality are more future-oriented.*"[P8]; "*Creativity can be supported by AI, as it can remix and regenerate based on human-inputted creative data, but humans possess the originality.*"[P4]. Five participants (P4, P8, P11, P18, and P20) stressed that final decision-making cannot be delegated to GenAI. Human verification is deemed necessary for each stage of design and development projects: "*AI must be intentionally used, monitored, and validated by humans. They are essentially Large Language Models, which are computers trained to converse like humans. The quality of the content and data provided by AI is not necessarily supported by actual research data verified by human researchers.*"[P8]. P11 expressed their confidence, stating "*I am positive that we won't be replaced by AI; rather, we will collaborate with AI. We are the brains, and AI serves the hands. Important decisions are not going to be made by AI.*"[P11]

4.6 Theme 5: Ethical Concerns and Ownership

Copyright, privacy, data biases and transparency, skill degradation and unemployment, social disparity, and equal access are frequently mentioned ethical concerns among all participants.

4.6.1 Originality, copyright, and ownership. Ten participants emphasized the significance of crediting the original creators of artworks or art styles utilized in UX work. P3 and P4 suggested that blockchain technology could be useful in ensuring direct ownership attribution to the original creators, regardless of the extent to which the original work has been modified. P4 stated, "*Ownership must remain traceable regardless of how extensively the*

AI outputs have been modified, derived, or reproduced from the originals. Perhaps blockchain can provide a solution here." P14 expressed her concerns over design plagiarism, *"From the confidentiality point of view, what data can be placed into GenAI tools, how we can make sure that we are using legal sources and we are not violating GDPR regulations. There are already cases that designers copy others' work to build their own portfolios. GenAI can make plagiarism in design much worse."[P14]*.

Expanding on the subject of ownership, nine participants believed that humans must be the owners, with GenAI tools serving as supportive aids to humans in achieving the final results. P11 commented, *"AI is not human; ownership belongs to humans. AI is a tool, much like Figma. I don't believe ownership should be assigned to technology or tools. If you are the one refining, crafting the prompt, contributing creativity and thoughts to AI for generating the work, and overseeing the entire process, ownership should be attributed to humans."[P11]*. P14 shared, *"I actually believe I shouldn't use ChatGPT or other AI tools for the final results that we need to deliver to clients. AI is merely used to provide examples; in the end, customers and the customer content authorization team need to review the design to ensure it aligns with customers' needs. We can use it as an initial guide to generate content like 'Lorem Ipsum' for mockup designs. But there should be a human at the end to go through the design requirements. In this way, ownership goes to humans."[P14]* However, eight participants recommended attributing ownership to the part of work supported by AI or labeling it as AI-contributed and ensuring transparency about the tools used. P18 provided a fitting analogy, *"The ownership attribution for using AI in future work should be similar to how researchers present their research findings, mentioning the sources and systems used as references."[P18]* This was echoed by P19, *"Ownership should be seen as a collective effort with input from various team members, including GenAI."[P19]*.

*4.6.2 **Skill degradation and unemployment**.* Five participants highlighted their concern that human UX Design work might be less appreciated, potentially leading to complacency among human designers and a decline in their skills. They worry that AI taking over tasks previously considered essential for designers could contribute to skill degradation. This concern is particularly relevant for junior designers, who could miss out on opportunities to further develop their skills. As such, human designers might transition into more managerial or generalist roles. P16 envisioned this, stating, *"Designers may fall into the trap of becoming complacent. Junior designers might have fewer chances to learn the design process but, instead, they may focus on mastering AI systems. Consequently, designers could evolve into generalists."[P16]*

Nine participants specifically highlighted that unemployment and skill degradation could evolve into significant societal issues if not addressed seriously from the outset. P4 and P5 expressed concerns that human designers' skills might become narrow as we increasingly specialize in specific tasks if AI potentially takes over many parts of the work in the design workflow, potentially limiting our creativity as designers: *"AI can put us into a bubble. We feel that we are doing higher-level work, and the career barrier of becoming a designer is getting higher. But somehow we are forced to be more specialized in a limited range of tasks. The loss of oversight over the design and development workflow may jeopardize our creativity."[P5]*. P12 thoughtfully reflected on this issue, *"Our expertise matures through year-over-year practice, encompassing not only design skills but also design thinking and genuine user empathy. If companies decide to employ prompters or AI operators in the future to replace junior designers' roles, how can these prompters or AI operators receive the proper training equivalent to what we receive in design schools or through design practice? More importantly, how can junior designers acquire new skills or senior designers improve their expertise if AI takes over the tasks they need to practice and uphold their design skills?"[P12]*. P10 additionally suggested, *"Current GenAI tools can easily achieve intern designers' capabilities, posing a threat to early career designers. All major companies need to ensure that there will be sufficient positions for junior designers. It's not solely about AI; it also involves societal systems and the entire industry supporting the career advancement of junior professionals. We need a more robust ecosystem for human designers to thrive."[P10]*.

4.6.3 **Privacy, transparency, and equal access to GenAI**. Eight participants pointed out that privacy is a significant concern within the realm of GenAI. As these AI models ingest large amounts of data to learn patterns and generate content, there is potential for the unintentional exposure of sensitive information, such as personal or confidential details that users did not intend to share: "*If I want to use ChatGPT to extract information from technical documents, I don't know how I should prevent sensitive information from being leaked. For my personal life as well, it is not clear how much of my personal data will be retained to further train the AI models.*"*[P19]* Three participants (P2, P4, and P6) stressed the importance of AI being trained on unbiased data and ensuring equal access to GenAI tools. This is due to concerns about social disparity and the potential for country policies to limit people's ability to learn and access AI tools, as well as the possibility of biased data leading to questionable outputs. P6 mentioned, "*Big companies and developed countries may gain control over the data fed into AI. It's also easier for them to access GenAI tools compared to some developing countries.*"*[P6]*. P2 added, "*It is important to ensure that individuals who are relatively less educated and have limited knowledge of GenAI can still use these tools to enhance their work and daily lives.*"*[P2]*.

4.7 Theme 6: The Future of GenAI in UX Design

When the 20 participants were asked about the proportion of their work that could potentially be impacted by GenAI in the future, nine of them estimated that 30% of their work could be potentially impacted. Six of them guessed 50%, three believed that less than 20% would be impacted, while two believed that more than 70% would be impacted.

4.7.1 **Envisioning collaborative design with GenAI**. Seven participants envision a triangulated system that involves collaboration and input from users, designers, and GenAI. This approach aims to minimize biases and ensure that crucial nuances, essential for design innovations, are not overlooked. As P11 mentioned, "*Human designers may overlook certain nuances that could hold importance for users. I wish for GenAI to enhance this aspect by providing its input grounded in vast past data and knowledge, potentially elevating user experience design to the next level.*"*[P11]*.

