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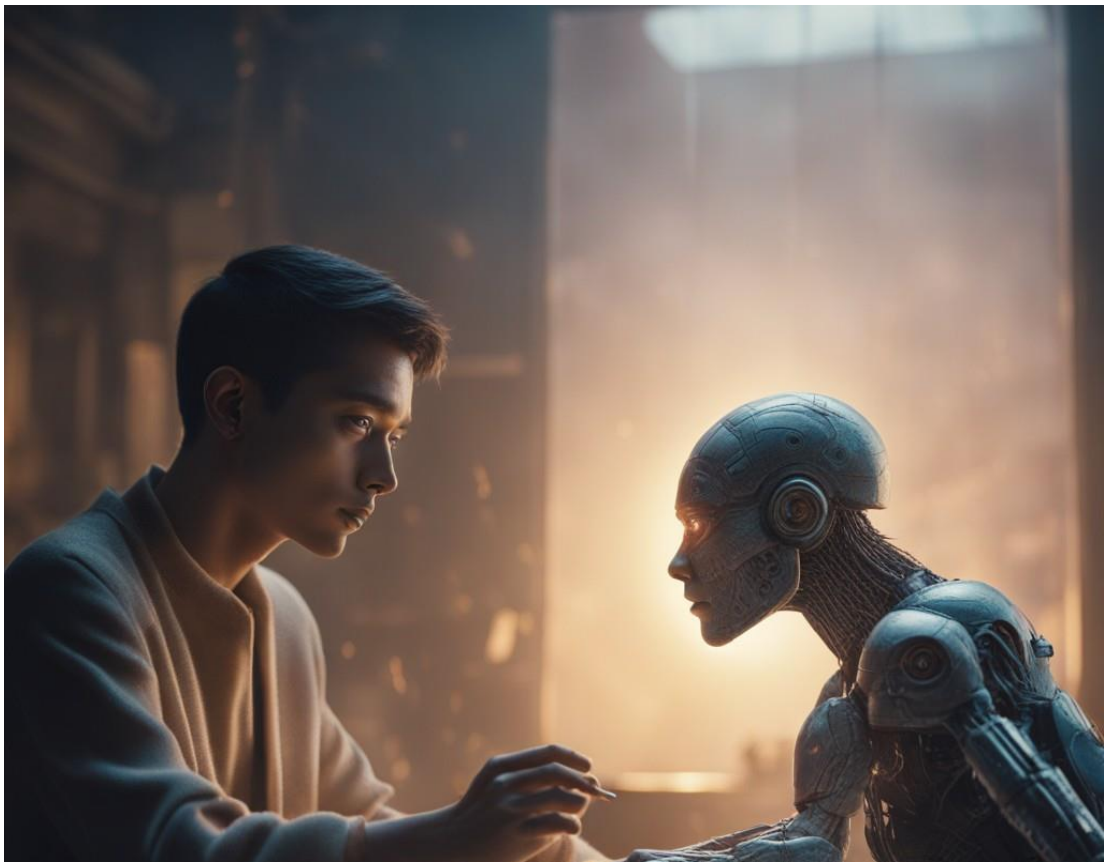

Designing with AI

Assessing the state of play of AI co-creation in web design

Master’s thesis in Interaction Design and Technologies

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Abstract

Given the growing use of AI-supported design tools and the existing research-practice gap in Human-Computer Interaction (HCI), there are valid reasons to assess the state of play of AI co-creation in design. By surveying design practitioners, experiences, fears, and perceived benefits may be learned to help guide future research and create a starting point for the shaping of practical recommendations for leveraging of AI tools within the design domain. This study applied a mixed-method approach, surveying 71 design practitioners and interviewing seven to identify the perceived impact, risks, benefits, and concerns regarding AI co-creation. It was found that 76 percent of design practitioners engage in AI co-creation, extending over virtually the entire design process. Practitioners enjoy the perceived expedition of task initiation and the iterative work method that AI co-creation offers; however, they also raise several concerns such as data privacy, copyright, and potential knowledge loss. In addition, some experience a struggle to keep up with the rapid development of AI services, adding pressure on design practitioners. In conclusion, seven recommendations for designers, three for employers of design practitioners, and two for AI services were derived from the study results. Additionally, it was found that company culture regarding AI, the impact of AI co-creation on knowledge sharing in collaborative settings, and AI's ability to reinforce, prevent, and be biased towards itself simultaneously are viable topics for future research.

Keywords: AI co-creation, AI, User experience, Digital design, Web design, AI tools, Designing with AI, Artificial Intelligence, AI maturity

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Clara Heldtander, Gothenburg, January 2024

List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

AI	Artificial Intelligence
AIA	Artificial Intelligence Act
ASR	Automatic Speech Recognition
CICID	Content creation, Information analysis, Content enhancement and post-production, Information extraction and enhancement, Data compression
ETBG	Editors, Transformers, Blenders, Generators
HCI	Human-Computer Interaction
IxD	Interaction Design
LDMs	Latent Diffusion Models
ML	Machine Learning
NLP	Natural Language Processing
UI	User Interface
UX	User Experience
QA	Quality Assurance
WCAG	Web Content Accessibility Guidelines

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1
Introduction

Since the 1990s, User Experience (UX) and Interaction Design (IxD) have emerged as core disciplines in product development, focusing on user satisfaction and optimizing the interaction between user and product. The scope of the domains overlap, both prioritizing user needs and expectations; thus, many practitioners use the terms interchangeably. UX and IxD focus on understanding user behaviors, ensuring seamless interactions, and creating aesthetically pleasing designs, all contributing to a positive user experience. Further, usability and accessibility are crucial elements that promote inclusivity and satisfaction. In addition, continuous testing and iteration based on user feedback refine the design solutions, ensuring that products meet functional requirements and user preferences [1].

During the design process, practitioners utilize various tools and methods, from sketching with pen and paper to creating advanced digital prototypes [2]. In recent years, the use of Artificial Intelligence (AI), computer systems that use algorithms to exhibit human-like intelligence, has increased in digital design tools [3]. It is seen in products such as text-to-image generators, photo-editing software, and text generators [4–6]. Moreover, several research projects have started to explore human AI co-creation, i.e., the use of AI in the design process, holding a positive outlook on AI's ability to enhance the work of design professions, enabling more time spent on creative solutions and less on time-consuming, tedious tasks [7–9]. However, a critical gap persists between research advancements and their practical application within the industry, commonly known as the "research-practice" gap [10, 11]. Although academia has made efforts to bridge this gap, such as the AI tool user needs assessment by Y. Lu et al., further work is required [12]. Understanding the current landscape of AI co-creation and how designers perceive it to affect their work can offer valuable insights directing future research, consequently bridging the research-practice gap. Moreover, concerns, attitudes, and recommendations regarding AI co-creation can be identified by surveying design practitioners. This may aid in forming constructive and progressive methods for safe and effective engagement in AI co-creation, particularly useful for design practitioners and employers navigating the fast-changing AI landscape.

This study will employ a mixed-method approach to explore the AI co-creation state of play, focusing on its use in web design, i.e., the design of web-based applications and websites [13]. A survey will be conducted with web design practitioners to assess to what extent they engage in AI co-creation, what types of tools and functionalities they prefer, and for which kinds of tasks. Following, interviews will be held with

the same target group to explore the perceived impact of AI-supported design tool usage, also diving deeper into concerns, risks, and other thoughts relating to the topic. Ultimately, this study aims to offer a starting point for leveraging of AI tools within the web design domain through practical recommendations while addressing concerns and opportunities regarding AI co-creation in design practice.

1.1 Aim

This thesis aims to offer practical recommendations for leveraging of AI tools within the web design domain while also addressing concerns and opportunities regarding AI co-creation in design practice.

To accomplish this aim, the research questions outlined in the upcoming section will be addressed.

1.2 Research question

To what extent do web design practitioners engage in AI co-creation, and how do they consider it influencing their design processes?

1.2.1 Supporting research question

According to design practitioners, what are important considerations regarding AI co-creation in web design?

1.3 Target group

This study targets design practitioners in web design with professional experience in the field. Age, gender, or company type will not be regarded; however, all should be above 18 years of age.

1.4 Limitations

As with any study, it is important to acknowledge the limitations. Firstly, this study primarily focuses on design practitioners in web design, which may restrict its direct application to other domains. However, it is anticipated that while not all guidelines or tools may be universally applicable, some could still prove valuable in diverse contexts.

Secondly, the study's generalizability may be limited due to its focus on a specific geographic region, namely Sweden. Cultural and regional factors can influence attitudes toward technology adoption, and the findings may not be universally applicable. However, the unique focus on Swedish practitioners adds a distinct perspective to the predominantly U.S.-based research, broadening the global understanding of

AI adoption in creative contexts.

Thirdly, the rapidly evolving landscape of AI technologies presents a challenge. The study's findings may have a relatively short shelf life due to the continuous emergence of new AI tools and technologies. Nevertheless, efforts will be made to focus on broader categories of AI tools to enhance the study's long-term relevance.

Lastly, as with any self-reported research, there is a potential for response bias in surveys and interviews [14]. Participants may provide answers that they perceive as socially desirable or that align with their self-image. Efforts will be made to minimize this bias, but it is a limitation inherent in studies of this nature.

Despite these limitations, this study strives to provide relevant insights for further research and practical applications for AI co-creation in web design.

2
Background

To understand how AI may aid web designers in their work process, it is necessary to have a fundamental understanding of the design process, what it encapsulates, and the core tasks in web design. Additionally, being familiar with the most frequently used AI technologies in AI co-creation products provides a sufficient comprehension of what AI enables. Therefore, this chapter addresses these subjects, ensuring a solid understanding necessary to comprehend the study.

2.1 The design process

Web design centers on the user experience and content creation for websites. An important aspect in current practice is usability, referring to the ease of use and efficiency with which users can navigate, interact, and accomplish tasks on a website [13]. It also entails accessibility, ensuring that people with disabilities can use the web effectively, extending its benefits to those who are non-disabled, such as aging individuals, those with temporary disabilities, and individuals with situational limitations [15].

To design websites where users can accomplish tasks effectively, whether it be buying a product, booking a flight, or finding a recipe, designers follow a design process. At its core, it revolves around empathizing with users, defining problem areas, and ideating creative solutions. Constructed of a series of steps, each with its own goal and purpose, the design process is iterative, meaning it is common to return to previous steps and revise solutions [16].

Various design practitioners and methodologies present different divisions of the design process ranging from a broad to a more detailed approach, and with different focuses. A rather neutral process is the one proposed by UX pioneers Jacob Nielsen and Don Norman, dividing the design process into six steps [16]:

- **Empathize:** Understanding users through research
- **Define:** Identifying pain-points and defining user needs
- **Ideate:** Generating ideas
- **Prototype:** Materializing the ideas into refined designs
- **Test:** Testing your designs with users
- **Implement:** Implement the design, whether through code or production

On the more expansive side, J. Beard et al. adopt a three-step design process: discovery, exploration, and implementation. This process excludes the Test and Implement stages of the design thinking process suggested by Nielsen and Norman. Instead, it has a more explicit focus on client vision and stakeholder management [17]. Furthermore, a goal-oriented design process is proposed by A. Cooper et al. to mitigate a suggested gap between user research and design. This process is divided into research, modeling, requirements, framework, refinement, and support. While also being divided into six phases, this process emphasizes the Empathize and Define stages of the Nielsen and Normans process [18]. Figure 2.1 shows how these three processes intersect.

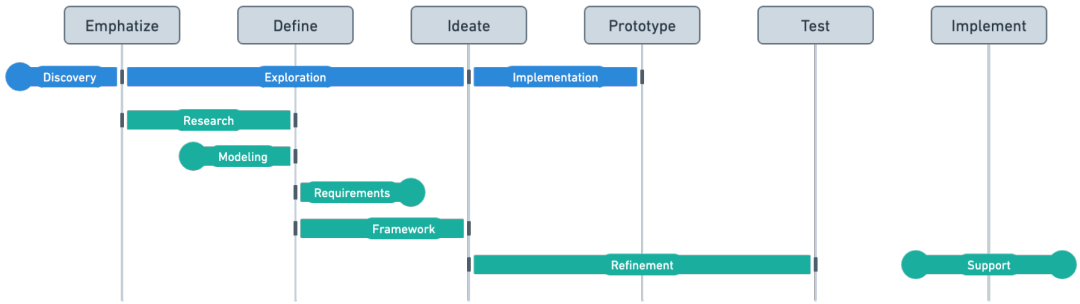

Figure 2.1: An illustration of how the design processes proposed by J. Nielsen and D. Norman (grey), J. Beard et al. (Blue), and A. Cooper et al. (Green) intersect with one another.

In addition to the aforementioned design processes, other variants exist; however, the core content typically remains consistent. The choice of process depends on project goals, personal preferences, and the specifics of the design task at hand. Ultimately, the diversity within the design process showcases its adaptability, allowing for tailored approaches that suit various contexts.

2.1.1 Methods and activities in the web design process

Several methods and activities are performed during the design of a website. During Empathize and Define, designers often engage in tasks such as user research, reviewing existing products, defining requirements, and creating personas, user flows, and scenarios. In the Ideate phase, designers often engage in creativity-enhancing tasks such as brainstorming, compiling mood boards, sketching, et cetera. This phase is closely followed by the Prototype phase, where the design is refined, and the Test phase, where designers test their solutions to see if they meet the project goal and requirements. Lastly, the design is implemented, i.e., turned from prototype to code. This phase often fosters close contact between designers and developers [18].

During any stage in the design process, designers may conduct user research or user testing to verify that they are moving in the right direction or to learn more about user's needs, wishes, and pain points. Additionally, following the launch of a website, updates may be required, such as adding new content or pages, making adjustments

to the design, and quality assurance (QA) [19].

In addition to the tasks above, web designers may engage in content creation, i.e., the production of copy (text), imagery, illustrations, animations, and the like [18]. Moreover, to ensure that their designs comply with accessibility guidelines designers often adhere to the Web Content Accessibility Guidelines (WCAG) [20]. This will become more prevalent in 2025 as several web services, such as transport and e-commerce, will be required to comply with national accessibility laws and regulations as part of the new European Accessibility Act [21].

2.2 A brief introduction to AI

AI refers to computerized systems displaying behaviors akin to human intelligence [3]. Originating in 1956, advancements in processing power and the surge in data throughout the 2020s have significantly propelled AI's contemporary growth.

2.2.1 AI technologies in co-creation tools

In contemporary AI co-creation tools, certain AI technologies exhibit more prevalent implementations. In November 2022, *ChatGPT* was released, an advanced chatbot able to generate and summarize text, answer questions, give feedback, et cetera [6]. This tool primarily utilizes **Natural Language Processing** (NLP) which involves the understanding, interpretation, and manipulation of written or spoken language [22]. Conversational tools like *ChatGPT* may aid designers during many parts of the design process, from *Empathize* by explaining certain concepts or summarizing transcripts to *Test* by providing examples of interview questions [23].

Moreover, **Latent Diffusion Models** (LDMs), a technique employing complex algorithms in an iterative process to generate highly realistic and detailed images, is used in novel text-to-image tools like *Midjourney* and *Stable Diffusion* [4, 24, 25]. These types of tools are useful during ideation and content creation, aiding brainstorming and enabling the creation of unique visuals [26].

As both NLPs and LDMs rely upon training on vast amounts of data to be able to produce high-quality results, products implementing these technologies have faced allegations of copyright infringement, suggesting that they use copyrighted material in their training. These allegations stem from debates on whether AI-generated works should be covered by copyright. Some artists argue that AI tools are part of their creative process, and thus, their work should be protected. However, others contend that granting copyright to AI works, which may have trained on copyrighted material, could be seen as legitimizing theft [27]. As of the authoring of this report, copyright protection can only be granted if the works are human-made; thus, AI-generated text and images do not meet these criteria due to the absence of human intervention [28]. Additionally, the Council presidency and negotiators from the European Parliament provisionally agreed in December 2023 on the proposal for standardized regulations concerning AI, known as the Artificial Intelligence Act

(AIA). A notable item among the rules is that AI program developers must disclose any copyrighted material used to develop their systems [29].

Beyond NLP and LDMs, a common technology used primarily in AI-powered user research tools is **Automatic Speech Recognition** (ASR). ASR is a subset of NLP that converts spoken language into text or commands without human intervention [30]. In user research tools, such as *Kraftful*, this technology can be used to transcribe spoken words in real-time or from recordings, facilitating analysis [31].

While NLP, LDMs, and ASR are more prevalent in contemporary AI co-creation tools they also employ other technologies. Additionally, they may exhibit more functions than those enabled by NLP, LDMs, and ASR. In Section 3.2 various categorizations found in the literature are presented, further demonstrating the application areas of AI in design.

3
Theory

The following chapter presents contemporary literature on AI co-creation, a central concept in this study, providing a summary of relevant research on the use of AI in design work. Additionally, two different categorizations of AI design tools are described, offering a deeper understanding of AI's applicability in design. Lastly, the topic of prerequisites for AI adoption is addressed.

3.1 Human AI co-creation

AI tools differ from traditional computational tools in their ability to display human-intelligence-like behavior [32]. They are high-performing in providing random stimuli, i.e., unexpected conceptual elements, disrupting designers' established thought patterns, and sparking curiosity and creativity [33]. This has fostered a human-AI relationship wherein they complement each other's capabilities to enhance final output quality [34]. This collaborative process can be defined as human AI co-creation or mixed-initiative co-creativity [35].

Human AI co-creation redefines the designer's role from solely being a creator to encompass being an editor, collaborator, and curator [36]. Its efficacy is most pronounced when the AI demonstrates more developed capabilities than the human [37]. Conversely, instances where the AI's capabilities are equal to or less than humans have proven counterproductive. Figoli et al. defined this relationship as the *AI>Human rule*, emphasizing that collaboration is most effective when AI is more performative than humans in specific tasks [38]. Further, they identified three main impacts of human AI co-creation:

- **Task redistribution and efficiency:** Acknowledging AI's proficiency in handling repetitive and straightforward tasks allows for reallocating responsibilities within the design process. This can free human designers from mundane activities, enabling them to focus on more strategic aspects of a project, such as ideation based on both problem and context, which has proved challenging for AI [8].
- **Complementarity:** Recognizing the complementary nature of human-AI co-creation emphasizes the importance of assigning tasks based on each entity's distinct strengths and capabilities. Tasks are allocated considering the unique competencies of both humans and AI.
- **Team performance:** AI has been shown to enhance the quality of work in

low-performing teams, providing opportunities to improve overall team performance. However, caution is advised when integrating AI into high-performing teams, as AI's current limitations might negatively affect the team's overall output [38].