4.7.2 **Promoting AI literacy and access for designers**. Six participants expressed a hope for increased AI literacy through education, benefiting both experienced and junior designers. P13 noted, "*Students may feel apprehensive about this significant AI revolution. Education is essential to prepare both junior and senior designers for the impact of AI and how to leverage it to enhance our human design skills.*"*[P13]*. Additionally, these six participants envision future AI tools to be more accessible for designers. In other words, they desire AI tools that offer greater visual and intuitive usability, moving beyond sole reliance on text-based inputs. P12 elaborated, "*The recent Apple Vision Pro headset is inspiring. Its visual and intuitive design appears promising. Thus, AI should also evolve to become more visual, intuitive, and universally accessible to all users.*"*[P12]*.

4.7.3 **AI's desired role in enhancing design processes**. Ten participants expressed their desire for GenAI to mature further, supporting them in various design tasks. They hoped that GenAI could assist in designing graphics, writing prompts, generating smart components, providing successful design examples, and automating the handoff of designs to development teams. P4 noted, "*I am anticipating easier ways to write prompts or automatically generate components that adapt to different screens, recommend smart animation transitions, and even generate 3D content for immersive environments in the future.*"*[P4]*. Many other participants also voiced their desires for specific GenAI support in various tasks in the future. For instance, they hoped AI could summarize state-of-the-art knowledge for research and strategy (P10, P18, and P19), serve as a synthetic user to expedite sprints (P1 and P18), offer professional guidance in accessibility design (P12), help designers quickly master and switch between different design tools (P18), aid in labeling and clustering qualitative raw data from user studies (P5, P9, P10, P12, and P18), and seamlessly translate designs into development (P5, P18, and P19).

As P10 mentioned, "*I would like AI to assist me in summarizing design briefs or technical documentation, and translating them into easily digestible materials for designers, especially when dealing with unfamiliar technologies or terminologies.*"*[P10]*. P18 specifically highlighted the constantly changing landscape of design tools, expressing a desire for "*GenAI to reduce the time designers spend keeping up with rapidly evolving technology. Design tools change every few years. If AI could help designers transition seamlessly between old and new tools or consolidate everything into a single tool, designers would have more time to understand user needs and design.*"*[P18]*. P5 expressed a wish for "*GenAI tools to help me assess the feasibility of designs on the development side during the early design stage and assist in documenting designs in Figma, facilitating smooth handoffs to the development team in a format accessible and understandable to developers. Currently, I still have to manually document designs, take numerous screenshots, and verbally explain them to the development team.*"*[P5]*. P18 also wished for this, "*I would greatly appreciate it if AI could streamline the process of transitioning the final design proposal to implementation.*"*[P18]*.

4.7.4 ***The challenge of defining GenAI outcome metrics****.* Another envisioned future for GenAI, according to participants (P10, P17, and P18), involves the challenge of defining metrics to measure the quality of AI-generated output. As P17 commented, "*If many businesses use the same GenAI tools, it may result in similar designs and lacking diversity and innovation. Also, AI can lead to generating numerous outputs and leave the challenge to us, humans, to choose among them.*"*[P17]*.

5 DISCUSSION

5.1 Study Limitations and Future Work

In our investigation, we opted for a breadth-first approach to better understand the overall impact that GenAI may have on UX Design, which naturally comes at the cost of depth – we did not delve deeper into any particular UX products, tools, or workflows. As such, prioritizing breadth over depth was strategic, enabling the capture of a wide range of perspectives and considerations within the UX field. This serves as an important stepping stone for future works to delve into specific tools and use cases to provide a more in-depth analysis. Second, our interviews were limited by the small sample size (N=4) of startup participants. Startups often have unique team structures and resource constraints, leading to different approaches to addressing UX Design challenges compared to established companies. This invites future work to study the organizational practices of startup ecosystems, and how GenAI is embedded within such structures. Furthermore, although the majority of our participants had experience using GenAI tools such as chatGPT (GPT-3.5) and Midjourney, the study invited participants to watch demonstrations of GenAI tools without actual hands-on usage. This limited interaction might have overlooked practical insights that could arise only from direct hands-on experience with such tools.

5.2 Enjoyment and Agency in Human-GenAI Collaboration

Enjoyment and meaning are two recurring key words in our conversations with UX Designers. As UX Designers not only aim to excel in their work but also seek to derive pleasure from it. Enjoyment in work can be viewed through the lens of motivation theory, including both extrinsic and intrinsic motivations [45]. Extrinsic motivations revolve around whether the technology efficiently serves as a means to accomplish tasks, treating technology such as GenAI as a tool. Intrinsic motivations center on whether UX Designers find their work inherently rewarding and the engagement with technology enjoyable, considering technology such as GenAI as a toy [8]. We argue that, in UX Design, where creativity and problem-solving play central roles, this intrinsic motivation becomes paramount. Designers are not just driven by the end results; they also seek fulfillment and enjoyment throughout the design process. In other words, the future of AI-human collaboration should empower individuals to focus on tasks that truly matter to them, allowing AI to handle more mundane aspects. This approach not only enhances productivity but also fosters job satisfaction [56].

Closely related to enjoyment, we found that agency in human-AI collaboration is also a recurring theme. Will AI take on more agency while humans play a supervisory role? Or will humans retain primary control and have the ability to override AI's decisions when necessary? Alternatively, will AI and humans collaborate in a mixed-agency approach, where both contribute to decision-making and execution [86]? UX designers believe that we should differentiate between well-defined, routine tasks and complex, creative problem-solving tasks. Humans bring contextual understanding, ethical judgment, and accountability, and should lead complex work that requires creativity, empathy, ethics, and complex decision-making. Tasks led by AI and decisions made by AI should be transparent, explainable [20], and easily adjustable by human collaborators. The ideal scenario involves humans learning from AI insights, while AI improves based on human feedback (see e.g., [28] for a review on challenges for Reinforcement Learning from Human Feedback). Overall, we found that UX designers' beliefs align with those of Fanni et al. [25], who advocate for "active human agency" and argue that AI policies should include provisions that enable users to promptly challenge or rectify AI-driven decisions (cf., contestable AI [63]). This approach aims to empower individual autonomy and bolster fundamental human rights in the digital age. We find that the foregoing dimensions of enjoyment and agency to not only be unique human factors, but we suspect will increasingly play a role in the extent that UX Designers retain usage of such tools.