A study by S. Freese provided insights into the practical implications of human-AI co-creation, particularly regarding task redistribution, efficiency, and complementarity. A comparison of workshop results where groups were tasked with designing a website menu structure without AI and with AI showed that AI was useful in providing initial suggestions and creating initial drafts; however, it had limitations in handling complexity and context, often offering generalized solutions. Interestingly, the group without AI assistance initially felt disadvantaged due to the lack of AI tools. However, this feeling faded as they noted how the AI-assisted group struggled with the AI software and did not complete the task faster [39].

S. Freese proposed the *Effectiveness Trilogy*, a three-component framework consisting of *Expertise*, *Experience*, and *Usability* to leverage AI effectively. *Expertise* involves a deep understanding of the subject area, enabling users to evaluate and guide AI-generated solutions effectively. *Experience*, gained through trial and learning prompt-writing, enhances proficiency in AI tools, fostering better results. *Usability*, linked to intuitive program usage, maximizes gained experience, saving time and optimizing goal achievement. These elements, interconnected and essential for successful outcomes, highlight the pivotal role of human judgment in assessing AI-generated solutions. S. Freese states that designers must possess two of these components to enable high-quality results with AI tools [39].

Regarding the impact on team performance, research has produced mixed results on AI's impact. B. Song et al. demonstrated that AI-assisted design teams explore the solution space more broadly, exhibit greater agility, and that AI assistance improves the competence of individuals [40]. This conclusion was drawn from a complex problem-solving study in which teams were tasked with designing a drone delivery system meeting specific criteria. Opposing the result of B. Song et al., G. Zhang et al. argue that deep learning AI improves the initial performance of low-performing teams but always impedes high-performance teams. This result was obtained through an experiment where teams of three were asked to design a truss bridge in a provided Graphical User Interface (GUI) with and without the help of deep learning AI. In the study, the experiment results and post-experiment questionnaire showed that in high-performing deep learning AI-aided teams, participants became less motivated and demonstrated reduced effort to solve design problems. Despite the participants feeling that they accomplished the tasks with less mental demand, this perception was an illusion; in reality, their performance suffered. Consequently, reduced human effort can lead to sub-optimal design outcomes and hinder the team's overall success [37].

3.2 AI tool categorizations

To facilitate discussion and continued research on the involvement of AI in the design process, efforts have been made to distinguish between available AI-supported design tools. N. Anantrasirichai and D. Bull propose a categorization based on tool functionality, while a study by A. Hwang categorizes tools specifically content creation and editing [8, 41].

3.2.1 Functionality-based categorization of AI tools

This categorization identifies distinct functionalities of AI tools in design. **Content creation** tools use AI to generate original work. **Information analysis** tools use statistics of data to improve productivity, for example, summarizing texts or giving recommendations of similar content. Further, **Content enhancement and post-production workflows** focus on using AI to improve work quality, for example, upscaling or deblurring images. **Information extraction and enhancement** use AI to interpret, clarify, and create new ways of extracting new information. Lastly, **Data compression** uses AI to reduce data size while preserving quality. In web design, this is useful for compressing images while maintaining high quality, as large file sizes extend the page load time [42]. Notably, these categories are not mutually exclusive; AI tools often synergize, combining functionalities across categories for enhanced versatility and functionality [8]. Throughout this study, this categorization will be referred to as CICID.

3.2.2 AI tools for content creation and modification

Diving deeper into *Content creation* and *Content enhancement and post-production*, A. Hwang delineates the following four categories (Figure 3.1), hereon referred to as *ETBG* [41].

- **The Editors** (Figure 3.1 top left) - facilitate various execution processes, allowing users to carry out content editing at ease. They do not primarily generate new ideas or outputs; users typically have predefined directions for their creative products when using these tools.
- **The Transformers** (Figure 3.1 top right) - modifies and transforms content across varying forms. Similar to Editors, transformers do not generate new ideas either. Users exercise more control over Editor and Transformer type tools, bringing limited novelty to the creative process.
- **The Blenders** (Figure 3.1 bottom left) - blends one or more creative inputs to create new ideas. Blenders introduce a level of novelty and unpredictability. However, the novelty and uncertainty vary, and the results can be somewhat predictable.
- **The Generators** (Figure 3.1 bottom right) - based on user-provided guidance and/or constraints generates "ready-to-use" outputs. Generators introduce significant unexpectedness into the creative process. Users typically set initial design requirements but have limited control during the tool's operation. They

must wait for the tool's generative outputs, giving AI a prominent role in the creative dialogue.

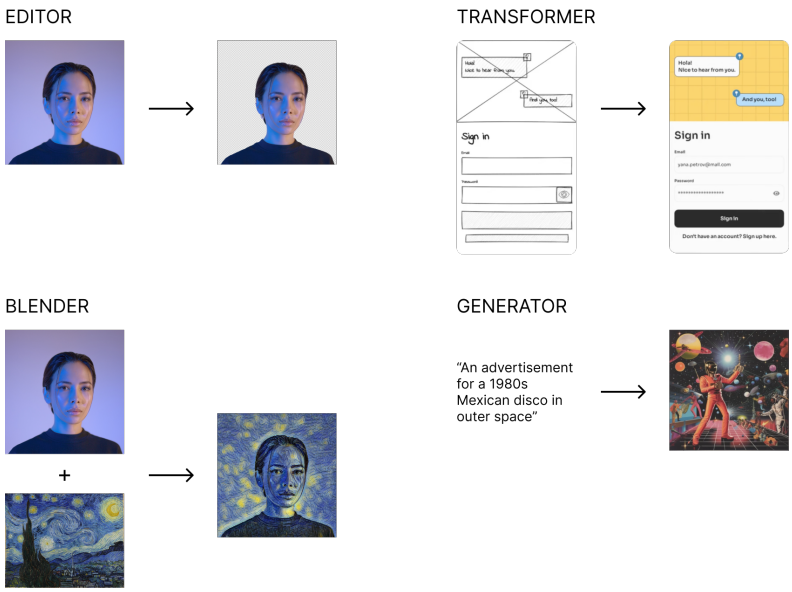

Figure 3.1: A demonstration of the ETBG categorization proposed by A. Hwang [41]. From the left: Adobe Express auto-remove background feature [43], UiWizard's sketch-to-wireframe tool [44], Fotor's photography stylizer [45], and Midjourney's text-to-image feature [4].

3.3 Prerequisites for AI adoption

AI's progression both as a creator and tool to augment designers' work has sparked discussions surrounding job displacement and the future of creative professions [46–50]. Academia generally holds a positive outlook, suggesting that AI will augment rather than replace creative professions in the near future [7–9]. However, suggestions have been made that fear of job displacement may hinder creative professionals from embracing AI co-creative tools, potentially limiting the full realization of AI co-creation [41]. Consequently, prerequisites for AI adoption serve as an interesting topic. While there are theories on openness to change, i.e., an individual's willingness to accept and consciously understand the possibility that change may be necessary in various contexts and scenarios, these center on business processes and management-initiated change [51]. It remains unclear how these theories apply to AI co-creation, as the initiative to engage in it may originate from outside the professional domain, for example, in hobbies or personal experiences.

4
Methods

In the following chapter, appropriate approaches and methods are presented in order to properly be able to assess the extent to which designers engage in AI co-creation and understand what impact this may have on their design processes. The concept of user research is explained, followed by suitable user research methods. In addition, the research methodology literature review and the thematic analysis method are described. These methods are deemed relevant to gain a comprehensive understanding of AI co-creation and the empirical material, essential to enable adequate identification of important considerations regarding AI co-creation in web design.

4.1 Literature review

A literature review is a comprehensive examination and synthesis of existing research and academic articles related to the study. It is used to provide a solid foundation and understanding of the current state of knowledge within the topic. The literature review is conducted by systematically searching and analyzing academic sources, such as peer-reviewed articles, books, and reports. The goal is to identify key themes, trends, and gaps helping to contextualize the study within the broader academic discourse [52]. The main limitation of a literature review is its reliance on existing studies, which may not cover the latest developments. The quality of the review depends on the available literature and the researcher's ability to synthesize information. Additionally, there is a risk of bias in the selection of sources thus leading to a potential overlook of diverse perspectives [53].

4.2 User research

User research encompasses various dimensions to understand user behaviors, attitudes, preferences, and needs. It broadly integrates qualitative and quantitative methodologies and can encompass both behavioral and attitudinal aspects to obtain comprehensive insights [54].

Qualitative research delves into the why and how of user behaviors and attitudes. This involves methods such as interviews and focus groups. For instance, conducting in-depth interviews allows researchers to explore user experiences, motivations, and challenges. Quantitative research, on the other hand, focuses on numerical data and statistical analysis. Surveys are one method that provides quantitative insights. They help gather structured data on user preferences or demographics [55]. This

study will employ both qualitative and quantitative methods to enable a holistic understanding of designer's perceived engagement in AI co-creation.

Moreover, this study will focus on the attitudinal aspects of user research, referring to the exploration of user's beliefs, opinions, and perceptions. On the contrary, the behavioral aspect of user research refers to understanding how users interact with specific products or services, studying their actions and decisions. As the study does not seek to observe or evaluate how designers interact with one specific type of product, methods for exploring behavioral aspects such as eye-tracking and A/B testing are not relevant [54].

4.2.1 Surveys

Surveys, or questionnaires, are a structured data collection method that involves administering a set of standardized questions to a sample of participants. They are used to gather quantitative data to measure factors such as attitudes, opinions, and behaviors [52]. For survey studies aiming to collect a sufficient amount of data to provide valuable insights, allow for meaningful analysis, and identify potential trends and correlations within the data, a larger sample size ($N \geq 50$) is recommended [56].

While survey studies are useful for obtaining a general understanding, their reliance on self-reported answers may result in biased results. For example, respondents may adjust their answers depending on social desirability and recall. Additionally, low response rates may compromise the sample representativeness and reliability [57].

4.2.2 Observation

Observation is a fundamental research skill involving the systematic recording of various phenomena, including people, artifacts, environments, behaviors, and interactions. Observational methods in design vary in formality, ranging from semi-structured approaches that prioritize immersion and open-mindedness to more formal structured observations employing predefined tasks [52].

Disadvantages of observation studies include the potential for observer bias, the challenge of interpreting non-verbal cues accurately, and the limited insight into user's thoughts and motivations, as observations mainly capture behavior. Additionally, the presence of an observer can influence user behavior, leading to less natural responses [58].

4.2.3 Diary Study

The diary study is a method for collecting in-depth information from participants about their daily lives and experiences, making it a suitable tool for exploratory research. Participants are usually provided with blank journals, a topic overview, instructions, and sample entries. They may be asked to document specific behaviors, encounters, or interactions at various times throughout the day, week, or month [52].

Similar to survey studies, diary studies also face limitations due to their reliance on participant's self-reporting. Additionally, diary studies may lack real-time insights and struggle to capture the full context of user experiences. Moreover, participant commitment and compliance can vary, affecting the reliability of the collected data [59].

4.2.4 Semi-structured interviews

The interview is a qualitative research method aiming to gain in-depth insights into participant's experiences, perceptions, and attitudes [52]. Of the available interview formats, the semi-structured interview is the most common in qualitative research. Organized around a series of open-ended questions they can be performed with an individual or in groups, and strike a balance between flexibility and structure [60]. Group interviews hold the potential for sparking dynamic discussions, while individual interviews provide a conducive environment for participants to share honest opinions and insights [61]. Unlike structured interviews, which use a fixed set of closed-ended questions, semi-structured interviews permit probing and follow-up questions. This enables a deeper dive into participant's responses, facilitating a richer exploration of their experiences and viewpoints. On the other hand, unlike unstructured interviews where questions are not pre-arranged, semi-structured interviews ensure that the intended subjects are systematically covered [52].

The semi-structured interview method possesses some limitations. Firstly, the flexibility in questioning may lead to variations in data quality, as not all participants may discuss relevant aspects. Secondly, interviewer bias can influence responses, and the structured nature may limit the exploration of unforeseen insights. Lastly, the reliance on participant's verbal communication might not fully capture non-verbal cues, potentially missing valuable contextual information [62].

4.2.5 Focus groups

Focus groups are a qualitative research method frequently employed by researchers to gather opinions, emotions, and attitudes from a group of participants about products, services, campaigns, or brands. This method capitalizes on group dynamics, fostering a peer-like environment where participants feel comfortable sharing experiences, emotions, and insights [52].

One of the main drawbacks of utilizing focus groups in user research is the potential for dominant voices to influence group opinions, leading to conformity bias. Further, the group may not represent diverse perspectives, and participants might not express individual opinions freely. Group dynamics can also impact the quality of insights, and the moderator's influence may steer the discussion in certain directions. Additionally, participants may not always feel comfortable sharing personal experiences in a group setting [63].

4.3 Thematic analysis

Thematic analysis is a method of qualitative data analysis that involves identifying, analyzing, and reporting patterns or themes within a dataset. It is commonly used to uncover and understand the underlying themes, concepts, and meanings within qualitative data [64]. While thematic analysis shares similarities with other data analysis techniques such as affinity diagramming, thematic analysis focuses on generating qualitative insights and understanding the underlying meanings. Affinity diagramming, on the other hand, is a more informal and versatile technique for organizing information, often used in group settings to facilitate decision-making or creative processes [52].
As the analysis will be conducted by one researcher, the main disadvantage of the method is subjectivity in identifying and interpreting themes. Moreover, as the method involves condensing rich data this may lead to oversimplification and loss of nuance. Lastly, thematic analysis heavily relies on the researcher's preconceptions, and there is a risk of overlooking unexpected insights [65].

5
Process

In this chapter, the thesis execution is described, highlighting the methodological approach employed. Starting with a literature review an identification of current AI tools followed, both informing the survey's design. Following the survey study, interviews were held. The interview questions elaborated on the survey results, diving deeper into the perceived impact of AI tools on the design process.

5.1 Literature review

The project started with a literature review aimed at understanding the current academic landscape concerning the utilization of AI in web design. In total 15 articles relating to different aspects of the thesis were read. The articles were mainly sourced via Google Scholar and platforms for peer-reviewed literature such as ScienceDirect and ACM Digital Library. Search terms involved combinations of words such as *UX design*, *AI*, *AI co-creation*, *Web design*, *Human AI Interaction*, and *User Experience*.

The reviewed literature collectively indicated a growing interest in the integration of AI within design processes and highlighted the potential for ML's impact on UX research. Among the aspects covered were technology readiness, AI's impact on collaboration within design teams, and the uniqueness of human creativity. However, a noticeable gap was identified: a lack of explicit insights into design practitioner's actual co-creation experiences with AI tools and their future perspectives on AI's applications in design.

5.2 The state of play of AI tools for web design

As a result of AI's rapid evolvement, there was uncertainty regarding the relevance of any mentioned AI tools in the literature. Therefore a brief scan of the current media was conducted to assess which tools were most commonly mentioned as of September 2023. In total, 144 AI-supported tools were found of which 63 were mentioned more than once.

The scan was conducted as follows. Six search terms were chosen based on relevance to the thesis. For each term, all mentioned tools in the top 10 Google search results were noted. Most results were articles or blog posts regarding useful AI-supported design tools. Any tools that did not use AI were disregarded, as well as tools that were no longer available. Table 5.1 shows the terms and number of tools registered

per term. The unique tools were then sorted by the number of mentions, where the top 21 (Figure 5.1) were later referred to in the survey.

Term	**No. mentioned tools**
AI tools + design teams	35
AI tools + graphic design	40
AI tools + UI design	22
AI tools + UX research	70
AI tools + UX design	89
AI tools + web design	97

Table 5.1: Number of tools registered for each search term

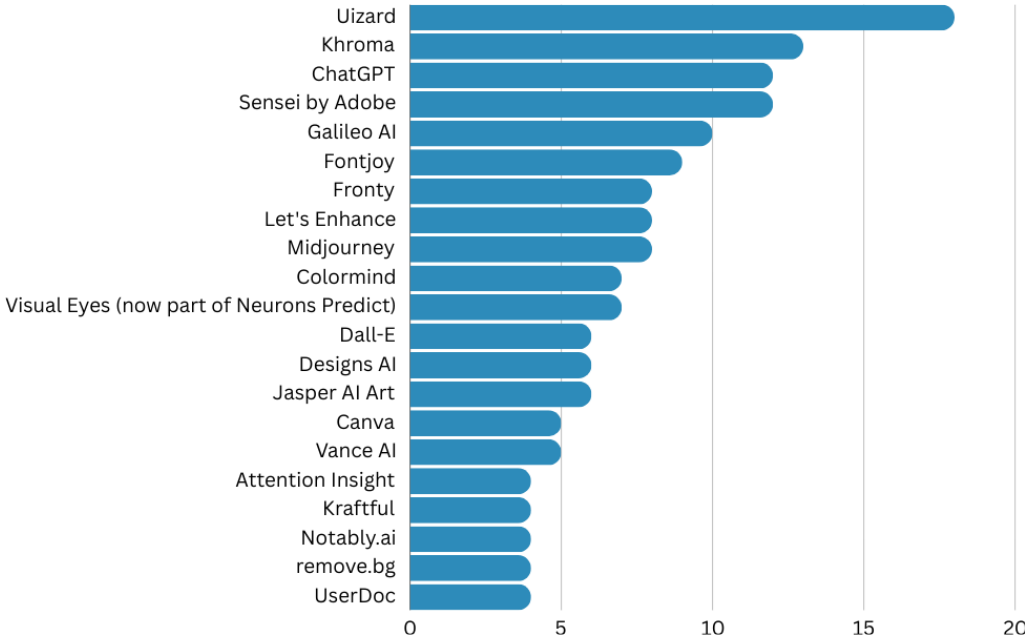

Figure 5.1: A graph showing the most frequently mentioned AI design tools in the top 10 Google Search results for the search terms shown in table 5.1

To explore the extensive array of registered tools, I initially categorized them based on the CICID and ETBG frameworks proposed by [8] and [41], mentioned in Section 3.2. This categorization highlighted that the majority of tools primarily focus on content creation and generation, while fewer tools pertain to data compression and Blender functionalities. However, many tools exhibit features that span multiple categories. Consequently, I opted to further categorize them based on their primary functionalities, resulting in an in-depth understanding of the current AI tool landscape. This process unveiled a total of 11 distinct categories:

1. AI Assistants
2. Color Palette Generators
3. Content Generation

4. Copy Generators
5. Image/Video Editors
6. Image/Video Generators
7. Product Testing Services
8. User Feedback Analysis
9. Website Design Generators
10. Wireframing Tools
11. Other

In the 'Other' category, 14 tools that did not align with any other category, such as a font pairing generator, a design system generator, and a logo analyzer, were placed. Analysis of Appendix A reveals that most tools specialize in image and video generation, and user testing analysis. Similarly to CICID and ETGB, some of the tools spanned multiple categories. For example, several AI Assistants may also serve as Copy Generators.