5.3 GenAI Interpolating, Humans Extrapolating, and Creativity Exhaustion

In today's efficiency-driven agile working culture, UX Design is essential for getting the design right and the right design [12]. It brings together a team to go through each sprint, progressing from idea to prototype to user research within short time frames [18]. GenAI's remarkable speed in generating content and solutions have the potential to facilitate the fast-moving sprints. However, we must be aware that while GenAI can produce vast quantities of outputs in an instant, humans are the innovators behind these creations. Essentially, AI is interpolating, estimating values or generating outcomes within the range of existing data. Thoring et al. [88] approach this from the lens of evolutionary creativity theory [83], where Variation and Selection are key components. While GenAI interpolates (Variation), it currently lacks the capability of extrapolating out of the latent space and continuing into unknown territory or merging into another latent space without supervisory human control (Selection) [88]. Indeed, AI might excel at "peripheral work" [79] or repetitive tasks within known data patterns. However, since AI is trained with known data, relying heavily on AI can lead to homogenized solutions (e.g., the AI-generated user interfaces all look similar) [6] or amplify biases in the data (e.g., the resulted design favoring certain demographic group) [4, 24]. In contrast, consider children, who receive around four or five orders of magnitude less language data than LLMs, and vastly outperform capabilities of AI [29]. Indeed, we humans excel at extrapolating, making predictions beyond the known data range using not only our creativity, intuition, and domain knowledge, but also benefit from multimodal grounding and the social and interactive nature of received sensory input [29]. In essence, humans excel at the "core work" that they identify with, which contributes to not only their success, but also their happiness [79].

Another potential setback revolves around the danger of human creativity exhaustion in keeping up with the pace of GenAI output. GenAI's relentless speed can exert immense pressure on human creators. While AI is not directly subject to physical factors like fatigue [3], humans are expected to innovate continuously and rapidly on a large scale. On one hand, AI's speed sets a challenging standard for human creators; on the other hand, it also lowers the training requirements to become an artist or a creative, as many people can create artistic paintings without picking up a brush. Moreover, as AI learns from human creations and refines its abilities, it raises the bar for what is considered innovative. Human creators in general, and UX Designer in particular, may feel compelled to push their limits to compete with AI, which can be mentally and emotionally draining. To sustain human creativity, instead of competing with AI's speed, human creators seem to be better off focusing on tasks that require critical thinking and emotional depth, where the human touch is irreplaceable. To that end,

support systems and education should be introduced to alleviate the pressure on humans and help mitigate the risk of creativity exhaustion, a point to which we discuss next.

5.4 AI Literacy and Participatory AI in UX Design

In UX Design, there is a growing presence of tools with AI features or supporting AI plugins. AI is gradually being integrated into various stages of the UX workflow [62]. AI literacy begins with a fundamental understanding of AI concepts, including how machine learning works, the types of AI systems, their capabilities, limitations, and implications. This understanding is crucial for UX designers to harness AI's power, ensure equal access to AI education and tools, and actively participate in shaping and refining AI technologies, especially those used in their design processes. By adopting a participatory AI approach, UX Designers are part and parcel of the conversation around the future of GenAI development – this enables UX designers to strengthen their feedback and expertise, ensuring that AI tools align effectively with human intentions and UX design practices [54, 60].

Another core element of AI literacy is that UX Designers should be able to think critically and question AI-generated outputs. There is a need for a comprehensive framework or guidelines for evaluating AI outcomes. This framework could encompass the assessment of AI's credibility, performance, accuracy, and impact on user experiences [84], as well as provide mens for contestability [63]. The foregoing echoes efforts to ensure committees consisting of AI experts, ethics experts, and importantly creative professionals, are brought together to oversee GenAI's progress, and provide standards and best practices for evaluating GenAI output and mitigating harm on creative professionals (cf., [47]).

5.5 Copyright and Ownership for GenAI Output in and beyond UX Design

In our study, UX Designers emphasized the significance of crediting the original creators of artworks or styles utilized in AI work. They mention the use of blockchain technology (cf., [23]), where of special interest are computational provenance mechanisms [89] that track and document the origins, processes, and transformations of AI-generated content or artifacts. As such, this involves recording information about how a piece of content, such as text, images, or other media, was generated, which AI models and algorithms were used, and any data sources that contributed to the creation of the content. In so doing, this would facilitate the attribution of ownership should they draw on model output throughout their UX practice. We found that many UX Designers in our study believed that humans should be the owners of the design outcomes. However, this was so only if GenAI tools serve as supportive aids, and human designers remain in the driver seat by leading the entire process, adding detailed touches and synthesizing user inputs. However, they recommended attributing ownership to the part of the work supported by AI or labeling it as AI-contributed while ensuring transparency about the tools used. Interestingly, in a recent study, Draxler et al. [19] found that people often do not disclose AI as an author when using personalized AI-generated texts in writing, although they attribute ownership to the AI. Comparing human and AI ghostwriters, they found that attributing authorship to oneself is more prevalent when writing with AI support. Given disagreement in attributing ownership, it is necessary to develop an authorship attribution framework that takes the user and their relationship to the generative model into account.

The discourse around copyright, privacy, ownership for UX design practice is inherently connected to the wider discourse on GenAI as a whole. Whether dealing with text, images, or video, the foregoing raise the question of whether the GenAI output being generated is ethical and legally compliant to begin with. Indeed, recent work by Jiang et al. [47] in assessing the impact of visual GenAI on artists paints a bleak picture regarding the outspoken harms on artists, which can well extend to other creative works (including the work of UX designers). For example, "fair use" within US copyright law may not always end up protecting the artist, whether due to case-by-case determination, or the high cost in pursing legal battles. Whether the way forward constitutes better watermarking approaches to ensure copyright and traceable accountability [89, 100], or the further development

of regulation and policy at an (inter-)national level (e.g., European AI Act[10] [92]), it is clear GenAI development needs to be acted upon responsibly - for and beyond UX Design practice. As such, we believe drawing on the key human-centered principles (e.g., aligned with human well-being, respecting privacy, and having appropriate governance and oversight) of responsible AI development [32] are of immediate necessity to protect designers moving forward.

5.6 The Future of GenAI-infused UX Design: Fears and Opportunities

The rapid advancements in GenAI and UX Design underscore the necessity of ongoing monitoring and research in both fields. As GenAI tools continue to evolve, it is essential to ensure that they align with human values, ethics, and creative processes, despite any uncertainty that may arise from currently unresolved empirical and conceptual issues in human psychology [11]. To that end, by answering our research questions of current **(RQ1)** and future **(RQ2)** perceptions of GenAI, this study serves as a foundation for exploring the opportunities and challenges presented by GenAI in UX Design, where we emphasize the importance of responsible and informed collaboration between humans and AI in this domain, which leads to the question: are such fears of GenAI for UX Design warranted?