5.3 Survey on AI usage

A survey was conducted to get a broader understanding of the state of play of AI co-creation among design practitioners. The survey was also used to assess which AI tools were used, for which tasks, and the designer's attitudes towards AI co-creation in design practice.

5.3.1 Survey configuration

The survey was administered electronically through the survey tool Typeform. The platform choice was informed by cost and the possibility of adding conditions, i.e., having follow-up questions differ depending on answers. To increase the chances of survey completion, multiple and single-choice questions were prioritized [66]. The only open-ended questions in the survey were a. their professional role and b. an encouragement at the end of the survey to share any thoughts on the subject that were not covered by other questions. Respondents were asked between nine and 13 questions in total, depending on their answers. All questions and response types are included in Appendix B.

A pilot survey was conducted with five former peers of the author from the 30th of September to the 2nd of October. The result of the pilot study led to a revision of a few questions in terms of clarity. After revision, the main study was conducted. Answers were collected during a 26-day period between the 4th and 30th of October. The survey was shared:

- with friends of the author in the UX field
- in a Facebook group with alumni from the Industrial Design Bachelor Program at Chalmers University of Technology
- with 15 UX designers found through LinkedIn search

- with 13 Swedish design companies found via Google of which 2 answered and shared the survey among employees
- in a Facebook group with 33k female Swedish engineers
- in a Swedish UX community with 1k members
- at a UX meet-up in Gothenburg with 80+ visitors

An interesting event happened when the survey was promoted at the UX meet-up. One visitor who was conducting the survey asked how they could know that a tool they were using was powered by AI. In this case, it was about a Figma plug-in, however, they stated that there were additional tools that they were unsure of as well. This indicated that there might be difficulties in recognizing when AI is used as well as limited knowledge of what AI is.

5.3.2 Survey demographics

Of the 105 people who began the survey 74 completed it, leading to a completion rate of 70.5 percent. Three of the answers did not meet the target group criteria as they were students and were therefore disregarded. The average completion time was two minutes. Of the remaining 71 respondents, 57 worked with web design, and 54 used AI tools or AI-supported features in their work, corresponding to 80 and 76 percent respectively. The level of experience ranged from 0.5 years to 20+ years as shown in Figure 5.2.

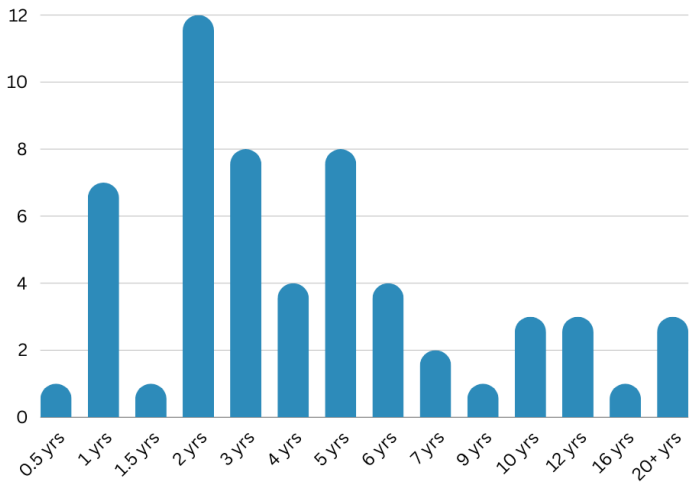

Figure 5.2: The distribution of years of experience among survey respondents.

As demonstrated in Figure 5.3 survey participants mostly engaged in work tasks such as prototyping and UI design, user testing and UX research, interviews, and copy-writing. Additional tasks mentioned by the participants were product owner tasks, marketing, education, system support, workshops, presentations, project management, and graphic content creation.

Participants generally perceived themselves as open to AI tool usage for design work, with the majority describing themselves as either open or very open. Four

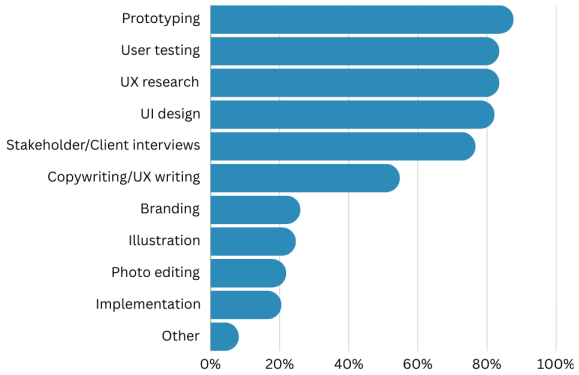

Figure 5.3: A bar chart showing which work tasks survey participants engaged in.

participants felt resistant to AI use, and nine remained neutral. The distribution is shown in Figure 5.4. A "very resistant" option was an available option, but as none of the participants chose this option it is not shown in the figure. Among the participants who reported not using AI tools in their work, the most common reasons were not having had time to learn how to use them, not being allowed to use them, and finding that they lack transparency, as shown in Figure 5.5.

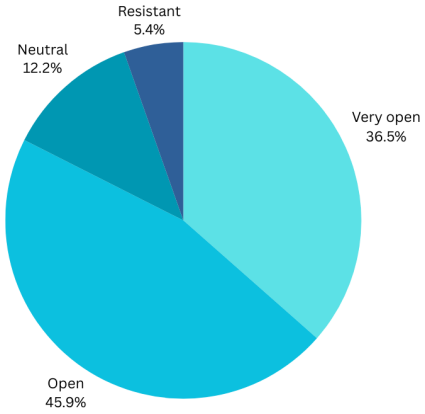

Figure 5.4: A pie chart showing the distribution between openness and resistance towards using AI tools for design work.

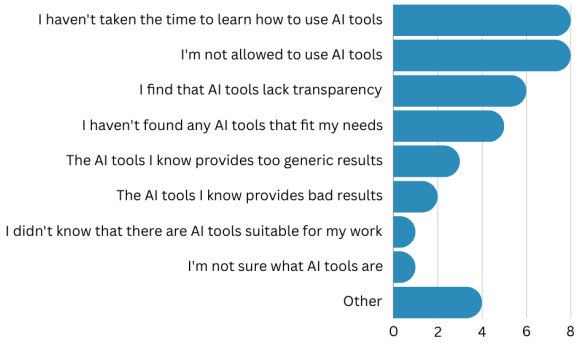

Figure 5.5: Reasons for not using AI tools, among survey participants who reported not using AI tools in their work.

5.4 Interview study

Interviews were held to follow up on survey results and deepen the understanding of how designers do or do not engage in co-creation with AI tools and what the perceived impact is on their design process, if any. A pilot interview was held with one peer of the authors, who had also participated in the pilot survey, to evaluate the interview questions in terms of clarity and possible bias. Based on the feedback given at the end of the interview some of the questions were revised.

Participants for the main interview study were found through the survey, as respondents were able to include their email addresses in case of interview interest. In total, 18 people included their email, of which seven agreed to be interviewed, i.e., all interviewees had participated in the survey. Information about the participants is shown in Table 5.2.

Participant no.	**Role**	**Experience**	**Uses AI**	**Perceived impact of AI on work**
P1	Marketing Coordinator	0.5 years	Yes	Positive
P2	Graphic Interface Developer	2 years	No	-
P3	UX and Visual designer	2 years	Yes	Very positive
P4	UX designer	4 years	Yes	Positive
P5	Senior UX designer	7 years	Yes	Positive
P6	UX Lead	10 years	Yes	Positive
P7	Creative Director	12 years	Yes	Positive

Table 5.2: A table describing the interviewee's professional roles and years of experience, as well as whether they use AI and how they perceive that AI impacts their design process.

The interviews were semi-structured, focusing on diving deeper into answers as opposed to covering all questions. During the interview, participants were shown an image of their work tasks that they declared in the survey, as well as AI tools they use (shown in a box) or AI tools they know of (bullet list) (Figure 5.6). This was meant to aid the interviewees to be able to better reflect upon their work processes. Upon presenting the image the participants were able to mention any other tasks that they might perform that were not listed. A complete list of the base questions posed during the interviews is included in Appendix C.

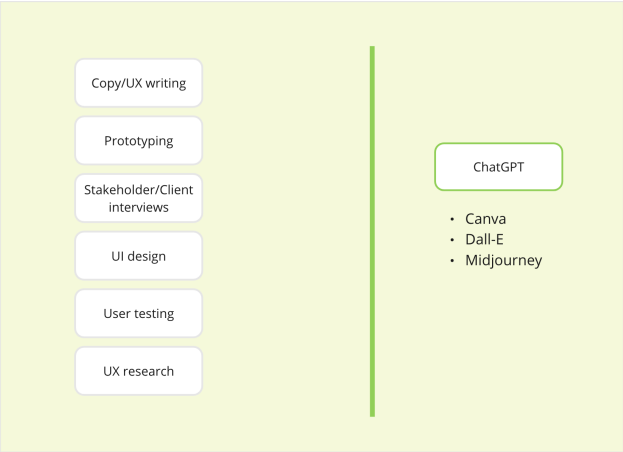

Figure 5.6: An example of the image shown to participants during interviews, displaying their preliminary work tasks on the left, and AI tools they use (top right) as well as AI tools they know of (bottom right).

All interviews were held in Google Meets, ranging between 40 and 60 minutes, and the spoken language was Swedish. To enable transcription, the interviews were recorded, and the user research platform *UserEvaluation* was used to automatically transcribe all recordings. The transcripts were annotated directly in UserEvolution, and an AI insights function was used to get AI-generated insights based on the transcript, with the potential of complementing the manual annotations. The results of the AI insights function varied in quality and relevance, as exemplified in Figure 5.7 and 5.8.

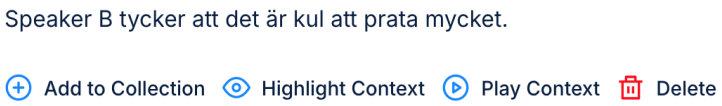

Figure 5.7: Translation: "Speaker B likes to speak a lot". An example of a low-quality AI-generated insight from the user research tool *UserEvaluation*. The insight does not offer any contextual information, relevance, or relation to the topic.

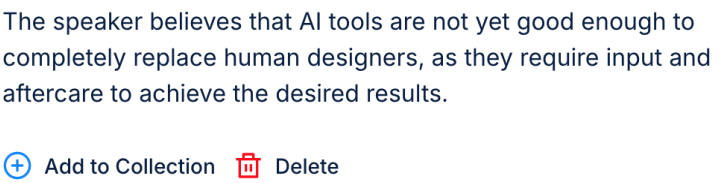

Figure 5.8: An example of a high-quality AI generated insight from the user research tool *UserEvaluation* where the insight includes justification for the claim made in the first part of the sentence.

5.5 Analysis

A thematic analysis was employed as the analysis method. Quotes and AI insights from *UserEvaluation* were copied onto post-its in *Miro* as interviews progressed. Each interview was assigned a unique Post-it color to be able to differentiate between them; then the Post-its were grouped and named based on theme. The main goal of the analysis was to a. identify themes and b. obtain a deep understanding of the study results in order to be able to compile reasonable recommendations.

Miro offers an AI service capable of, among other things, deriving key insights from post-it groups. After reviewing the groups manually and summarizing key findings, the *Miro* AI was tested out of curiosity to see what might differ and if any new findings could be found. Although many points were alike one stood out. *Miro* AI mentioned that:

«*There is a desire for AI tools that can help with learning and staying updated with AI advancements in the field of design.*»

When asking which post-its this finding was based on the *Miro* AI wrote:

«*Apologies for the confusion. The specific mention of a desire for AI tools that can help with learning and staying updated with AI advancements in the field of design is not explicitly indicated among the post-its in the selection. It was derived from the general discussions about designers wanting to stay relevant, keep up with developments and innovations in AI, and the importance of understanding AI technology and its ethical aspects. The statement reflects a broader sentiment expressed by design practitioners in the selection rather than being directly mentioned in a specific post-it.*»

Indeed interviewees highly valued staying updated with AI tools, and the idea of an AI tool to assist designers in tracking AI advancements should not necessarily be dismissed. However, contrary to the assumption by *Miro* AI, interviewees did not actively seek an extra AI tool for this purpose meaning that this finding is somewhat misleading.

6
Results

This chapter synthesizes insights from the survey, interviews, and thematic analysis, highlighting the interaction between design practitioners and AI co-creation tools. First, the level of engagement in AI co-creation is illustrated, followed by a description of how AI is used during specific stages of the design process according to interview participants. Accompanying this are concerns and reflections raised by the participants regarding AI use in design work. Second, the perceived impact of AI usage on the design process is described. Additionally, risks and reflections mentioned during interviews are presented. Third, I present a compiled list of considerations and recommendations regarding AI co-creation derived from the study aimed at designers, employers, and AI companies. In addition, I suggest novel applications of AI for web design based on discovered pain points and wishes during interviews.

6.1 Level of engagement in AI co-creation

The compiled survey and interview results showed that designers engage in AI co-creation during virtually the entire design process, with the majority reporting using AI tools weekly (Figure 6.1). Predominantly, AI is employed for tasks such as copywriting, inspiration search, image generation, and UX research (Figure 6.2), delineating three primary categories of used AI tools: AI assistants, i.e., chat-based text generators, Image generators, and Image Editors. The tools are used in a co-creation way where AI-generated results often need human intervention post AI, i.e., it is seldom that a generated result can be used directly. Figure 6.3 presents all tasks where AI usage was reported, placed below their corresponding phase of the design process.

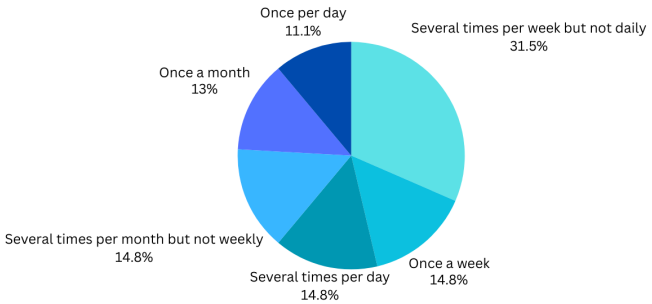

Figure 6.1: Perceived frequency of AI tool usage among the survey participants who used AI tools in their work, 54 out of 71 participants.

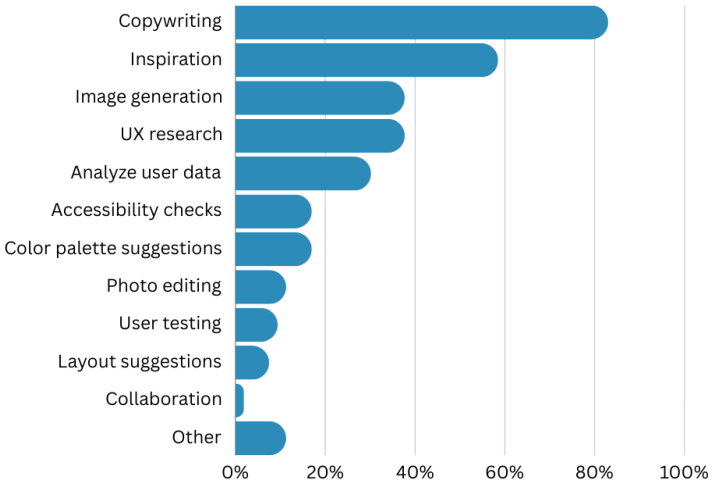

Figure 6.2: Distribution of AI tool usage for various tasks among survey participants.

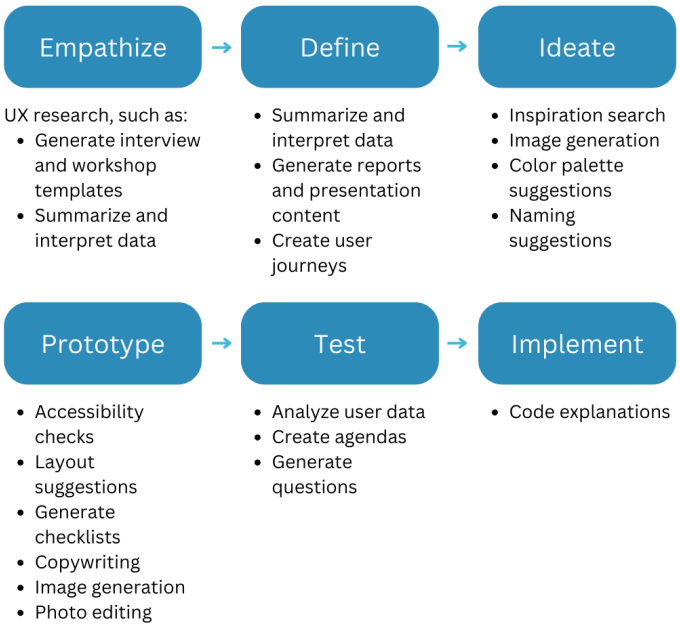

Figure 6.3: Tasks during each stage of the design process where survey and interview participants reported using AI.

6.1.1 AI co-creation during Empathize and Define

In the early-stage tasks related to understanding user needs, defining problem areas, conducting user research, and performing user tests, often conducted through interview studies, respondents reported using the AI Assistant *ChatGPT* exclusively. They stated that they felt experienced enough to assess the quality and truthfulness of results, thus being able to leverage AI to expedite the initiation of the following tasks:

- Summarizing content for reports and presentations and interpreting information such as transcripts and documents
- Generating proposals for agendas and questions for interviews and workshops questions
- Obtaining explanations of concepts, terms, and UX methods

6.1.2 AI co-creation during Ideate and Prototype

Participants reported using AI assistants, image generators, and image editors during the ideation and prototyping stages. *ChatGPT* was used in these stages to:

- Create checklists regarding accessibility compliance and UI elements, for example, to remember which elements are commonly present on a log-in page
- Generate initial written design suggestions or bounce ideas off of
- Generate naming suggestions, color pairings, et cetera
- Assist with copywriting by generating first drafts, translating, spell-checking, and re-phrasing

For tasks like copywriting, the respondents stepped into a curating role, expressing that while they might not excel in crafting copy, they are proficient at evaluating its quality, ultimately using AI to augment their skills.

«P5: *I use AI for things that don't require or involve important information or things that might be false. And that's where copywriting fits quite well because it's something that you can quite easily assess yourself, and there's not much risk that it's something that's not true.*»

Further, respondents reported the employment of image generators such as *Midjourney*, *Dall-E*, and *Stable Diffusion*, during the ideation and prototyping stages to a. create placeholder images more fitting to the design than stock photos or empty spaces, and b. create conceptual pictures for presentations, campaigns, et cetera.

Lastly, interviewees stated using various image editing AI tools and features like *Adobe Sensei* and *Firefly*, *remove.bg*, *Let's Enhance*, and *Designs AI* to:

- Remove image backgrounds
- Alter or expand image backgrounds
- Alter sections of an image

- Upscale AI-generated images, as they often have a lower resolution. For example, Stable Diffusion generates images in 512x512 px

Interviewees highlighted the evolving nature of AI in image editing and its impact on their workflows. Particularly, previously a moderately time-consuming task, background alterations have been streamlined with AI. However, it was noted that image editors face limitations in handling finer details. According to interviewees, AI excels in editing larger portions of images but currently struggles with precision in more intricate elements. As one interviewee explained:

«P1: *People can look a little strange with AI, backgrounds work great, but changing the position of a hand, for example, often produces mediocre results. You can't fix small details with AI yet.*»

This underscores the necessity for human intervention post-AI editing to ensure satisfaction and quality of the final output.

6.1.3 AI co-creation during Test and Implement

AI tools were reportedly used similarly during the Test phase as during Emphatize and Define, meaning to summarize and interpret information and generate proposals for test agendas and templates. Moreover, 20 percent of survey participants stated that they worked with implementation, where *ChatGPT* was used to generate code explanations.

6.1.4 Concerns regarding AI co-creation during the design process

While AI usage was reported for several tasks in the design process, highlighted in the preceding subsections, interviewees voiced concerns and important considerations, particularly regarding using AI assistants and image generators. Addressing concerns is essential to foster a more secure and reliable environment for AI co-creation.

6.1.4.1 Reliability and data security

The reliability of AI-generated information is a concern among interviewees. They highlight the need for human verification of AI-derived outputs, even for tasks they perceive as "error-proof", such as translation or copy drafts. Several respondents emphasized the risk of inadvertently accepting incorrect answers due to careless reading or unintentional oversight, as exemplified in the quote below:

«P6: *[There is a risk] that you get a completely wrong answer but don't notice it because you read carelessly or don't think twice. You kind of get answers depending on how you ask; if you ask the "wrong" questions and the result ends up a little wonky, you might not realize it.*»

Another noteworthy aspect is the apprehension of potential breaches in data privacy and security in AI tools. Interviewees explained how they are cautious about sharing client-specific information, source code, or personal data, stemming from uncertainties about how the tools handle and utilize it and whether ethical standards are adhered to in their operations. Moreover, the survey showed that for 30 percent of those who did not engage in AI co-creation, the reason was a perceived lack of transparency. This highlights the necessity for increased data transparency. One interviewee expressed astonishment at the fact that guidelines on data transparency are so ill-adhered:

«P3: *According to WCAG etc, when it comes to GDPR and that type of personal data, there are clear directives that say that you should have an easy-to-read text, it should be easy to understand and it should be on the front page. It should not be a pop-up, but it should be directly where you interact. From there, you should be able to move on to the more legal text, but you should have an easy-to-read summary that anyone can understand: what information do you save, for what purpose do you save it, how long do you save it, and so on. And I am surprised that it is so bad. I mean, for the AI tools I've used, it is like they don't even care.*»

Further, respondents reported varying experiences of AI policies at work. While some companies have strict rules against sharing client-specific information, source code, or personal data, others lack instructions, reportedly leading to uncertainty. Some interviewees adapted their own guidelines in the absence of company-wide ones:

«P5: *I try to think carefully about not sharing sensitive data, and also try to be critical, not just take things for granted, but question and maybe search it once to see if it's true.*»

6.1.4.2 Bias and copyright

Concerns about biases in AI-generated images surfaced during the interviews. One respondent shared an experience where an attempt to generate *an image of a group of students solving a problem together* resulted in 25 men with black turtlenecks and Scandinavian origin, highlighting ethnic and gender biases within these systems. Several interviewees stressed the pivotal role of representation in design for fostering inclusivity, emphasizing the need to address bias and stereotypes. As explained by one interviewee:

«P6: *If you don't consider that the data you get may be biased, it could easily spread. The more you accept it, the more likely it is that it will become more frequent. Huge risk.*»

However, one respondent presented a dual aspect of AI's bias tendencies: the potential for AI to be both biased and unbiased simultaneously. They stated that while AI models might reflect biases in their training data, they may also exhibit a level of impartiality superior to humans. Further, the respondent suggested that AI, under

certain circumstances, could have the capability to recognize and avoid stereotypes. This underscores the complexity of AI-generated content, signifying the need for cautious oversight and continuous refinement in their development.

Another aspect discussed regarding AI-generated content was uncertainties regarding copyright and ownership. While some interviewees viewed it with little concern, others remained cautious. In total, none of the interviewees knew what copyright regulations apply to AI-generated material, with some reporting to avoid using AI-generating tools altogether due to the uncertainties:

«P2: *I'm very hesitant to use AI-generated images in my designs, in the final products, just because I have no idea, and I don't think anyone really knows, exactly what the copyright laws are for AI-generated images. [...] I mean, you don't want to accidentally make a customer go down for copyright infringement or something like that.*»

Furthermore, concerns were raised about generative AI models using artistic work for training without compensation, prompting reflections on whether it can be equated with designers drawing inspiration from other's work.

«P7: *But that's a bit unclear. If you train an AI on someone's art - should they get paid for it? I mean, a young student who goes to an art museum and learns how to paint by looking at certain artworks, should they pay that artist because they learned from their artworks? It is difficult.*»

6.2 Reflections on AI's impact on the design process

50 out of the 54 respondents who engage in AI co-creation considered it to have a positive or very positive impact on their work, three remained neutral, and one did not know. Primarily, survey respondents noted an efficiency increase and experienced heightened inspiration. Also, respondents appreciated AI's ability to handle time-consuming tasks, as depicted in Figure 6.4. During the interviews, several highlighted the capacity of AI tools to expedite the beginning of tasks, frequently employing *ChatGPT* to generate first drafts.

The use of AI tools has fostered a new working method. Instead of merely using tools, designers report working iteratively with AI, bouncing ideas off it. This iterative approach is reportedly due to the 'intelligence' of AI tools, the challenge of achieving desired results immediately, and the iterative nature of the design process itself. One interviewee described their iterative process for creating conceptual images using Stable Diffusion and Photoshop, a departure from their prior methods.

«P7: *I usually do a photo batch, where you do a really bad photoshop, like "I need an old man there, I need a roof and a sky and a vehicle in the air over there".*

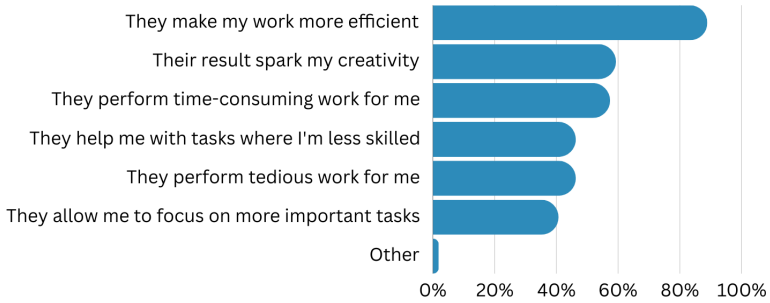

Figure 6.4: Perceived impact of AI co-creation on design work among survey respondents.

And then I send it into Stable Diffusion and let it sort of "think". Often with some kind of function that analyzes the depth of the image and keeps the composition, but varies everything else. And then there is a lot of back and forth. Put the image in Stable Diffusion, take it out, photoshop it again, send it back, take it out, photoshop it, send it back. Yeah, like that. [...] And it's like, that's just because it's much, much faster. I could've just as well photoshopped it myself, nice and precise.»

While receiving optimal results on the first try can be used as creative motivation, similar to the rare occurrence of the first idea being the ultimate design solution, respondents also express frustration with this aspect of AI tools. They struggle with uncertainty, unsure whether the problem lies in their prompt-writing skills or the tool's inability to deliver. One respondent reflected on whether they sometimes spend more time trying to get good answers than it would have taken to complete the task without AI. Another adds that complex programs like Stable Diffusion, which require a lot of computing power, result in long waiting times. Interviewees stated that learning how to write good prompts partially comes from trial and error; for example, one discovered that adding "write short answers" improved the quality of the results significantly. However, the ability to obtain good results also comes from understanding how the tools work and how to apply different prompt rules. One interviewee mentioned the possibility of using AI assistants to generate prompts for other AI tools:

«P7: *You tell it [ChatGPT]: "Now you are going to generate prompts for this [Stable Diffusion]; they should be in this format. This is how such a service works; here are words that make things like this happen." You just paste in a lot of stuff like that, and then you can say that you want a picture of a pig flying and blah blah blah, and then it gives you something like "Pig flying, sunset, magical, sunlit, 8K, realistic, HDR" and so on [...] it works quite well sometimes.*»

One interviewee described an intriguing shift in their approach to UX problems since they began using AI assistants: they sometimes frame these issues as prompts, i.e., consider how they might articulate the problem to an AI assistant. This novel perspective was reported to be highly effective in problem definition, offering a fresh, innovative approach to formulating a problem statement.

Further, interviewees indicated that AI co-creation prompts more independent work, reducing the need for immediate collaboration or peer input. This newfound independence was perceived as empowering and time-saving, allowing for longer individual ideation before seeking external perspectives. However, concerns surfaced about the potential loss of shared understanding in collaborative dynamics, especially in tasks that benefit from being done collectively, like affinity mapping. One respondent highlighted this drawback:

«P5: *You lose some of the benefits of structuring together [if you use AI]. Coming up with how you associate things with each other together and getting an overall picture as a group. How things are connected. If you only use AI, you skip that step, and then you don't get that facilitation, so I would say that's a disadvantage.*»

However, it should be noted that all interviewees highlighted their continued appreciation for peer input, even if it is requested later on in processes and even if they use AI tools, emphasizing the enduring importance of human collaboration.

6.2.1 Risks and ethical reflections in integrating AI tools in design practices

During the interviews, reflections emerged regarding integrating AI into the design process, addressing potential risks and challenges. Respondents expressed how AI may enhance skills, particularly benefiting non-experts by elevating their foundational level. However, they believed that for advanced users, the transformative impact of AI may be less significant.

«P7: *I think it's good, I think it helps a lot of people who have low, what can I say, people who are new in their career and haven't learned much yet, they quickly get up to a higher level compared to before. But for someone with a lot of experience, I don't think it makes that much of a difference. Like, the world's best illustrator doesn't need AI, but someone who can't illustrate at all can suddenly make a decent illustration. The minimum skill level is raised a lot with these tools, I think.*»

Additionally, there were contemplations on whether an overreliance on AI might lead to a lack of personal challenge, potentially hindering the pursuit of optimal solutions:

«P4: *[I also] think that there is a risk that you don't challenge yourself enough. [If] you always take the faster route then maybe you don't find the best solutions but just take one instead.*»

Further, one interviewee stressed the importance of having foundational knowledge before employing AI tools, stating that it helps one assess and be able to discover when AI produces faulty results. Another made the following reflection on knowledge loss due to AI involvement:

«P7: *But, there are always risks, are you getting less good at something just because*

you use tools that solve it for you? I noticed that ten years ago when I did UI designs daily, I was perhaps better at it than I am now because now I am a little further back in the chain and help and guide others who do it instead. I am still involved in doing it, but it is a bit like I am the one telling them what to do, and it is perhaps a bit the same with AI tools. I tell the AI what to do, and that may cause me to lose some skills. But, like, who has done it, then? I mean, I take credit for something we've done together [in a project] even if I'm not the one who did the sketches, for example.»

Another area of concern highlighted the potential shift in the structure of design roles within organizations due to AI integration. While interviewees did not fear job displacement themselves, some foresaw a consolidation of different design professions into singular roles, potentially concentrating various specialized design tasks under one person's responsibility.

«P5: *Like copywriter, that might be [a role] that I cover now instead of having an external one because I can do pretty good texts with AI. I imagine that different design roles will be concentrated around one person instead of several people working on their areas. It feels like that could be a risk.*»

Further, several interviewees made remarks about the rapid development of AI and the difficulty of keeping up with it. P3 explicitly labeled it as «*Difficult and very time-consuming*». Another interviewee explained that:

«P6: *People have posted quotes like "if you don't use it [AI] you will be replaced by someone who already uses it" so then I feel like I really have to use it as a tool otherwise I won't keep up with the development. It's still very new to me, but I don't feel hateful towards it, but it's a bit scary and stuff.*»

While several interviewees were encouraged by their employers to explore AI tools, some explained that in reality, it is not feasible. As one survey participant commented:

«*I've wanted to put more time into digging deeper into the "How to optimize my work by using AI", but I do not get the time that I need to learn during work hours. Would love to know more!*»

P2 and P3 seconded this and stated that they currently try out AI tools in their spare time when time permits, due to the unavailability to do so during work hours. It was suggested that instead of simply encouraging the exploration of AI tools, employers should explicitly provide dedicated time for it. This need was also indicated in the survey, where the reported main reason for not engaging in AI co-creation was a lack of time to explore AI tools.

Lastly, the environmental impact of AI processes surfaced as an under-discussed issue. Participants emphasized the excessive computational power required for ren-

dering and searches, leading to environmental costs that are often overlooked.

«P6: *And one thing that I think is addressed far too little is the environmental aspect because executing a rendering takes a lot of computing power. Similarly, performing a search takes a lot of data, and in a world that is getting warmer by the day, it may not be entirely justifiable to do that all the time, so you have to think about the cost. And I think we don't talk about this environmental cost enough.*»

6.3 Considerations and recommendations regarding AI co-creation in web design

This section presents practical recommendations and considerations, addressing concerns and opportunities for AI co-creation in design practice. They are derived from a compiled understanding obtained through the analysis of the literature review, survey, and interview study. To clarify, these are not intended as mandatory requirements but rather as suggestions to take advantage of the benefits that emerged during the study and attempt to minimize potential risks.

6.3.1 For design practitioners

Recommendations for design practitioners leveraging or contemplating using AI tools within their design process are provided below. These address keeping up with AI product development, concerns, and how AI may be used to augment design work.

1. **Consider using conventional tools in favor of AI tools.** Respondents reported feeling stressed regarding staying informed of AI advancements in design tools (Section 6.2.1. Additionally, examples were given of occurrences where AI provided poor, false, or biased results (Section 6.1.2 and 6.1.4.2). Therefore, I recommend considering whether engaging in AI co-creation is optimal for a task, recognizing that a conventional tool may be more effective or less prone to produce flawed results.
2. **Consider leveraging AI to increase the efficiency of task initiation.** Participants stated they experienced a shorter time between task start-up and first drafts. This perceived increase in efficiency was one of the core benefits of AI co-creation discovered during the survey and interviews (Section 6.2). This potential benefit is also supported by literature, where task efficiency is mentioned as one of the main impacts of AI co-creation [38].
3. **Explore AI's ability of skill enhancement.** Figoli et al. suggest that AI co-creation may be used in a complementary way [38]. In addition, interviewees provided examples of when they use AI tools to enhance their proficiency, such as copywriting and illustrating (Section 6.1.2).
4. **Maintain a critical approach to AI-generated results.** A frequently mentioned risk of using AI tools was the occurrence of poor, false, or biased results (Section 6.1.4.2). To avoid implementing these types of results in

projects, it is important to remain critical of AI-generated content and perform thorough reviews to prevent the spread of biases and false or skewed information.

5. **Prioritize learning the craft before relying too heavily on AI tools.** Interviewees reflected upon potential knowledge loss due to the use of AI (Section 6.2.1), with P6 emphasizing that possessing foundational knowledge may aid one in assessing the quality and truthfulness of AI-generated content. Literature also suggests that domain knowledge is integral to effectively leveraging AI tools [39].
6. **Before engaging in AI co-creation, consider evaluating how it may affect collaboration in the project.** While literature suggests that AI co-creation may enhance the performance of low-performing teams, it also highlights the potential drawback of reduced human effort in high-performing ones (Section 3.1). In addition, P5 emphasized the potential risk of decreased knowledge-sharing in collaborative tasks when AI is introduced (Section 6.2). Therefore, I recommend conducting a preliminary analysis before introducing AI to collaborative tasks to identify potential areas that may be influenced.
7. **When engaging in AI co-creation, explore an iterative work method and prioritize improving prompt writing.** Interviewees reported obtaining desired results when working iteratively with AI tools instead of attempting to receive successful results on the first try. Additionally, they declared that learning efficient prompt writing improved their ability to achieve better results (Section 6.2). Using an iterative work method with good prompts may therefore be an advantageous approach when engaging in AI co-creation.

6.3.2 For employers of design practitioners

Emphasizing company-wide guidelines, continuous learning opportunities, and ethical considerations, the following recommendations aim to streamline the potential adoption of AI tools, targeting employers of design practitioners.

1. **Consider implementing policies on AI tool usage.** Participants expressed uncertainty about AI-generated content copyrights and sought guidelines on AI co-creation to prevent, for example, accidentally violating company security rules (Section 6.2.1). Implementing policies regarding AI tool usage, involving staying informed on copyright laws related to AI-generated content, may foster a more secure and informed work environment. This could enable increased confidence and compliant use of AI tools, or, in the case where AI tools are not allowed, explain as to why.
2. **Consider giving time and opportunity to employees to explore new tools.** To decrease stress and pressure to constantly keep pace with AI advancements in the design field, as reported by the respondents, consider providing dedicated time, workshops, and training events to explore and adapt to new AI tools (Section 6.2.1). An example of how to playfully introduce AI tools to employees was given by P7, who mentioned that their company organized an event where employees explored various image-generation tools and

then collectively guessed which song lyrics the images were prompted with. By providing foundational experience with, in this case, image-generation tools, all employees received new additions to their toolsets.
3. **Consider encouraging discussion surrounding AI and AI tool usage.** I recommend promoting an open discussion about AI and its application in design practices, as it may foster a culture where employees feel comfortable sharing concerns, experiences, and ideas related to AI tools. Ultimately, this can leverage existing and new AI co-creation knowledge in the organization to help form relevant policies, linked to item number 1.

6.3.3 For companies providing AI co-creation tools

Addressing AI tool providers, the following recommendations advocate for transparency, user control, and environmental responsibility, urging AI companies to prioritize ethical usage and minimize environmental impact in their tool development and deployment.

1. **Increase transparency regarding data privacy and usage, and provide the option to control when and how data is used.** One of the main reasons respondents opted not to use AI tools is a perceived lack of control and uncertainty regarding data privacy (Section 6.1.4.1). Giving users greater control over their data and offering clear insights into data usage implications can enhance trust and satisfaction, potentially expanding the user base.
2. **Consider environmental impact.** Address the environmental footprint of AI tools by considering server locations and ethical considerations and exploring ways to minimize energy consumption. Companies must take responsibility for their environmental footprint, which extends to digital services often overlooked in sustainability considerations.