We observed (Sec. 4.5) that experienced UX Designers' were defensive about the very idea that "AI can potentially replace human designers". Experienced designers, on the one hand, have confidence in their superpowers in terms of design skills, the collision of wisdom and enlightenment in human-human communication, and possessing high empathy towards users. However, they emphasized (Sec. 4.6) the real risks that GenAI could pose on the junior UX Design workforce, posing the dilemma: if junior human designers don't do the mundane work that can essentially be replaced by GenAI, then how will they reach the seniority levels wherein GenAI cannot replace? On the other hand, even experienced designers raised fears about AI in general, and GenAI in particular, and how this may in the future render their expertise partially obsolete. Specifically, some concerns revolved around emergent AI capabilities, where as AI becomes more sophisticated (e.g., more parameters with more diverse and larger training data), there is the possibility of it advancing beyond the intended scope or control [6, 76]. On the flip side, some of our participants may not have been aware of the rapid pace of developments – for example, GenAI models can be fine-tuned on unique stakeholder datasets [98], which would elevate ideation, brainstorming, and documentation within the UX design process. Nevertheless, the risks persist should even fine-tuned models lead to situations where GenAI systems generate designs or make decisions that are not aligned with refined user experience principles, stakeholder satisfaction, or worse, violate human values, ethics, or cultural norms [95, 101], even when designers may take the driver seat of selecting and refining the output with additional prompts (cf., [15]) on custom-trained models. These concerns align with user perceptions of machine consciousness (of GPT-3) [80], which lead to several tensions, of which most relevant to our use case are interaction and experience, control and independence, and rigidity and spontaneity. Furthermore, as in digital art, people who exhibit strong anthropocentric creativity beliefs may be biased to brush off GenAI design output as overall less creative and awe-inspiring should they know it was made with GenAI [65].

However, unpredictability, polarity, and such tensions often signify new opportunities as emerging AI capabilities can lead to innovative problem-solving approaches and entirely new design concepts that while inspire human creators, can radically disrupt the practice (reminiscent of paradigmatic shifts in the natural sciences [51]). However, while we already see a radical disruption to several elements of UX Design practice (cf., Fig. 2), much remains to be desired (and cautious about) as GenAI capabilities increase. Essentially, we contend that ensuring harmonious alignment between human-AI collaboration for UX Design practice, methods and strategies are required to ensure that GenAI systems comprehend and respect human designers' values and interpret and respond to their concerns effectively. For this, we call upon further research in and beyond responsible AI

---

[10]https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0206

to continue placing the human at the center of technology development, and importantly, on reconciliation efforts should ethical values differ amongst groups [46]. Indeed, as Rakova et al. [74] argue, to better enable responsible AI work, organizations need to update their prevalent practices, which requires addressing prevalent work practices, emerging work practices, and mapping their aspirational future. To this end, a path forward is to continue drawing on participatory AI and value-sensitive design [5, 20, 31, 44] to create AI for social good [90], and ultimately foster human and creative safeguarding mechanisms, allowing UX Design practice and its practitioners to adapt and flourish gracefully.

6 CONCLUSION

Our work set out to investigate how UX Designers perceive GenAI tools, and how this is reflected in their current workflows and practices. Further, we identified the opportunities and risks do UX Designers envision for the future of human-AI collaboration in UX Design practice. Through in-depth interviews with 20 UX Designers who have diverse years of experience, we found that experienced designers are confident in their originality, creativity, and empathic skills, and find GenAI's role overall as assistive. They emphasized factors of "enjoyment" and "agency" as uniquely humans, where humans will always remain in the driver seat over AI output. However, there were serious concerns over setbacks for junior designers, who may be impacted by skill degradation, job replacement, and creativity exhaustion. We draw several implications for responsible human-AI collaboration in UX design, specifically related to copyright and ownership, human creativity, and AI literacy and access. We call on continued efforts to develop responsible AI for ensuring human and creative safeguarding mechanisms, allowing UX Design professionals to immediately yet gracefully adapt to the dawn of GenAI, and its disruptive impact on UX Design practice.

REFERENCES

[1] Abdallah MH Abbas, Khairil Imran Ghauth, and Choo-Yee Ting. 2022. User experience design using machine learning: a systematic review. *IEEE Access* 10 (2022), 51501–51514.

[2] Saleema Amershi, Dan Weld, Mihaela Vorvoreanu, Adam Fourney, Besmira Nushi, Penny Collisson, Jina Suh, Shamsi Iqbal, Paul N Bennett, Kori Inkpen, et al. 2019. Guidelines for human-AI interaction. In *Proceedings of the 2019 chi conference on human factors in computing systems*. 1–13.

[3] Kareem Ayoub and Kenneth Payne. 2016. Strategy in the age of artificial intelligence. *Journal of strategic studies* 39, 5-6 (2016), 793–819.

[4] Emily M. Bender, Timnit Gebru, Angelina McMillan-Major, and Shmargaret Shmitchell. 2021. On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?. In *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency* (Virtual Event, Canada) *(FAccT '21)*. Association for Computing Machinery, New York, NY, USA, 610–623. https://doi.org/10.1145/3442188.3445922

[5] Abeba Birhane, William Isaac, Vinodkumar Prabhakaran, Mark Diaz, Madeleine Clare Elish, Iason Gabriel, and Shakir Mohamed. 2022. Power to the People? Opportunities and Challenges for Participatory AI. In *Equity and Access in Algorithms, Mechanisms, and Optimization* (Arlington, VA, USA) *(EAAMO '22)*. Association for Computing Machinery, New York, NY, USA, Article 6, 8 pages. https://doi.org/10.1145/3551624.3555290

[6] Rishi Bommasani, Drew A. Hudson, Ehsan Adeli, Russ Altman, Simran Arora, Sydney von Arx, Michael S. Bernstein, Jeannette Bohg, Antoine Bosselut, et al. 2021. On the Opportunities and Risks of Foundation Models. *arXiv preprint arXiv:2108.07258* (2021). https://crfm.stanford.edu/assets/report.pdf

[7] Zalán Borsos, Raphaël Marinier, Damien Vincent, Eugene Kharitonov, Olivier Pietquin, Matt Sharifi, Olivier Teboul, David Grangier, Marco Tagliasacchi, and Neil Zeghidour. 2022. AudioLM: a Language Modeling Approach to Audio Generation. arXiv:2209.03143 [cs.SD]

[8] Petter Bae Brandtzæg, Asbjørn Følstad, and Jan Heim. 2018. Enjoyment: lessons from Karasek. *Funology 2: From Usability to Enjoyment* (2018), 331–341.

[9] Virginia Braun and Victoria Clarke. 2012. Thematic analysis. In *APA Handbook of Research Methods in Psychology: Vol. 2. Research Designs*. in Cooper, H. (Eds.). APA, 57–71.

[10] Lizzy Burnam. 2023. We Surveyed 1093 Researchers About How They Use AI—Here's What We Learned. https://www.userinterviews.com/blog/ai-in-ux-research-report

[11] Patrick Butlin. 2021. AI Alignment and Human Reward. In *Proceedings of the 2021 AAAI/ACM Conference on AI, Ethics, and Society* (Virtual Event, USA) *(AIES '21)*. Association for Computing Machinery, New York, NY, USA, 437–445. https://doi.org/10.1145/3461702.3462570

[12] Bill Buxton. 2010. *Sketching user experiences: getting the design right and the right design.* Morgan kaufmann.

[13] Kelly Caine. 2016. Local Standards for Sample Size at CHI. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. Association for Computing Machinery, New York, NY, USA, 981–992. https://doi.org/10.1145/2858036.2858498

[14] Tara Capel and Margot Brereton. 2023. What is Human-Centered about Human-Centered AI? A Map of the Research Landscape. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 359, 23 pages. https://doi.org/10.1145/3544548.3580959

[15] Minsuk Chang, Stefania Druga, Alexander J Fiannaca, Pedro Vergani, Chinmay Kulkarni, Carrie J Cai, and Michael Terry. 2023. The Prompt Artists. In *Proceedings of the 15th Conference on Creativity and Cognition.* 75–87.

[16] Li-Yuan Chiou, Peng-Kai Hung, Rung-Huei Liang, and Chun-Teng Wang. 2023. Designing with AI: An Exploration of Co-Ideation with Image Generators. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference* (Pittsburgh, PA, USA) *(DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1941–1954. https://doi.org/10.1145/3563657.3596001

[17] Victoria Clarke, Virginia Braun, and Nikki Hayfield. 2015. Thematic analysis. *Qualitative psychology: A practical guide to research methods* 222, 2015 (2015), 248.

[18] Tiago Silva Da Silva, Milene Selbach Silveira, Frank Maurer, and Theodore Hellmann. 2012. User experience design and agile development: From theory to practice. *Journal of Software Engineering and Applications* (2012).

[19] Fiona Draxler, Anna Werner, Florian Lehmann, Matthias Hoppe, Albrecht Schmidt, Daniel Buschek, and Robin Welsch. 2023. The AI Ghostwriter Effect: Users Do Not Perceive Ownership of AI-Generated Text But Self-Declare as Authors. *arXiv preprint arXiv:2303.03283* (2023).

[20] Upol Ehsan and Mark O. Riedl. 2020. Human-Centered Explainable AI: Towards a Reflective Sociotechnical Approach. In *HCI International 2020 - Late Breaking Papers: Multimodality and Intelligence*, Constantine Stephanidis, Masaaki Kurosu, Helmut Degen, and Lauren Reinerman-Jones (Eds.). Springer International Publishing, Cham, 449–466.

[21] Damian Okaibedi Eke. 2023. ChatGPT and the rise of generative AI: Threat to academic integrity? *Journal of Responsible Technology* 13 (2023), 100060.

[22] Tyna Eloundou, Sam Manning, Pamela Mishkin, and Daniel Rock. 2023. Gpts are gpts: An early look at the labor market impact potential of large language models. *arXiv preprint arXiv:2303.10130* (2023).

[23] Chris Elsden, Arthi Manohar, Jo Briggs, Mike Harding, Chris Speed, and John Vines. 2018. Making Sense of Blockchain Applications: A Typology for HCI. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3173574.3174032

[24] Ziv Epstein, Aaron Hertzmann, Investigators of Human Creativity, Memo Akten, Hany Farid, Jessica Fjeld, Morgan R Frank, Matthew Groh, Laura Herman, Neil Leach, et al. 2023. Art and the science of generative AI. *Science* 380, 6650 (2023), 1110–1111.

[25] Rosanna Fanni, Valerie Steinkogler, Giulia Zampedri, and Jo Pierson. 2022. Enhancing human agency through redress in Artificial Intelligence Systems. *AI & SOCIETY* 38 (06 2022). https://doi.org/10.1007/s00146-022-01454-7

[26] Ed Felten, Manav Raj, and Robert Seamans. 2023. How will Language Modelers like ChatGPT Affect Occupations and Industries? *arXiv preprint arXiv:2303.01157* (2023).

[27] KJ Kevin Feng, Maxwell James Coppock, and David W McDonald. 2023. How Do UX Practitioners Communicate AI as a Design Material? Artifacts, Conceptions, and Propositions. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference.* 2263–2280.

[28] Giorgio Franceschelli and Mirco Musolesi. 2023. Reinforcement Learning for Generative AI: State of the Art, Opportunities and Open Research Challenges. arXiv:2308.00031 [cs.LG]

[29] Michael C Frank. 2023. Bridging the data gap between children and large language models. *Trends in Cognitive Sciences* (2023).

[30] Jonas Frich, Lindsay MacDonald Vermeulen, Christian Remy, Michael Mose Biskjaer, and Peter Dalsgaard. 2019. Mapping the landscape of creativity support tools in HCI. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems.* 1–18.

[31] Batya Friedman. 1996. Value-Sensitive Design. *Interactions* 3, 6 (dec 1996), 16–23. https://doi.org/10.1145/242485.242493

[32] Ozlem Ozmen Garibay, Brent Winslow, Salvatore Andolina, Margherita Antona, Anja Bodenschatz, Constantinos Coursaris, Gregory Falco, Stephen M. Fiore, Ivan Garibay, Keri Grieman, John C. Havens, Marina Jirotka, Hernisa Kacorri, Waldemar Karwowski, Joe Kider, Joseph Konstan, Sean Koon, Monica Lopez-Gonzalez, Iliana Maifeld-Carucci, Sean McGregor, Gavriel Salvendy, Ben Shneiderman, Constantine Stephanidis, Christina Strobel, Carolyn Ten Holter, and Wei Xu. 2023. Six Human-Centered Artificial Intelligence Grand Challenges. *International Journal of Human Computer Interaction* 39, 3 (2023), 391–437. https://doi.org/10.1080/10447318.2022.2153320 arXiv:https://doi.org/10.1080/10447318.2022.2153320

[33] Frederic Gmeiner, Humphrey Yang, Lining Yao, Kenneth Holstein, and Nikolas Martelaro. 2023. Exploring Challenges and Opportunities to Support Designers in Learning to Co-create with AI-based Manufacturing Design Tools. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems.* 1–20.