6.4 Potential applications of AI for web design

In addition to the proposed considerations and recommendations, several novel application areas for AI were discovered during the interview study. One suggestion was to use AI to improve the process of ensuring designs and code adhere to accessibility standards like WCAG. This could be done by leveraging AI algorithms to identify potential accessibility issues and recommend corrective measures, however, leaving decision-making to the designer. Another suggestion was employing AI algorithms to cross-reference design elements in prototypes with the code. Several interviewees expressed that ensuring the correct implementation of their designs often led to time-consuming back-and-forth with developers. Tools to aid in this process could, therefore, contribute to bridging the gap between design prototypes and the actual implementation in code.

Further, many potential applications were regarding prototyping tools like *Figma* and *Adobe XD*. For starters, AI may be used to automate connecting wireframes by identifying their contents and establishing connections. This feature could enhance

efficiency in prototyping by reducing manual labor. However, it is important to note the potential downside of requiring thorough double-checks of potential errors. Moreover, AI could assist in refining mid-fidelity wireframes by optimizing layout, suggesting color schemes, or offering style recommendations. This could elevate the overall visual appeal of mid-fidelity wireframes, useful for client presentations, ultimately saving the designer time. While respondents expressed a desire for quick enhancements to low- and mid-fidelity wireframes, they acknowledged that it might cause clients to fixate on a specific appearance rather than remain open to new designs further on. This aspect highlights one potential risk of a 'beautification feature'.

Furthermore, AI could assist in automating sample data input in wireframes, enabling designers to quickly visualize content layouts and structures without spending excessive time on data population. Lastly, the suggestion was made that AI could facilitate the translation of design system components into wireframes, maintaining consistency and coherence. This integration could ensure that designs comply with the design system and increase prototyping efficiency, given that many companies keep part of their design systems in wireframing tools like *Figma*.

7
Discussion

The following chapter discusses the methodology, execution, and study outcomes. It explores the effectiveness of the chosen methods and examines how different approaches might have influenced the results. Additionally, it delves into factors that affected the study outcome. These include designer's use of AI, unexpected discoveries, alignment with expectations, identified risks, comparison with theory, and potential future research.

As a reminder, the research questions discussed are:

- *To what extent do web design practitioners engage in AI co-creation, and how do they consider it to impact their design processes?*
- *According to design practitioners, what are important considerations regarding AI co-creation in web design?*

7.1 Designer's engagement with AI

Consistent with the theory, this study demonstrated that human AI co-creation is used in a complementary way. For example, copywriting was considered the most common task to use AI for, even though participants reported that this task accounted for a rather small part of their work. Some designers expressed that coming up with copy was difficult; however, they perceived themselves as experienced enough to recognize when it had been done poorly. Combined with text generators currently being one of the more advanced AI tools, this demonstrates the *AI>Human rule* in play, i.e., the suggestion that using AI is most effective when AI is more performative than humans in specific tasks. In this case, the tool performs better in coming up with copy, and in turn, designers are experts in editing and evaluating its quality. This example enriches the literature by providing a contemporary and relevant perspective.

By far, the most prominent benefit of AI co-creation was the perceived increase in efficiency. More precisely, it is in the quickening of task initiation and assistance with regaining inspiration after creative blocks rather than the expediting of tasks where designers primarily experience this benefit. This offers a more nuanced understanding of task efficiency in AI co-creation. Moreover, designers leverage AI for 'risk-free' tasks like removing image backgrounds, undoubtedly accelerating processes. However, AI's limitations prevent widespread trust in handling larger, impactful tasks such as user research analysis and intricate UI design. Most designers expressed

skepticism and caution regarding generative tools able to perform these types of tasks. Notably, while both content editing and content generation by AI can yield poor results, the potential negative consequences from inadequacies in generative AI might be more significant if undetected.

While this study has not profoundly explored AI's impact on team performance, interviewees did discuss similar phenomena as Figoli et al. but on an individual level. They argued that AI might have a positive effect on less experienced designers while not notably improving the work of highly experienced designers, compared to theory, where it is reported that AI may enhance the quality of work in low-performing teams but negatively affect high-performing ones. However, with the extent of this study, one can not conclude whether the two correlate, as it is not necessarily the case that a team of inexperienced designers equals a low-performing one. Beyond performance, AI's impact on collaboration was discussed, particularly regarding knowledge sharing and loss. This is an interesting and relatively unexplored aspect of AI co-creation, emphasizing the benefits and importance of working together on specific tasks, such as analysis, during the design process.

7.2 Perceived risks and responsible use of AI

Compliant with the debate regarding AI and copyright laws, participants were divided on the subject, one part being whether AI companies should compensate artists for training models on their work, the other being if AI-generated content should be subdued to copyright laws. While some considered it evident that artists should be compensated, others likened models being trained on artworks to humans taking inspiration, which is not forbidden. This analogy prescribes a sort of "humanness" to AI models. In a way, it could be seen as an elongation of human inspiration search. Instead of observing a collection of items and deriving your work based on the impressions, a model collects inspiration for you, creates a compiled version, and then you continue the work from there. However, this may be more morally acceptable on a small scale and is also seen from an image-centric perspective. There have been cases where AI models have reproduced precise phrases found in online articles, which is blunt plagiarism [67].

Contrary to research suggesting that a fear of job displacement may hinder designers from engaging in AI co-creation, ambiguity regarding copyrights of AI-generated content and lack of transparency regarding data security were found as possible contributing factors. A significant part involves not wanting to compromise client relationships by accidentally sharing sensitive data or setting them up for copyright infringement by including AI-generated content in end-products. While the rules on data security remain unclear, one does not break copyright laws by using AI-generated content. However, exclusive rights can not be obtained. This illuminates the need for increased transparency and control in AI products and the necessity of education and information.

Rather than feeling threatened by AI, as suggested in the literature, many intervie-

wees felt stressed and concerned about the rapid evolution of AI products. Possibly, designers are more afraid of being replaced by another designer using AI than AI itself - aligned with the popular quote «AI will not replace you; a person using AI will» [68]. It would be interesting to explore this further and, in hindsight, whether participants a. fear being replaced by someone who uses AI and b. whether this potential fear impacts to what extent they use AI could have been inquired in this study. Further, the survey and interview results hinted at a large difference in AI maturity among designers. On one hand, some participants had little experience with AI tools, receiving a small amount of time to explore new technologies. On the other, others were encouraged by their employers to explore, received opportunities to learn, or were in other ways actively engaged in keeping up with AI's rapid development, thus being more advantageously positioned to assess if and how new technologies may be used to augment their work. The raised concern that several design roles may be merged due to AI comes into play here. On the basis that designers who encompass multiple roles are most likely recruited for their multidisciplinary expertise, domain knowledge will still be needed to evaluate the quality of the results in the event of professions being replaced by AI use (Section 3.1), thus creating a demand for multidisciplinary designers with AI co-creation in their skill set. I do not perceive it unreasonable that companies with low design maturity will value reduced expenses over several niche design experts and, therefore, see this as an opportunity should AI products become good enough. This raises the question of whether designers or companies with high AI maturity will be better set for the future.

As mentioned in the result (Section 6.2), the majority of interviewees struggled with uncertainty in determining whether a poorly generated result was due to their lack of knowledge or the poor performance of the tool. This demonstrated that they lack the *Experience* aspect of S. Freese's *Effectiveness Trilogy* described in Section 3.1. While it is suggested that one can leverage AI effectively while only possessing two of the three components (as a reminder, the others are *Expertise* and *Usability*), I would say that possessing the *Experience* component offers a significant impact compared to the others. Surely, critically evaluating AI-generated results is integral for error prevention, and an intuitively designed tool benefits any product. However, without the skills to exploit as much of a tool's potential as possible, thus receiving poorer results, I would argue that critically assessing its quality is not nearly as important. For a poor result of a user research analysis with far-fetched conclusions or even a complete prompt misinterpretation, recognizing that the result is incorrect is rather easy. However, for a nuanced and seemingly good answer, noticing nuance differences, possibly with major consequences, may be more difficult. The misleading conclusion of the seemingly accurate analysis made by *Miro* AI is an example of this, mentioned in Section 5.5. To recall, *Miro* AI correctly concluded that participants expressed a desire to learn and stay updated with AI advancement in design. However, it falsely added that there was a desire for an AI tool to meet this desire.

Lastly, I agree with the one interviewee who emphasized the importance of address-

ing the environmental impact of using AI. With them being the sole participant to mention the environmental impact as an AI risk, they demonstrated how disregarded the subject is. For context, researchers from the University of Massachusetts have shown that training advanced AI models can emit almost as much greenhouse gases as five cars do during their lifetimes [69]. As humans are closing in on 1.5 degrees of global warming, it should be standard practice to consider the environmental impact, in this case, for the use of AI services. I consider it worth examining if and how UX and UI design solutions, such as Carbon Footprint Visualizations, may be used to affect user behavior for AI services.

7.3 Evaluation of methods and process

The initial listing of currently existing AI tools revealed a notable presence of tools with image or video editing and generation capabilities, or those designed for user feedback analysis, as mentioned in Section 5.2. Beyond providing an understanding of the state of play and enabling relevant multiple-choice alternatives in the survey, it facilitates future comparisons. Thus, this allows for the identification of changes in the prevalence and types of tools over the years. While the quantity of tools within a category may not directly correlate with their practical use or effectiveness, it serves as an indication. Categories may disappear or emerge, applying AI in novel ways. Perhaps the abundance of AI tools declines, centering on a few key tools. Ultimately, it will be interesting to observe how this market evolves.

While the survey gained 71 responses, which was considered sufficient for the scope of this study, this represents a fraction of the potential audience, hinting at the challenge of participant engagement within the broader target population. This challenge mainly affected the survey duration (26 days); for example, 50 percent of the answers were collected during the last ten days. Additionally, survey participant's interest in interview participation was low (22 percent). As neither survey nor interview participants received any compensation for participating, it depended solely on their 'goodwill'. Offering some compensation may, therefore, have raised the incentive to participate. In particular, offering compensation to interviewees could have benefited the study. Without it, much time was spent contacting and reminding those who had expressed interest, and there was a lot of downtime between interviews. In retrospect, a gift card lottery, or the like, could have been offered. Additionally, all but one interviewee used and had a neutral to positive outlook on using AI for design work. Therefore, gaining perspective from practitioners who a. feel resistant towards using AI, or b. perceive a neutral or negative impact of AI on their design process could have offered valuable additional perspectives to understanding the extent to which designers engage in AI co-creation, possibly uncovering new or highlighting identified important considerations.

The use of semi-structured interviews worked well. The interviews diverged somewhat from each other while the core remained the same, resulting in comparable results but wide coverage. However, conducting one or more additional pilot interviews could have been beneficial, possibly with individuals who had not participated

in the survey, to gain novel perspectives on the interview format and the questions. On the other hand, I perceived it to be more effective to base the questions on the interviewee's survey responses, as it allocated more time for the interviewees to reflect and give more thorough explanations than to provide foundational information.

During analysis, some gaps between the survey and interview responses were identified. While the purpose of the survey was to obtain an understanding of the general attitude towards AI co-creation and asses for which tasks AI tools are used, the analysis would have benefited from additional coverage. For example, obtaining data on which conventional tools and methods the participants used would have enabled me to assess better if and how AI tools replace them or are used as a complement. Also, enquiring whether respondents know for sure when they use AI would have provided a nuanced picture of to what extent AI is used. On one hand, practitioners might use AI more than they think; on the other, advanced technological features may be confused with AI. Moreover, for the multiple-choice questions « *What tasks does your work include?*» and « *What tasks do you use AI tools or AI-supported features for?*» in the survey, some respondents chose to include free-text answers. Upon reviewing the answers, I found most of the free-text ones to overlap with the pre-filled alternatives. For example, the free-text answer *Designing web views* versus the pre-filled *UI design*. This indicated that short explanations of what I perceived to be included in the tasks could have been added. Alternatively, more research should have gone into compiling the list to ensure the tasks were optimally named. Lastly, respondent's understanding of the copyright laws regarding AI proved to be a contributing factor in whether and how certain generative tools were used. Surveying this topic would have added an interesting quantitative insight into whether or not practitioners, in general, are aware of the copyright laws surrounding AI.

Other considered methods, such as observations and diary studies, might have been viable for this study. Observations would have allowed participants to thoroughly demonstrate how they conduct specific tasks, for instance, by sharing their screens during interviews. While it would have been interesting to observe how practitioners integrate AI tools in their workflow, many interviewees worked with classified projects; thus, recruiting participants would have required an alternative approach. Alternatively, participants could have been assigned fictional tasks, requiring a different preparation approach, which would have been difficult since the extent of AI co-creation in the target group was relatively unknown before the study. Furthermore, diary studies could have identified potential temperamental responses and emotional aspects towards AI co-creation. For example, do the participants experience irritation, satisfaction, or other emotions when engaging in AI co-creation? Additionally, this method could have obtained more detailed descriptions of AI use cases. While observations and diary studies offer the potential for enhancing the understanding of AI usage in web design, their inclusion was not feasible in addition to the chosen methods considered more beneficial for the study.

7.4 Future work

This study discovered several aspects for future research regarding AI co-creation. Firstly, the aspect of company culture regarding AI was not extensively addressed. Potential lies in surveying the impact of company culture on AI co-creation among designers. This could contribute to a more holistic understanding of what motivates designers to engage in AI co-creation.

Secondly, the raised concern about AI's impact on knowledge sharing and loss poses an interesting possibility to investigate the impact of AI co-creation on collaboration further, focusing on process as opposed to results alone. Such understanding opens up the potential for frameworks on how AI co-creation in collaboration may augment rather than replace designers or deteriorate results, if at all.

Thirdly, examining how information visualization could be utilized to increase the transparency of AI's environmental impact is relevant considering the current climate situation. It would be exciting to investigate how this may affect usage patterns of AI tools or if there are other ways to foster a more conscious use of digital services.

Lastly, the instance where *Miro* AI showed bias towards AI coupled with the interviewees mentioning a paradoxical aspect of AI's ability to both reinforce and prevent bias has potential for further research. While not being the core focus of this study, this tripartite antithesis raises the interesting question of «*How can we ensure not to reproduce human biases in AI models, as well as leverage AI to reduce bias while simultaneously ensuring that the technology is not biased towards itself?*».

8

Conclusion

This thesis set out to identify the state of play of AI co-creation in web design by using a mixed-method approach. The aim was to offer a starting point for leveraging of AI tools within the web design domain through practical recommendations. Following the existing research-practice gap in HCI, the study also focused on understanding concerns and opportunities as perceived by design practitioners. In doing so, this study would provide a basis for future research in AI co-creation, as it gives a more detailed idea of where the gap persists moving forward. Beyond aiding future research, the opportunities and concerns identified in the study may be of interest to both employers of design practitioners and design practitioners themselves.

The study results showed that more than two-thirds of design practitioners engage in AI co-creation and that it is applied during virtually the entire design process. It identified for which tasks designers reported AI co-creation to be effective. Additionally, although niched AI-supported tools exist, such as user feedback analysis solutions or color palette generators, designers prefer tools at present that may fulfill several tasks, for example, AI assistants. This study indicated that this is due to a. designers not having the resources to explore a variety of tools and b. AI assistants like *ChatGPT* currently belonging to the more advanced tools.

A vast majority of participants considered AI co-creation to have a positive impact on their work. In particular, they perceived the ability to expedite task initiation, recover from creative blocks, and work iteratively with generative AI tools as the main benefits. However, the participants also raised concerns regarding data privacy, the debate on copyright and AI-generated content, knowledge loss, and the environmental impact of training AI models. Additionally, some experienced uncertainty regarding whether they should and how to best utilize AI tools for their work, in combination with feeling stressed about the rapid evolution of AI services. Contrary to existing research, the results of this study suggest that it is a lack of data transparency and uncertainty regarding copyrights that makes designers refrain from engaging in AI co-creation, as opposed to fearing job displacement. Further, designers do not worry about being replaced by AI; if any, it is being replaced by those who use it.

The analysis of the quantitative and qualitative study resulted in seven recommendations regarding AI co-creation for designers, three for employers of design practitioners, and two for AI services. They serve as a first draft for enabling the industry to better adapt to the technology change, taking an open-minded yet critical stance.

For designers, the recommendations address considerations before and during engagement in AI co-creation, while for employers they provide general suggestions on how to create a more accommodating environment. In contrast, the recommendations for AI services center on data privacy and environmental impact.

Lastly, six potential novel applications of AI to aid designers were found. Four of these concerned features in digital prototyping tools, one identifying accessibility issues, and one ensuring correct implementation of designs into code. However, more work needs to be done to be able to properly evaluate the viability of these proposals.

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A

Appendix A - AI tools

Table A.1: All registered tools categorized according to tool type.

AI Assistants	**Color Palette Generators**
ChatGPT	Colormind
GeniusUI	Components AI (include component generating features)
Grain.co	Grammarly
Invision	Huemint
Mem	Khroma
Miro AI	
Notion AI	
Otter.ai	
Scispace Copilot	
Speak.ai	
Content Generation	**Copy Generators**
ContentBot	Acrolinx
Jasper AI Art	Article Forge
Writesonic	Copy AI
QoQo.ai	Elementor AI
Zyro	Frontitude UX writing
	Lokalise
	Magician Dot Design
	Rank Math SEO
	WordLift
	Writer
Image/Video Editors	**Image/Video Generators**
Adobe Firefly	Animaker (include editing features)
BeFunky	Art by Deep AI
Canva AI	Artbreeder
VistaCreate (Crello)	Astria AI
Deep Art Effects	AutoDraw
Design Wizard	Dall-E
Fotor	Deep Dream Generator
Corel Vector (Gravit Designer)	Designs AI

Let's Enhance
Movavi
Nero AI
Remove.bg
Sensei by Adobe
VanceAI
Vectr

Product Testing Services
Attention Insight
Google Optimize
Hotjar
Maze AI
Mixpanel
Mouseflow
Nelio A/B Testing
Neurons Predict
Notably.ai
Optimizely
Phrasee
Research AI
Screpy
Symantec
Synthetic Users
UClassify
UXCam
Visual Eyes (now part of Neurons)
VWO

Website Design generators
10Web
AppyPie
Bubble
Debuild
Dora AI
Flair AI
Freepik AI image generator
Human Generator
Illustroke
InVideo (include editing features)
LimeWire
Midjourney
NVIDIA Canvas
PatternedAI
Pixlr (include editing features)
Recraft.ai (include editing features)
Runwayml (include editing features)
Scribble Diffusion
Stable Diffusion
This Person Doesn't Exist

User feedback Analysis
Ask Viable
Chattermill
Dovetail
Enterpret
Get Amped Research (Amped AI)
HeyMarvin
Kraftful
Lookback
LoopPanel
MonkeyLearn
Optimal Workshop
Refiner
Remesh
Revmap
Smartone
Sprig
Get feedback (Usabilla)
User Evaluation
Userlytics
UserTesting
UserZoom (Now part of UserTesting)

Wireframing Tools
Balsamiq
Figma
Galileo AI
Marvel AI
Microsoft Designer

Durable	Mockplus
Framer AI	Mokkup.ai
Hostinger	Prototypr AI
Wix ADI	Sketch to Code
	Teleport HQ
	Uizard
	Visily

Other Beautiful.ai (presentation generator) Brainpool (designprocess automation) DomainWheel (website namn generator) Easil (drag and drop designer) Fontjoy (font pairing generator) Fronty (image to code) Landbot (no-code chatbot builder) Lobe (ML model generator) Logo Lab (Logo Analyzer) Looka (Logo and brand generator) Magic Brief (Ad inspiration and brief generation) Postcards AI (email template builder) Stylebit (Design system generator and organizer) UserDoc (User stories, personas, and journey generator)	

B

Appendix B - Survey results

AI Tool Usage in Digital Design Survey

74 responses

What is your job title or role?