[34] Abid Haleem, Mohd Javaid, and Ravi Pratap Singh. 2022. An era of ChatGPT as a significant futuristic support tool: A study on features, abilities, and challenges. *BenchCouncil Transactions on Benchmarks, Standards and Evaluations* 2, 4 (2022), 100089. https://doi.org/10.1016/j.tbench.2023.100089

[35] Perttu Hämäläinen, Mikke Tavast, and Anton Kunnari. 2023. Evaluating large language models in generating synthetic hci research data: a case study. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–19.

[36] Ariel Han and Zhenyao Cai. 2023. Design Implications of Generative AI Systems for Visual Storytelling for Young Learners. In *Proceedings of the 22nd Annual ACM Interaction Design and Children Conference* (Chicago, IL, USA) *(IDC '23)*. Association for Computing Machinery, New York, NY, USA, 470–474. https://doi.org/10.1145/3585088.3593867

[37] Gunnar Harboe and Elaine M. Huang. 2015. Real-World Affinity Diagramming Practices: Bridging the Paper-Digital Gap. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (Seoul, Republic of Korea) *(CHI '15)*. Association for Computing Machinery, New York, NY, USA, 95–104. https://doi.org/10.1145/2702123.2702561

[38] Rex Hartson and Pardha Pyla. 2018. *The UX Book: Process and Guidelines for Ensuring a Quality User Experience* (2st ed.). Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.

[39] Monique Hennink and Bonnie N. Kaiser. 2022. Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science & Medicine* 292 (2022), 114523. https://doi.org/10.1016/j.socscimed.2021.114523

[40] Jonathan Ho, William Chan, Chitwan Saharia, Jay Whang, Ruiqi Gao, Alexey Gritsenko, Diederik P Kingma, Ben Poole, Mohammad Norouzi, David J Fleet, et al. 2022. Imagen video: High definition video generation with diffusion models. arXiv:2210.02303 [cs.CV]

[41] Matthew K Hong, Shabnam Hakimi, Yan-Ying Chen, Heishiro Toyoda, Charlene Wu, and Matt Klenk. 2023. Generative AI for Product Design: Getting the Right Design and the Design Right. *arXiv preprint arXiv:2306.01217* (2023).

[42] Eric Horvitz. 1999. Principles of mixed-initiative user interfaces. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. 159–166.

[43] Stephanie Houde, Steven I Ross, Michael Muller, Mayank Agarwal, Fernando Martinez, John Richards, Kartik Talamadupula, and Justin D Weisz. 2022. Opportunities for Generative AI in UX Modernization. In *Joint Proceedings of the ACM IUI Workshops 2022, March 2022, Helsinki, Finland.*

[44] Nanna Inie, Jeanette Falk, and Steve Tanimoto. 2023. Designing Participatory AI: Creative Professionals' Worries and Expectations about Generative AI. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–8.

[45] Alice M Isen and Johnmarshall Reeve. 2005. The influence of positive affect on intrinsic and extrinsic motivation: Facilitating enjoyment of play, responsible work behavior, and self-control. *Motivation and emotion* 29 (2005), 295–323.

[46] Maurice Jakesch, Zana Buçinca, Saleema Amershi, and Alexandra Olteanu. 2022. How Different Groups Prioritize Ethical Values for Responsible AI. In *Proceedings of the 2022 ACM Conference on Fairness, Accountability, and Transparency* (Seoul, Republic of Korea) *(FAccT '22)*. Association for Computing Machinery, New York, NY, USA, 310–323. https://doi.org/10.1145/3531146.3533097

[47] Harry H. Jiang, Lauren Brown, Jessica Cheng, Mehtab Khan, Abhishek Gupta, Deja Workman, Alex Hanna, Johnathan Flowers, and Timnit Gebru. 2023. AI Art and Its Impact on Artists. In *Proceedings of the 2023 AAAI/ACM Conference on AI, Ethics, and Society* (Montréal, QC, Canada) *(AIES '23)*. Association for Computing Machinery, New York, NY, USA, 363–374. https://doi.org/10.1145/3600211.3604681

[48] Zachary Kaiser. 2019. Creativity as computation: Teaching design in the age of automation. *Design and Culture* 11, 2 (2019), 173–192.

[49] Taenyun Kim, Maria D Molina, Minjin Rheu, Emily S Zhan, and Wei Peng. 2023. One AI Does Not Fit All: A Cluster Analysis of the Laypeople's Perception of AI Roles. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–20.

[50] Joke Kort, APOS Vermeeren, and Jenneke E Fokker. 2007. Conceptualizing and measuring user experience. *Towards a UX manifesto* (2007), 57.

[51] Thomas S. Kuhn. 1962. *The Structure of Scientific Revolutions*. University of Chicago Press, Chicago.

[52] Chinmay Kulkarni, Stefania Druga, Minsuk Chang, Alex Fiannaca, Carrie Cai, and Michael Terry. 2023. A Word is Worth a Thousand Pictures: Prompts as AI Design Material. arXiv:2303.12647 [cs.HC]

[53] Tomas Lawton, Kazjon Grace, and Francisco J Ibarrola. 2023. When is a Tool a Tool? User Perceptions of System Agency in Human–AI Co-Creative Drawing. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference* (Pittsburgh, PA, USA) *(DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1978–1996. https://doi.org/10.1145/3563657.3595977

[54] Mina Lee, Megha Srivastava, Amelia Hardy, John Thickstun, Esin Durmus, Ashwin Paranjape, Ines Gerard-Ursin, Xiang Lisa Li, Faisal Ladhak, Frieda Rong, et al. 2022. Evaluating human-language model interaction. *arXiv preprint arXiv:2212.09746* (2022).

[55] Florian Lehmann. 2023. Mixed-Initiative Interaction with Computational Generative Systems. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI EA '23)*. Association for Computing Machinery, New York, NY, USA, Article 501, 6 pages. https://doi.org/10.1145/3544549.3577061

[56] Robert W Lent and Steven D Brown. 2006. Integrating person and situation perspectives on work satisfaction: A social-cognitive view. *Journal of vocational behavior* 69, 2 (2006), 236–247.

[57] Joseph CR Licklider. 1960. Man-computer symbiosis. *IRE transactions on human factors in electronics* 1 (1960), 4–11.

[58] Lassi A. Liikkanen. 2019. It AIn't Nuttin' New – Interaction Design Practice After the AI Hype. In *Human-Computer Interaction – INTERACT 2019*, David Lamas, Fernando Loizides, Lennart Nacke, Helen Petrie, Marco Winckler, and Panayiotis Zaphiris (Eds.).

Springer International Publishing, Cham, 600–604.