74 out of 74 answered

Graphic-, UX- and Dataviz-Designer

UX Design Student

UX -student

Marketing Coordinator

UX designer

UX Designer

Ux intern

Senior UX Designer

UX designer / Human Factors designer

Partner

Product Manager

UX/Service Designer

UX Designer student

Senior UX designer

ux designer

Head of UX

UX designer

Gränssnitutvecklare

Digital content designaer

Design Lead

Product Design Manager

UX Strategist

UX Designer

Principal UX researcher

Product Manager

UX designer

UI/UX designer

CEO

UX senior

UX Designer & Projektledare

User Experience Manager

UI designer

Senior Accounts Payable

UX designer

UX writer

Ux Designer

UX Designer

UX Designer

UX designer

Webdeveloper / graphic designer

UX Designer

UX and Visual designer

UX designer

Product design Lead

UX designer

UX Designer and Researcher

Digital Designer

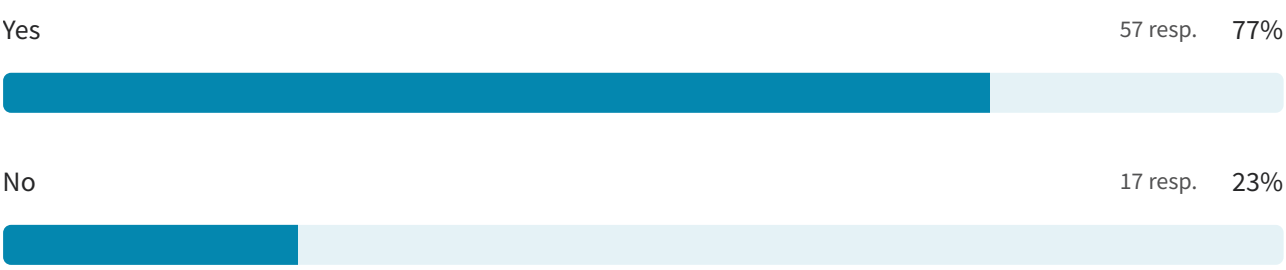
Design Director

Webbdesigner

Product designer

Do you work with web design?

74 out of 74 answered



How many years of experience do you have in web design?

56 out of 74 answered

9

less then one

0.5

3

1

0

6

5

1

7 years

2

20

2

About 3 years

20+

20+

16

3 years

3

almost 2 years

4 år

1

2

5

3

4

12

4

12

6

2

5

4

5

1

12

6

5

2

2

5

2

5

3 years

3

1-2

10

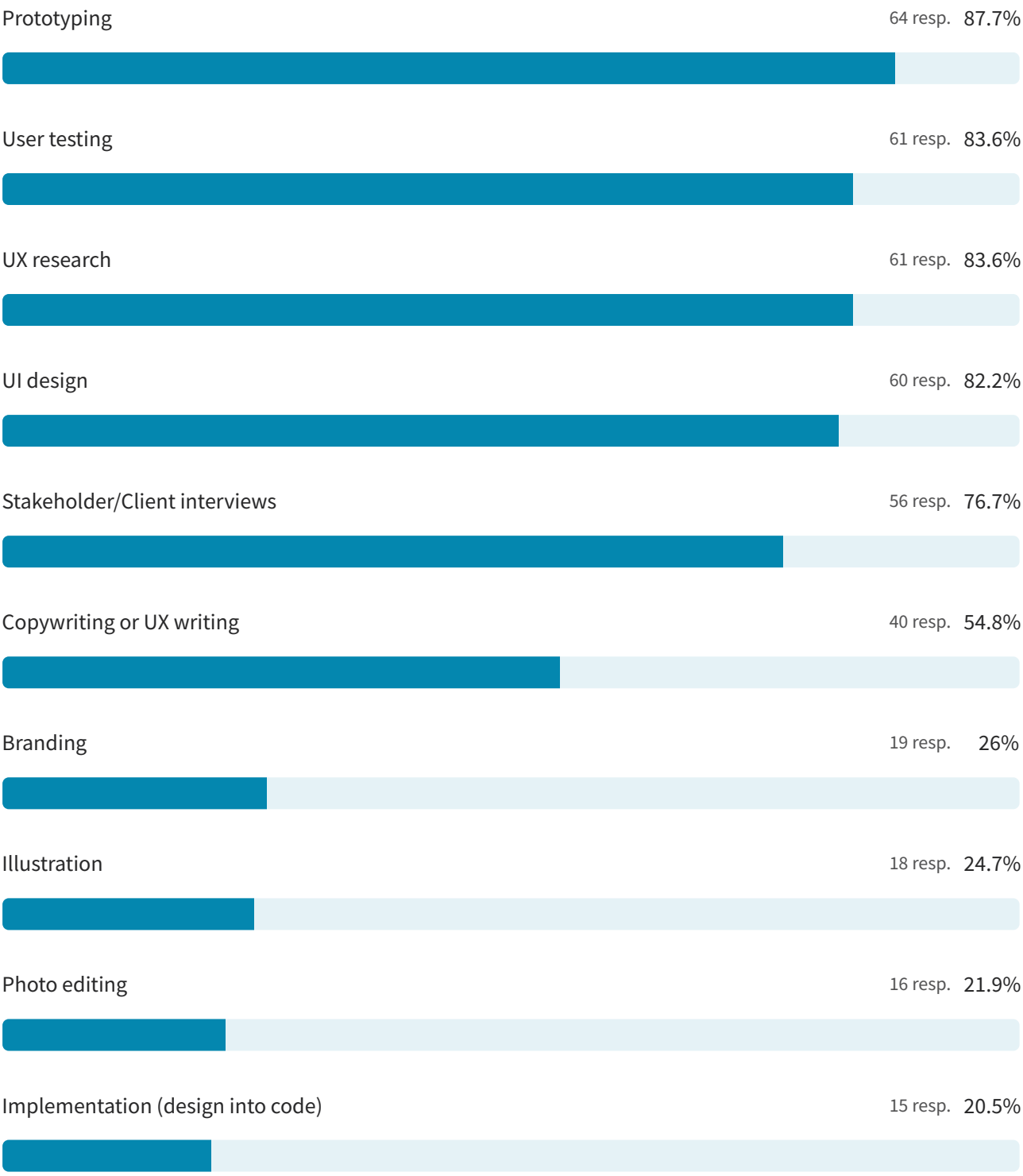
10

5

7 (excluding studies)

What tasks does your work include?

73 out of 74 answered



Other 6 resp. 8.2%

Project Managament; Print Design; Graphic Content (Banner, ...);

Presentations and backlog

Workshops

Education & system support

Partially helps with product owner tasks and marketing

Designing web views is what I mainly do

Do you currently use AI tools or AI-supported features in your work as a _____?

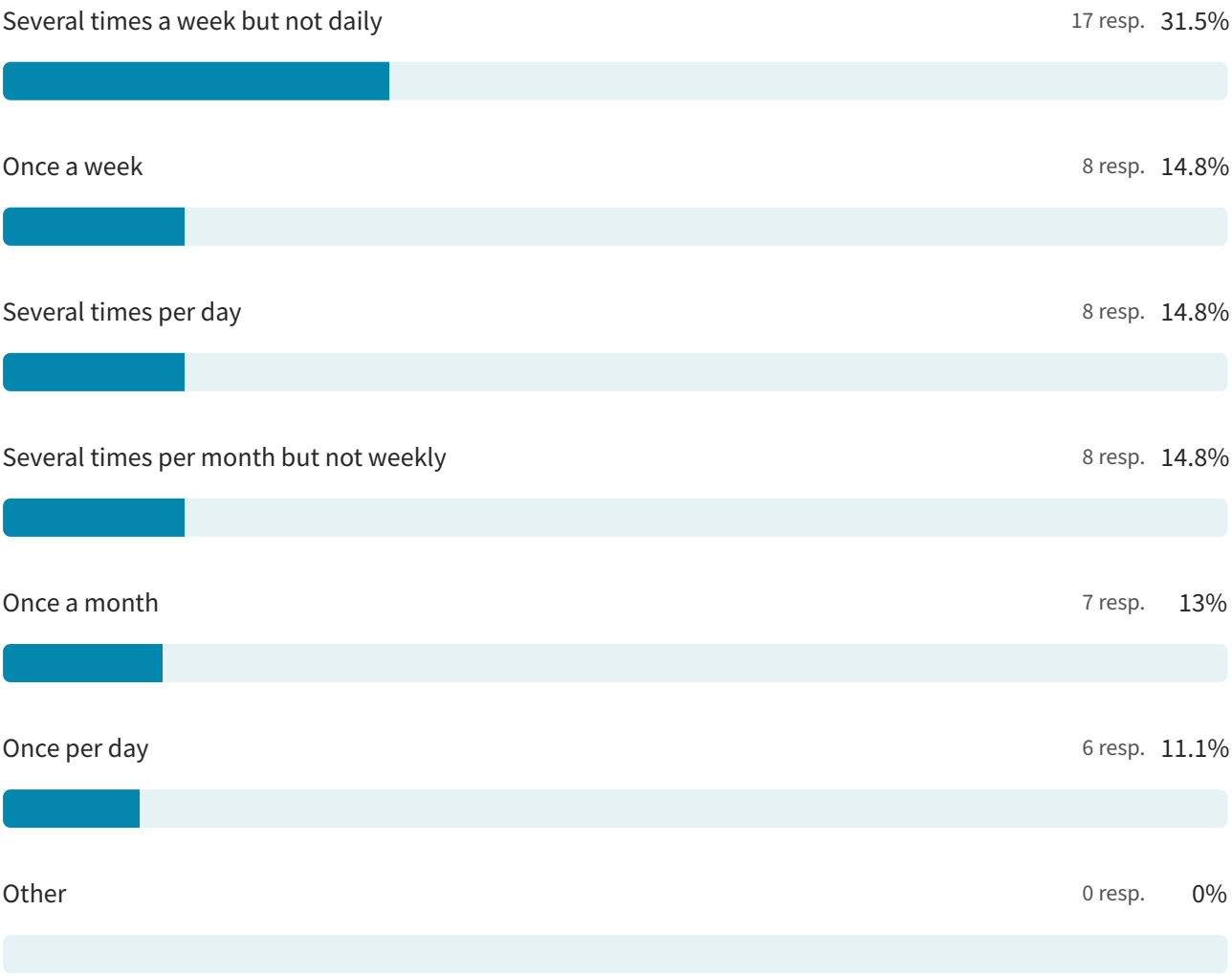
74 out of 74 answered

Yes 54 resp. 73%

No 20 resp. 27%

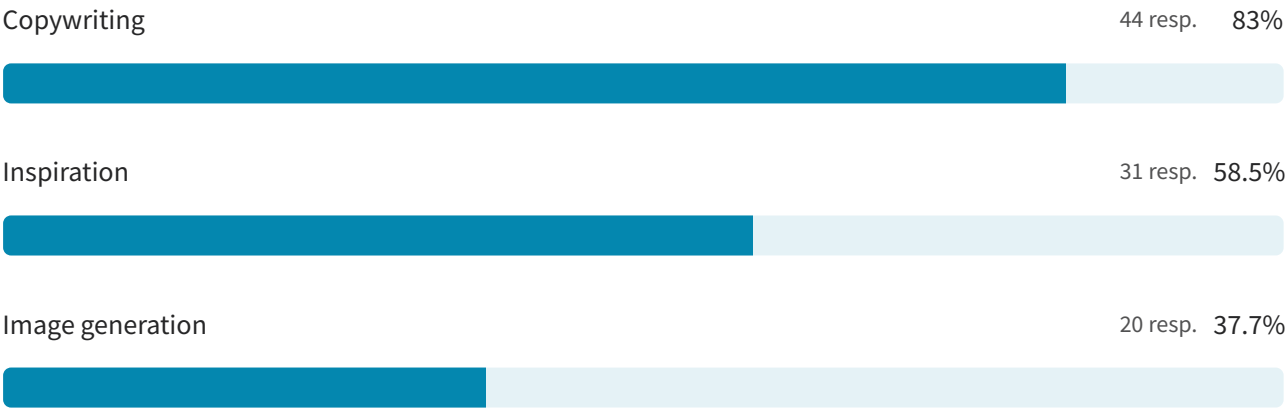
How frequently do you use AI tools in your web design projects?

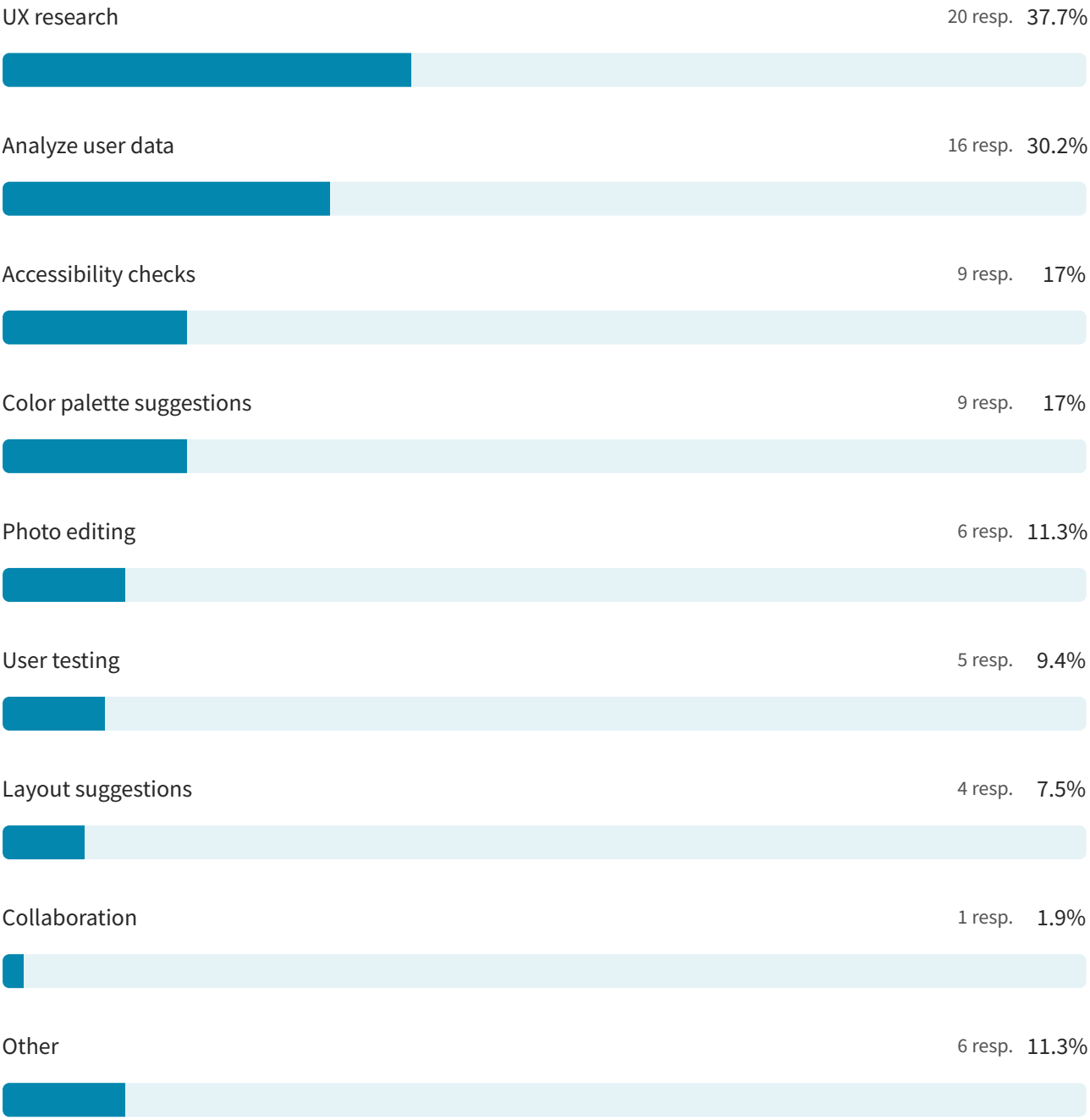
54 out of 74 answered



What tasks do you use AI tools or AI-supported features for?

53 out of 74 answered





Templates for UX Research methods such as generating User stories from the data I give it. Or giving a foundation for a UX research plan.

brainstorming, iterations, problem solving, design system,

Skapa presentationer och skriva guidelines

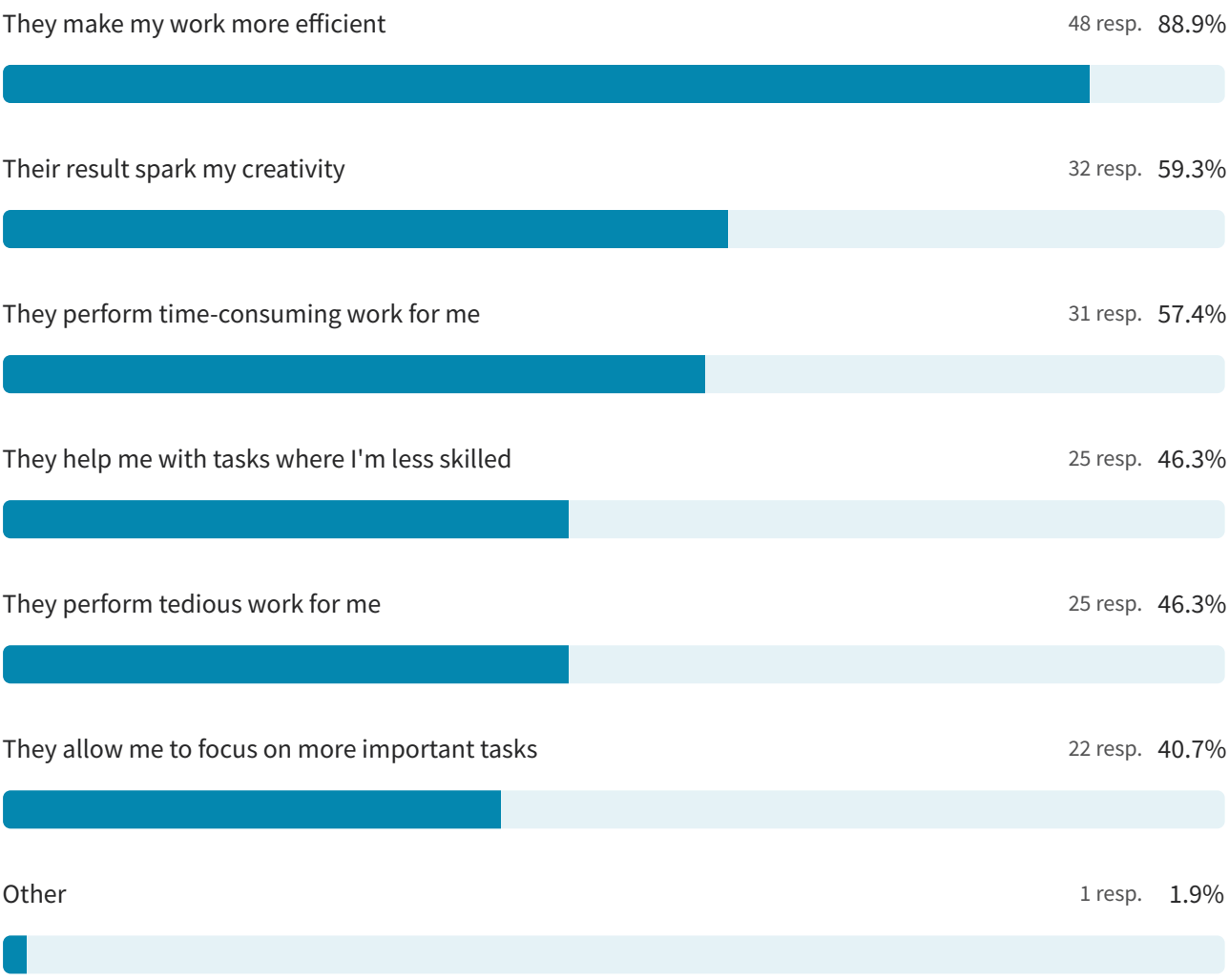
Code

Code exolanations

Generate user journeys, come up with questions, review questions

Why do you use AI tools for this/these task(s)?

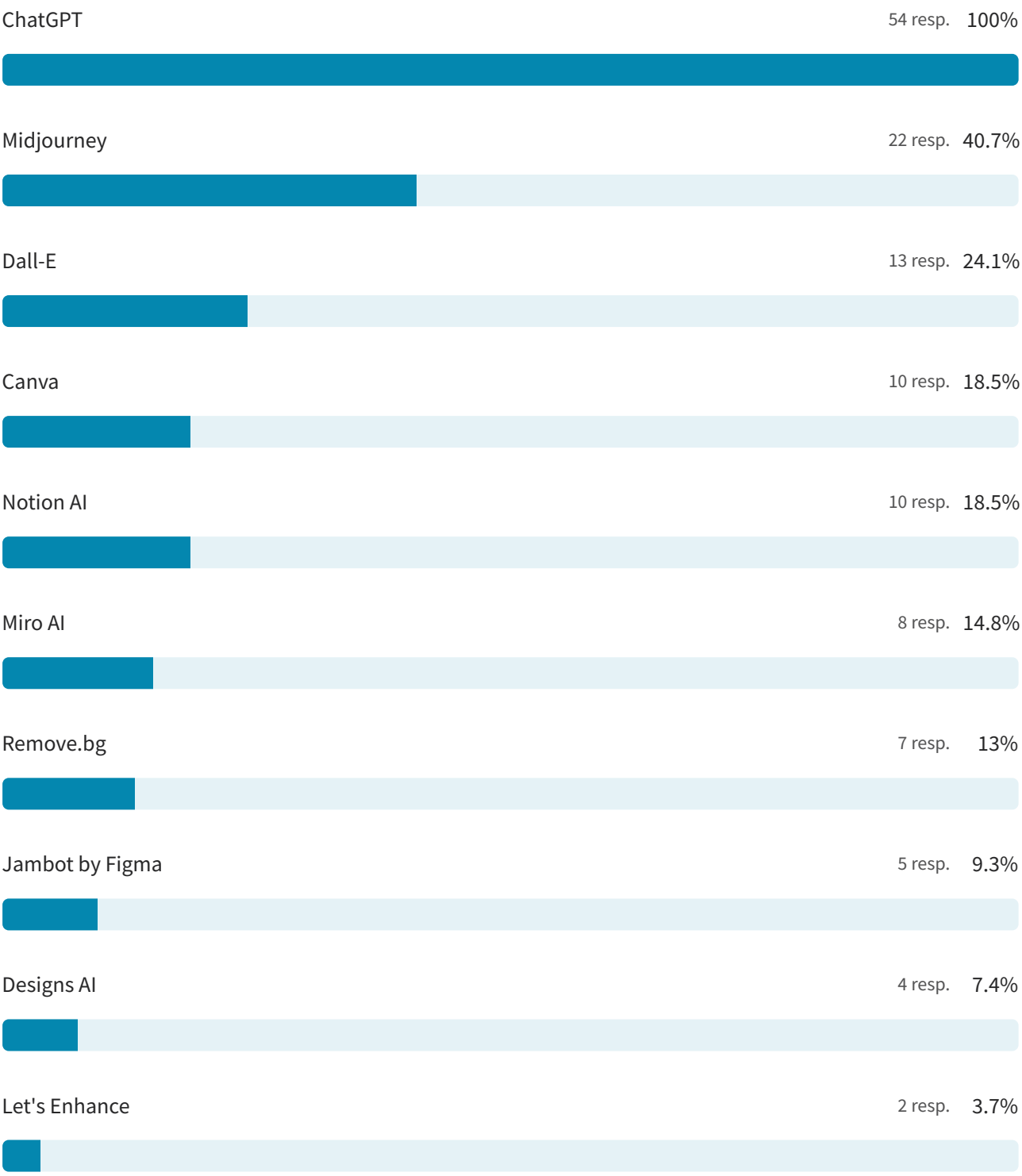
54 out of 74 answered

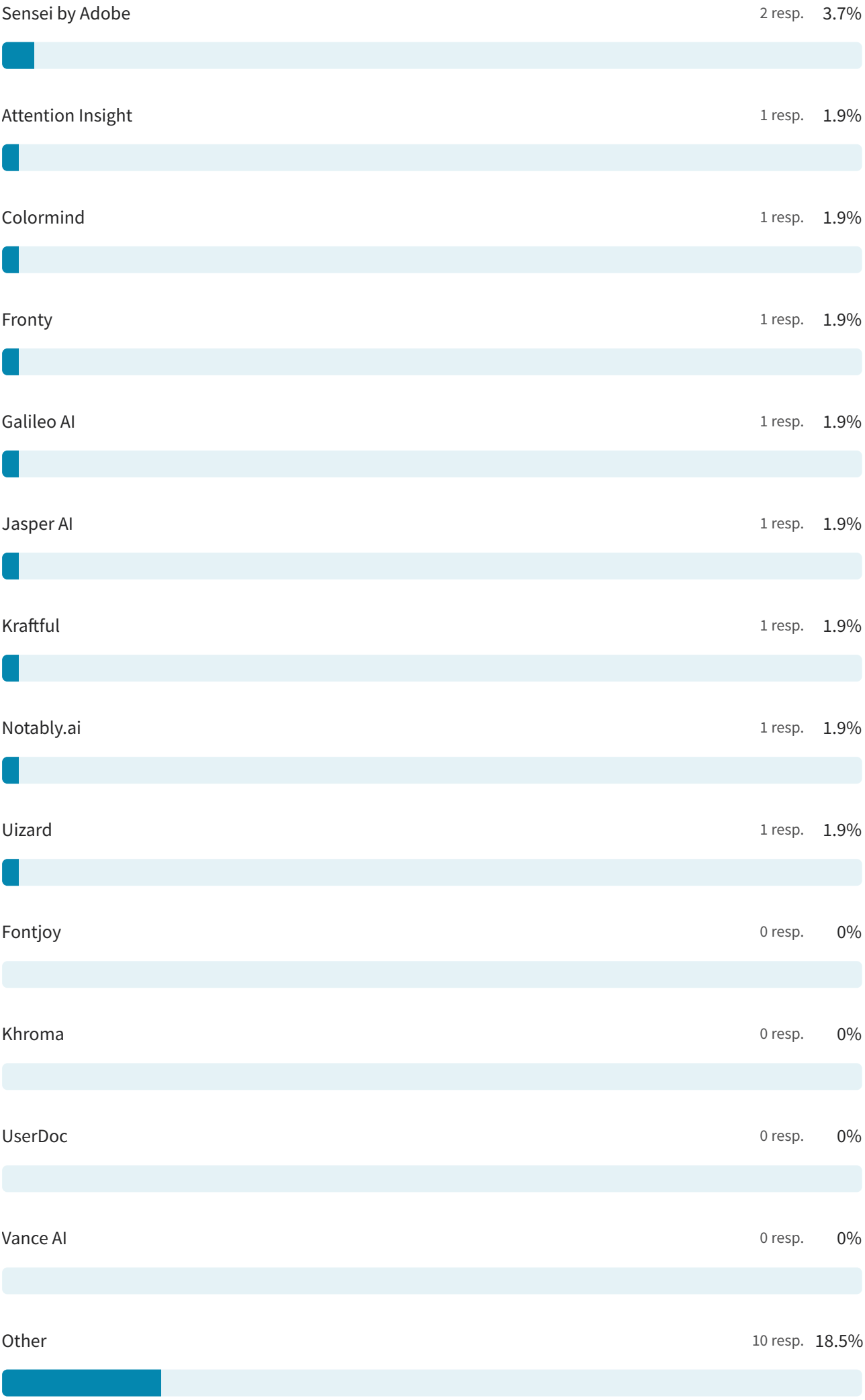


Ask for best practice tips .

Which AI tools do you use?

54 out of 74 answered




Sensei by Adobe
2 resp.
3.7%
Attention Insight
1 resp.
1.9%
Colormind
1 resp.
1.9%
Fronty
1 resp.
1.9%
Galileo AI
1 resp.
1.9%
Jasper AI
1 resp.
1.9%
Kraftful
1 resp.
1.9%
Notably.ai
1 resp.
1.9%
Uizard
1 resp.
1.9%
Fontjoy
0 resp.
0%
Khroma
0 resp.
0%
UserDoc
0 resp.
0%
Vance AI
0 resp.
0%
Other
10 resp.
18.5%

Perplexity; Bing AI; Semanttic AI for UX

Figma plugins A LOT

Adobe Firefly

ANN models etc, custom stuff

Grammarly AI assistant

Photoshop

Figma AI Autofill widget

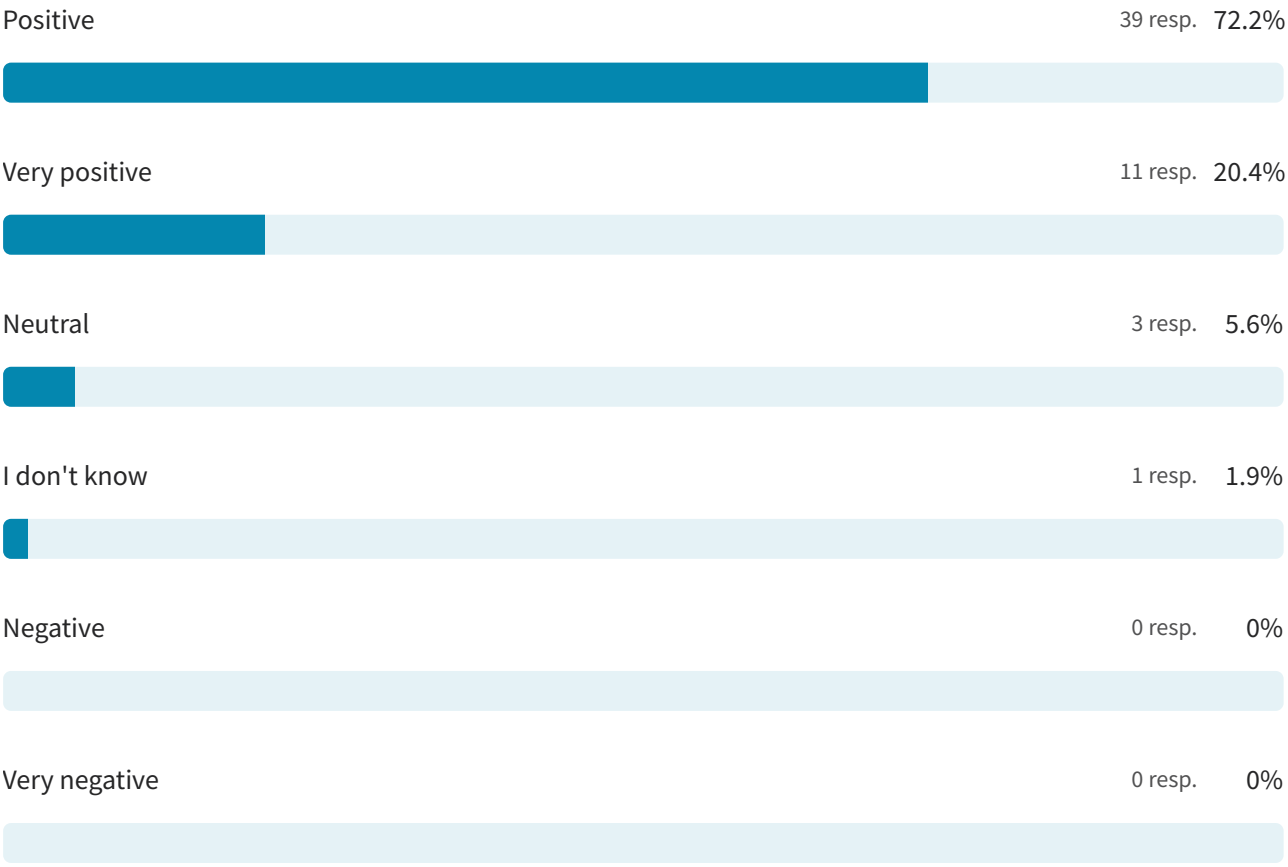
Google Bard

Built in AI-functions in Photshop and Figma ie.

Stable diffusion

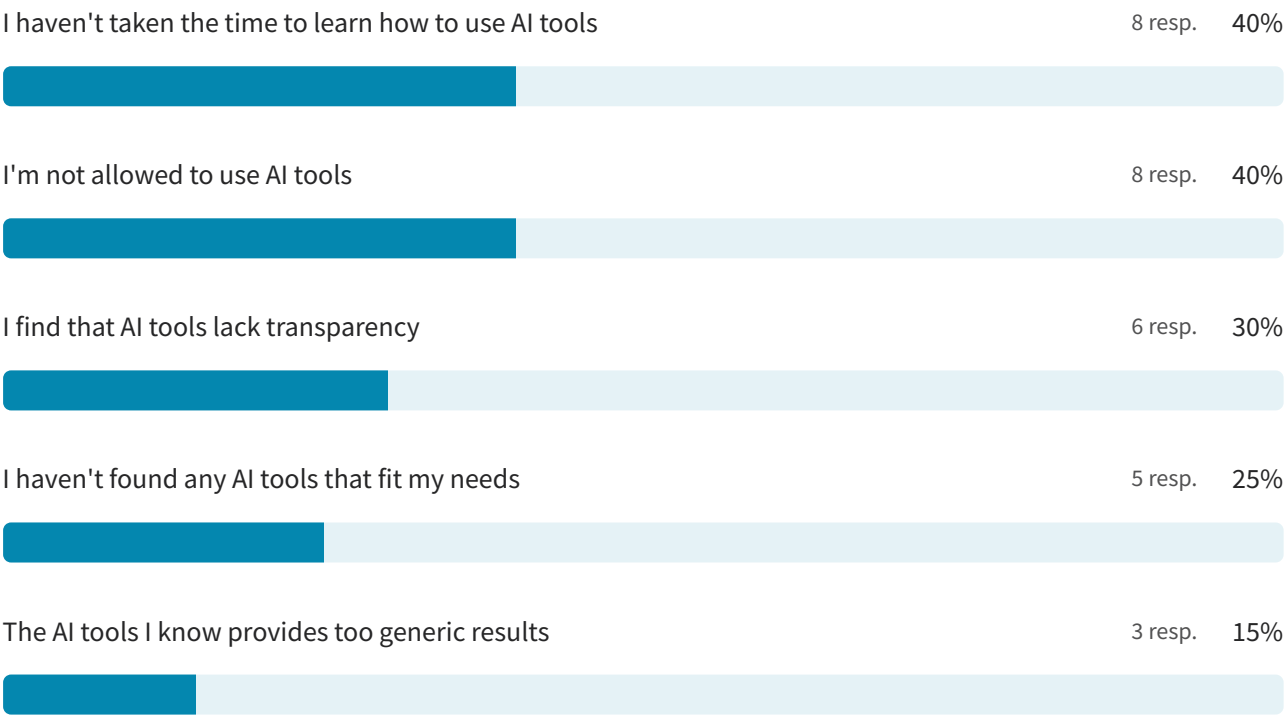
How do you perceive the impact of AI tools on your work?