[59] Zhiyu Lin, Upol Ehsan, Rohan Agarwal, Samihan Dani, Vidushi Vashishth, and Mark Riedl. 2023. Beyond Prompts: Exploring the Design Space of Mixed-Initiative Co-Creativity Systems. *arXiv preprint arXiv:2305.07465* (2023).

[60] Duri Long and Brian Magerko. 2020. What is AI Literacy? Competencies and Design Considerations. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–16. https://doi.org/10.1145/3313831.3376727

[61] Robyn Longhurst. 2003. Semi-structured interviews and focus groups. *Key methods in geography* 3, 2 (2003), 143–156.

[62] Yuwen Lu, Chengzhi Zhang, Iris Zhang, and Toby Jia-Jun Li. 2022. Bridging the Gap Between UX Practitioners' Work Practices and AI-Enabled Design Support Tools. In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI EA '22)*. Association for Computing Machinery, New York, NY, USA, Article 268, 7 pages. https://doi.org/10.1145/3491101.3519809

[63] Henrietta Lyons, Eduardo Velloso, and Tim Miller. 2021. Conceptualising Contestability: Perspectives on Contesting Algorithmic Decisions. *Proc. ACM Hum.-Comput. Interact.* 5, CSCW1, Article 106 (apr 2021), 25 pages. https://doi.org/10.1145/3449180

[64] Nora McDonald, Sarita Schoenebeck, and Andrea Forte. 2019. Reliability and Inter-rater Reliability in Qualitative Research: Norms and Guidelines for CSCW and HCI Practice. *Proceedings of the ACM on Human-Computer Interaction* 3 (11 2019), 1–23. https://doi.org/10.1145/3359174

[65] Kobe Millet, Florian Buehler, Guanzhong Du, and Michail D. Kokkoris. 2023. Defending humankind: Anthropocentric bias in the appreciation of AI art. *Computers in Human Behavior* 143 (2023), 107707. https://doi.org/10.1016/j.chb.2023.107707

[66] Bin Ning, Fang Liu, and Zhixiong Liu. 2023. Creativity Support in AI Co-creative Tools: Current Research, Challenges and Opportunities. In *2023 26th International Conference on Computer Supported Cooperative Work in Design (CSCWD)*. 5–10. https://doi.org/10.1109/CSCWD57460.2023.10152832

[67] Shakked Noy and Whitney Zhang. 2023. Experimental evidence on the productivity effects of generative artificial intelligence. *Available at SSRN 4375283* (2023).

[68] OpenAI. 2023. GPT-4 Technical Report. arXiv:2303.08774 [cs.DL]

[69] Antti Oulasvirta, Niraj Ramesh Dayama, Morteza Shiripour, Maximilian John, and Andreas Karrenbauer. 2020. Combinatorial optimization of graphical user interface designs. *Proc. IEEE* 108, 3 (2020), 434–464.

[70] Joon Sung Park, Lindsay Popowski, Carrie Cai, Meredith Ringel Morris, Percy Liang, and Michael S Bernstein. 2022. Social simulacra: Creating populated prototypes for social computing systems. In *Proceedings of the 35th Annual ACM Symposium on User Interface Software and Technology*. 1–18.

[71] John V Pavlik. 2023. Collaborating with ChatGPT: Considering the implications of generative artificial intelligence for journalism and media education. *Journalism & Mass Communication Educator* 78, 1 (2023), 84–93.

[72] Andrew Pearson. 2023. The rise of CreAltives: Using AI to enable and speed up the creative process. *Journal of AI, Robotics & Workplace Automation* 2, 2 (2023), 101–114.

[73] Sida Peng, Eirini Kalliamvakou, Peter Cihon, and Mert Demirer. 2023. The impact of ai on developer productivity: Evidence from github copilot. *arXiv preprint arXiv:2302.06590* (2023).

[74] Bogdana Rakova, Jingying Yang, Henriette Cramer, and Rumman Chowdhury. 2021. Where Responsible AI Meets Reality: Practitioner Perspectives on Enablers for Shifting Organizational Practices. *Proc. ACM Hum.-Comput. Interact.* 5, CSCW1, Article 7 (apr 2021), 23 pages. https://doi.org/10.1145/3449081

[75] Kevin Roose. 2022. The brilliance and weirdness of ChatGPT. *The New York Times* (2022). https://www.nytimes.com/2022/12/05/technology/chatgpt-ai-twitter.html

[76] S. Russell. 2019. *Human Compatible: Artificial Intelligence and the Problem of Control*. Penguin Publishing Group. https://books.google.nl/books?id=M1eFDwAAQBAJ

[77] Jana I Saadi and Maria C Yang. 2023. Generative Design: Reframing the Role of the Designer in Early-Stage Design Process. *Journal of Mechanical Design* 145, 4 (2023), 041411.

[78] Chitwan Saharia, William Chan, Saurabh Saxena, Lala Li, Jay Whang, Emily L Denton, Kamyar Ghasemipour, Raphael Gontijo Lopes, Burcu Karagol Ayan, Tim Salimans, et al. 2022. Photorealistic text-to-image diffusion models with deep language understanding. *Advances in Neural Information Processing Systems* 35 (2022), 36479–36494.

[79] NANNA SANDBERG, TOM HOY, and MARTIN ORTLIEB. 2019. My AI versus the company AI: how knowledge workers conceptualize forms of AI assistance in the workplace. In *Ethnographic Praxis in Industry Conference Proceedings*, Vol. 2019. Wiley Online Library, 125–143.

[80] Ava Elizabeth Scott, Daniel Neumann, Jasmin Niess, and Paweł W Woźniak. 2023. Do You Mind? User Perceptions of Machine Consciousness. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–19.

[81] Ben Shneiderman. 2020. Human-centered artificial intelligence: Reliable, safe & trustworthy. *International Journal of Human–Computer Interaction* 36, 6 (2020), 495–504.

[82] Ben Shneiderman. 2020. Human-Centered Artificial Intelligence: Three Fresh Ideas. *AIS Transactions on Human-Computer Interaction* (2020). https://api.semanticscholar.org/CorpusID:226748434

[83] D.K. Simonton. 1999. *Origins of Genius: Darwinian Perspectives on Creativity*. Oxford University Press. https://books.google.li/books?id=a2LnBwAAQBAJ

[84] Irene Solaiman, Zeerak Talat, William Agnew, Lama Ahmad, Dylan Baker, Su Lin Blodgett, Hal Daumé III, Jesse Dodge, Ellie Evans, Sara Hooker, et al. 2023. Evaluating the Social Impact of Generative AI Systems in Systems and Society. *arXiv preprint arXiv:2306.05949* (2023).

[85] Åsne Stige, Efpraxia D Zamani, Patrick Mikalef, and Yuzhen Zhu. 2023. Artificial intelligence (AI) for user experience (UX) design: a systematic literature review and future research agenda. *Information Technology & People* (2023).

[86] S Shyam Sundar. 2020. Rise of machine agency: A framework for studying the psychology of human–AI interaction (HAII). *Journal of Computer-Mediated Communication* 25, 1 (2020), 74–88.

[87] Jakob Tholander and Martin Jonsson. 2023. Design Ideation with AI - Sketching, Thinking and Talking with Generative Machine Learning Models. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference* (Pittsburgh, PA, USA) *(DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1930–1940. https://doi.org/10.1145/3563657.3596014

[88] Katja Thoring, Sebastian Huettemann, and Roland M Mueller. 2023. THE AUGMENTED DESIGNER: A RESEARCH AGENDA FOR GENERATIVE AI-ENABLED DESIGN. *Proceedings of the Design Society* 3 (2023), 3345–3354.

[89] Joel E Tohline et al. 2008. Computational provenance. *Computing in Science & Engineering* 10, 03 (2008), 9–10.

[90] Steven Umbrello and Ibo Poel. 2021. Mapping value sensitive design onto AI for social good principles. *AI and Ethics* 1 (08 2021), 3. https://doi.org/10.1007/s43681-021-00038-3

[91] Russ Unger and Carolyn Chandler. 2012. *A Project Guide to UX Design: For user experience designers in the field or in the making*. New Riders.

[92] Michael Veale and Frederik Zuiderveen Borgesius. 2021. Demystifying the Draft EU Artificial Intelligence Act: Analysing the good, the bad, and the unclear elements of the proposed approach. *Computer Law Review International* 22, 4 (2021), 97–112. https://doi.org/doi:10.9785/cri-2021-220402

[93] Florent Vinchon, Todd Lubart, Sabrina Bartolotta, Valentin Gironnay, Marion Botella, Samira Bourgeois-Bougrine, Jean-Marie Burkhardt, Nathalie Bonnardel, Giovanni Emanuele Corazza, Vlad Glăveanu, et al. 2023. Artificial Intelligence & Creativity: A manifesto for collaboration. *The Journal of Creative Behavior* (2023).

[94] Qian Wan and Zhicong Lu. 2023. GANCollage: A GAN-Driven Digital Mood Board to Facilitate Ideation in Creativity Support. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference* (Pittsburgh, PA, USA) *(DIS '23)*. Association for Computing Machinery, New York, NY, USA, 136–146. https://doi.org/10.1145/3563657.3596072

[95] Norbert Wiener. 1960. Some Moral and Technical Consequences of Automation. *Science* 131, 3410 (1960), 1355–1358. https://doi.org/10.1126/science.131.3410.1355 arXiv:https://www.science.org/doi/pdf/10.1126/science.131.3410.1355

[96] Bin Yang, Long Wei, and Zihan Pu. 2020. Measuring and improving user experience through artificial intelligence-aided design. *Frontiers in Psychology* 11 (2020), 595374.

[97] Qian Yang, Aaron Steinfeld, Carolyn Rosé, and John Zimmerman. 2020. Re-examining whether, why, and how human-AI interaction is uniquely difficult to design. In *Proceedings of the 2020 chi conference on human factors in computing systems*. 1–13.

[98] Yang Yuan. 2023. On the Power of Foundation Models. In *Proceedings of the 40th International Conference on Machine Learning (Proceedings of Machine Learning Research, Vol. 202)*, Andreas Krause, Emma Brunskill, Kyunghyun Cho, Barbara Engelhardt, Sivan Sabato, and Jonathan Scarlett (Eds.). PMLR, 40519–40530. https://proceedings.mlr.press/v202/yuan23b.html

[99] Chengzhi Zhang, Weijie Wang, Paul Pangaro, Nikolas Martelaro, and Daragh Byrne. 2023. Generative Image AI Using Design Sketches as Input: Opportunities and Challenges. In *Proceedings of the 15th Conference on Creativity and Cognition* (Virtual Event, USA) *(C&C '23)*. Association for Computing Machinery, New York, NY, USA, 254–261. https://doi.org/10.1145/3591196.3596820

[100] Haonan Zhong, Jiamin Chang, Ziyue Yang, Tingmin Wu, Pathum Chamikara Mahawaga Arachchige, Chehara Pathmabandu, and Minhui Xue. 2023. Copyright Protection and Accountability of Generative AI: Attack, Watermarking and Attribution. In *Companion Proceedings of the ACM Web Conference 2023* (Austin, TX, USA) *(WWW '23 Companion)*. Association for Computing Machinery, New York, NY, USA, 94–98. https://doi.org/10.1145/3543873.3587321

[101] Simon Zhuang and Dylan Hadfield-Menell. 2020. Consequences of Misaligned AI. In *Advances in Neural Information Processing Systems*, H. Larochelle, M. Ranzato, R. Hadsell, M.F. Balcan, and H. Lin (Eds.), Vol. 33. Curran Associates, Inc., 15763–15773.

	Steps	Main Activities	Tools
1	Business Requirements	• Analyze requirements gathered from stakeholders and documents. • Initiate a kickoff meeting with stakeholders to clarify expectations and understand business needs and potential technical challenges.	
2	User Requirements	• Define research goals and identify the necessary features to achieve those goals. • Synthesize insights from user research to create personas and empathy maps. • Dive into user's behavior, motivation, frustrations, pain points, and challenges to inform design decisions.	
3	Ideation	• Transform research insights into ideas through sketches. • Facilitate an internal review to gather feedback from design team members and refine concepts. • Organize workshops with stakeholders to generate and consolidate design ideas, fostering collaboration.	
4	Prototyping	• Develop interactive prototypes that visually and functionally represent the proposed design solutions. • Ensure prototypes capture user interactions, workflows, and navigation paths.	
5	User testing	• Plan and conduct user testing to validate the design's usability and gather feedback. • Utilize online or offline moderated user testing to guide participants through predefined tasks and observe their performance. • Employ unmoderated testing to gather remote user feedback and insights, often from a larger sample size.	
6	Iteration	• Analyze user testing results and feedback, identifying areas for improvement. • Iterate on the design based on the insights gained	
7	Solution	• Present the refined design solution to stakeholders, showcasing how it addresses user needs and business goals. • Collaborate with stakeholders to ensure the design aligns with the business vision and objectives.	
8	Design Handoff	• Provide the development team with design assets and documentation and guide them to ensure the design's consistency and accuracy across different screen sizes. • Address technical constraints and make UI adjustments to optimize the user interface for the final product.	

Table 2. The typical UX Design workflow in 2023.