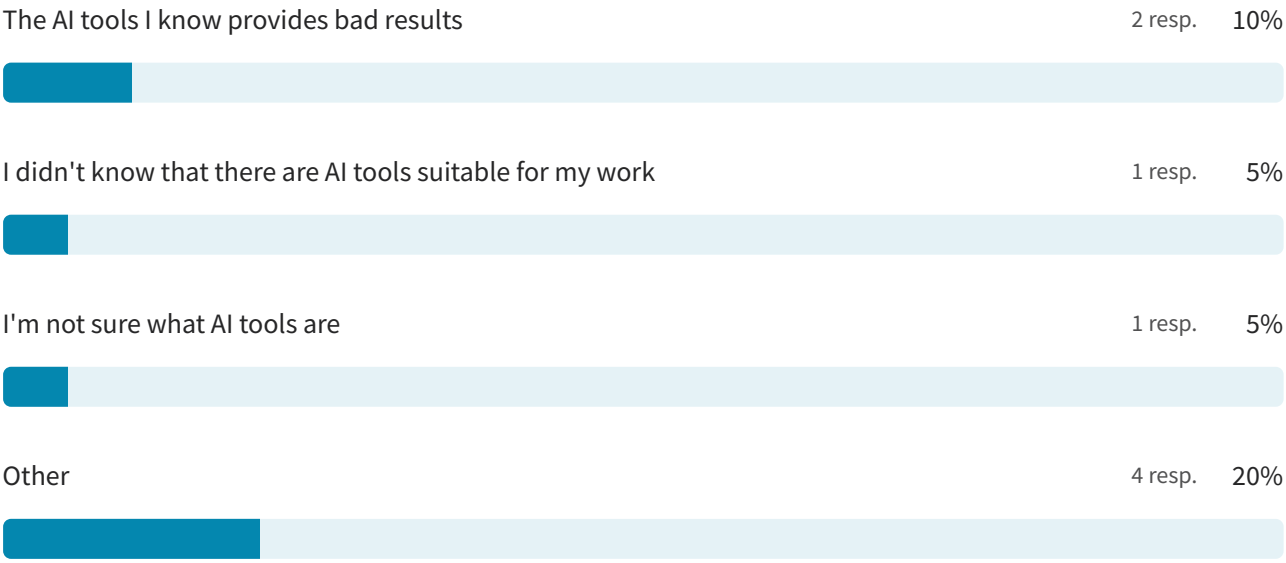
54 out of 74 answered



Why?

20 out of 74 answered





I’m unemployed

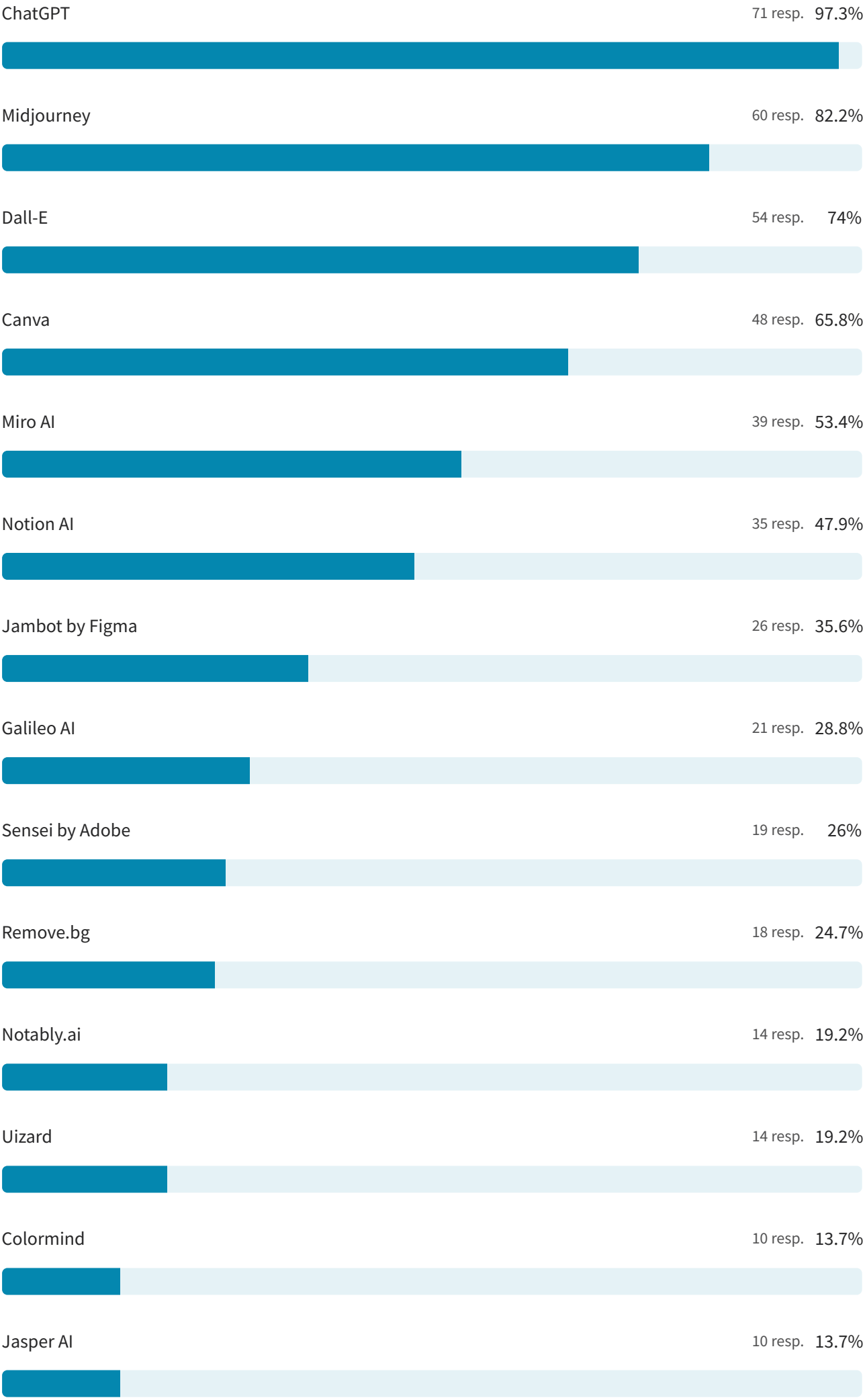
I haven’t find out when I should use those tools

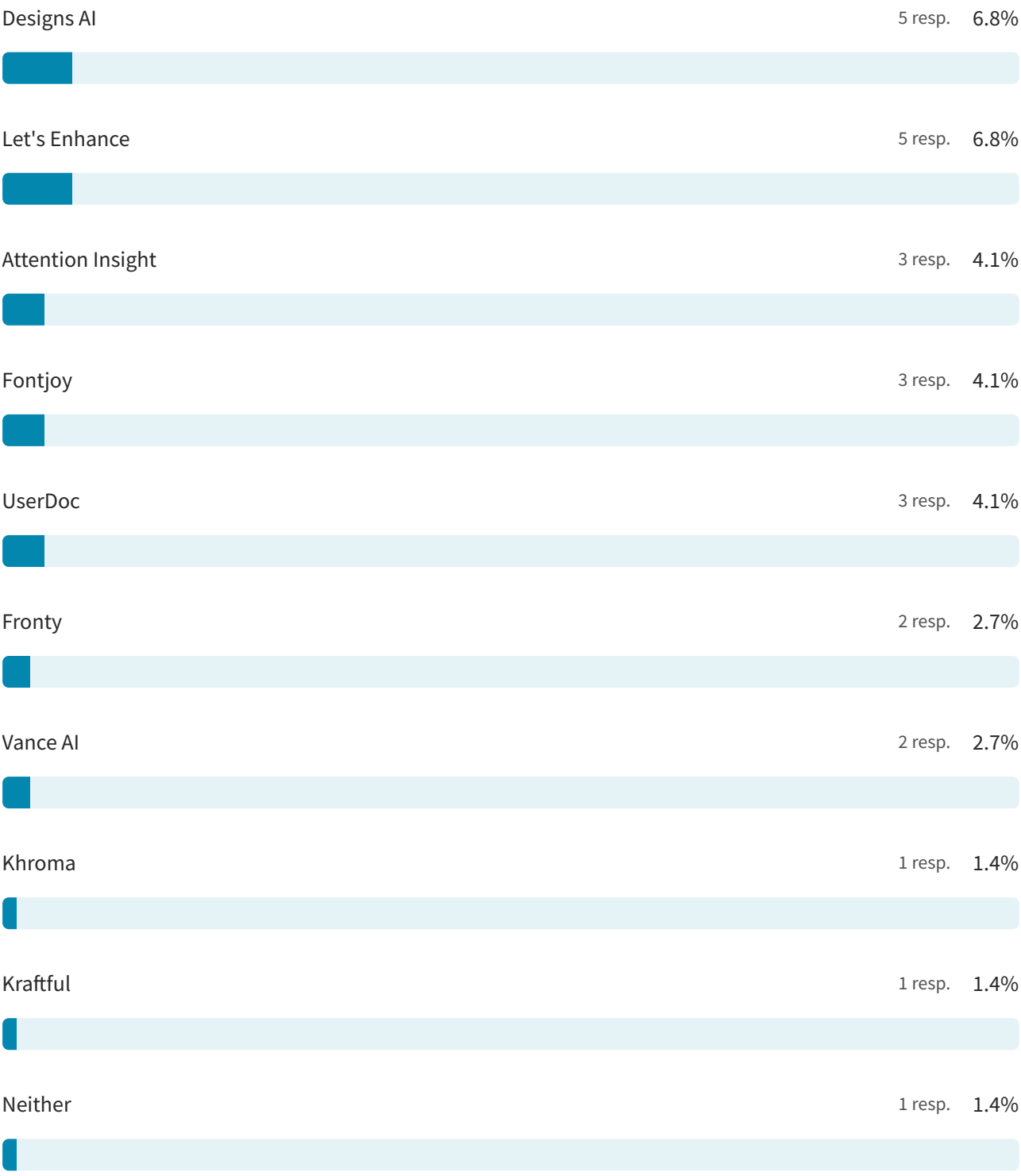
Uncertainty- what is allowed? I’m a consultant

I haven't felt the need to incorporate them into my work so far

Among the following, which AI tools have you heard of?

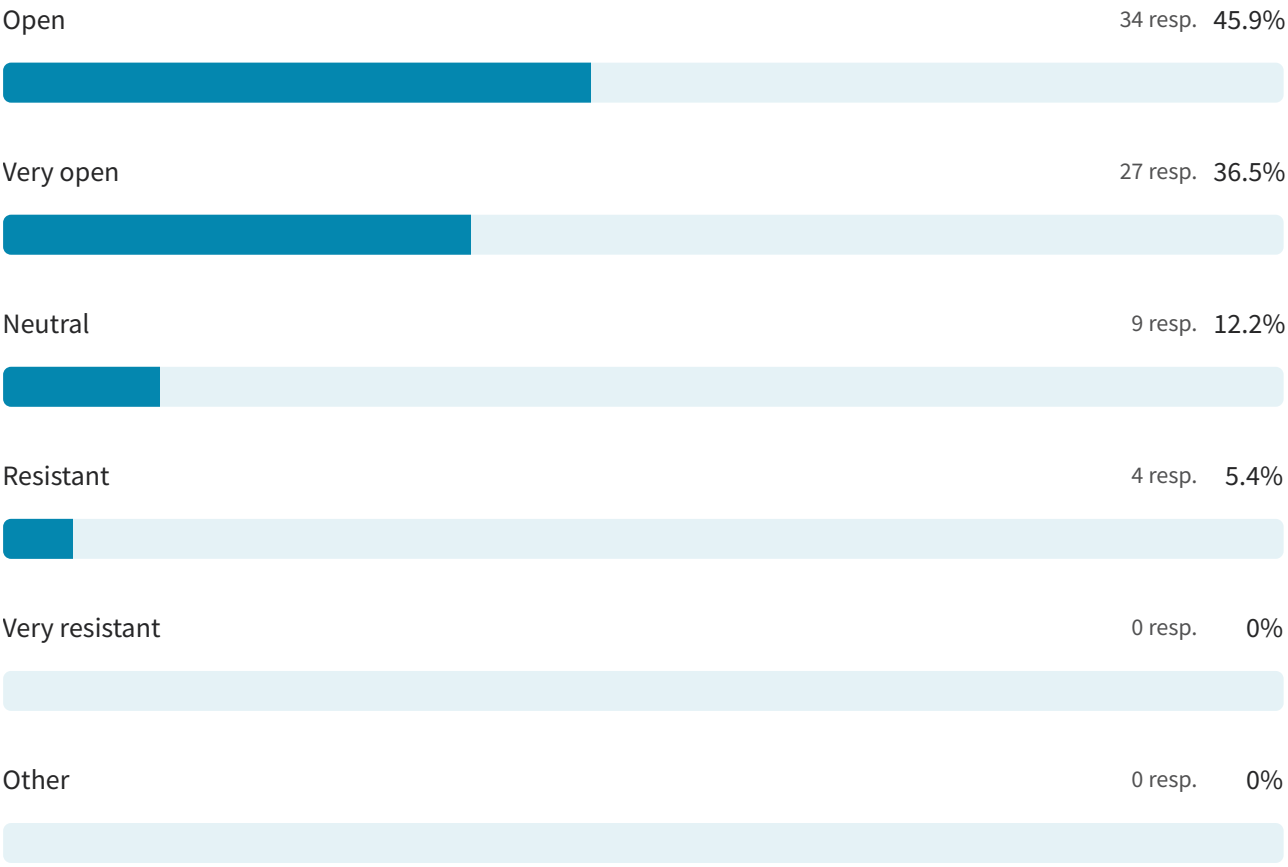
73 out of 74 answered


ChatGPT
71 resp. 97.3%
Midjourney
60 resp. 82.2%
Dall-E
54 resp. 74%
Canva
48 resp. 65.8%
Miro AI
39 resp. 53.4%
Notion AI
35 resp. 47.9%
Jambot by Figma
26 resp. 35.6%
Galileo AI
21 resp. 28.8%
Sensei by Adobe
19 resp. 26%
Remove.bg
18 resp. 24.7%
Notably.ai
14 resp. 19.2%
Uizard
14 resp. 19.2%
Colormind
10 resp. 13.7%
Jasper AI
10 resp. 13.7%



How open are you to adopting new AI tools or technologies in your design practice?

74 out of 74 answered



Please provide any additional comments, insights, or suggestions related to AI tools in web design that you think are important for this study.

25 out of 74 answered

> We need "instructions" on how to use it responsibly; no one should be left behind in the development, there must be good training in companies and freely available ones; the use of copyright must be clarified, currently illustrators, artists and important blog authors are left empty-handed ...

> AI just started t explode and be released on the market when I started my current job. It have defiantly helped me with UX-writing and creating images in photoshop. I do need a human hand thought, not all result is good. I can look very generic and not personal.

> As long as people are aware of the potential biases and flaws in AI tools, I reckon they can be used to help us spend more of our time on more meaningful tasks.

How to use AI when you work with higher security stuff?.... Should you really forbid new stuff cuz you do not know how they work? Can it give more pros then cons?

Haven’t seen any tools that have specific use cases that apply to my workflow right now.

If you know the correct answer, the tools can be very powerfull, but they can also be very convincing when the result is not at all correct so use with a lot of caution.

I am hesitant to use AI at work for design, since I don't know how it affects copyright when it comes to things like images. I have however use it a bit during the implementation stage, but I found it lacking in quality and quickly stopped using it.

I am positive to ai tools but unsure the legal views of the ai results. Therefor I am using the ai tools pretty much as inspiration only for my ordinary design work

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So far, AI tool usage has been great for jump-starting ideas...getting to a more advanced starting point before refining an idea. But for complete workflow integration, I don't think we're there yet. I imagine in the next couple years the ease of integration of specific tools into our workflow (as designers) will be greatly enhanced, and it will be second nature when crafting workflows, content, layouts, prototypes etc.

I feel that to many products talks about AI as marketing, and it makes me generally sceptic to the product. Got contacted by a startup a few weeks ago, the product sound great but since they used AI I every of the first 8 sentences, I was not interested. CkickUp is another product we use. Could you fix the basic structure issues and make my daily life easier instead of adding an AI..?

Webdesign is a narrow specification, also because UX is so much more

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I'm open to genuine ai tools that will optimise my workflow.i don't however wish to seek solving problems with auto generated tools, I see that as my job and only I know about the user needs, painpoints and business goals to deliver a true, user centric solution

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You need to know what to use it for and when not to use it. It can’t take decisions for you but it can help with ideation/overcoming blank canvas and come with suggestions.

I mainly use AI to gather information about UX. And to understand context, like how does a company work etc.

Allthough ChatGPT has been an efficient way of replacing lorem ipsum in prototypes I feel that we’ve only scratched the surface of AI possibilities over the last year. I hope we soon see more ways to incorporate AI with other interfaces than the text prompt input. Are we suffering from prompt fatigue in the AI landscape already?

I've wanted to put more time in to digging deeper in to the "How to optimize my work by using AI", but I do not get the time that I need to learn during work hours. Would love to know more!

I work in a security company and they are very strict in what 3rd party tools we are using to design in general

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I feel skeptical about AI tools and their impact on the field of design and the society on a broader scale I am concerned about artist's copyrights and how their work is being used to teach these models and I am also skeptical about the founders of many of these tools. For example Sam Altman, CEO of OpenAI, I don't agree with his politics and association with the ideology of longtermism

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The end goal is always to deliver the best experience. If there are tools such as AI that can help you improve quality or boost efficiency then I'll gladly use it in my work.

The current limitation is mainly data protection (making sure that client information isn't at risk), quality assurance (making sure what is produced really is correct) and tool constraints (limitations in input for instance). I foresee a lot more niche tools being developed for specific tasks and the limitations handled in a near future.

I use ChatGPT only to help with ux research methods and write texts/ux copy. I do think I'd use UI-creating AI's when we can easily connect them with the companies Design System, so they can generate UI's based on descriptions that use our own components.

For design purposes, I feel like they are not refined enought. But I see them comming there, and they help me with text heavy work task that I find tedious.

It’s an interesting djungle out there. Lots of tools popping out, each with it’s own pros and cons. We have an interesting future ahead

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Sometimes I don't know what is AI or not, maybe I use it more than i think.

I think AI tools could be of good use in UX design, however I think it's important that we do not rely bluntly on them. We still need to be active in creating the experience the users sought after.

C

Appendix C - Interview questions

1. What is your professional role?
2. Do you work alone or in a team? Do you work with other designers?
3. Please describe your work process for a typical project.
4. In your own words, what do you think is the most important aspect of your work?
5. Steering the discussion towards AI, please describe what you think defines an AI tool.

Screen sharing Figure 5.6

6. To clarify, is there any significant work task that is not listed in the picture?
7. Please describe what these tasks mean to you.
8. (For each task) What is important when you perform this task? Why?
9. (For each task) What do you think about performing this task? Why?
10. (For each task) Please give a rough estimate of how much of your total time you spend on this task.
11. (For each task) Which tool(s) do you use to perform this task? How?
12. Where does the listed AI tools that you use come in in these tasks? How do you use them? Please give examples.
13. Has the use of [each specific AI tool] changed your work process? How?
14. Are you able to do anything new with the help of AI that you could not before? What and why?
15. For the tasks where you do not engage in AI co-creation, please elaborate on why.

Stop screen sharing

16. Do you follow any policies or guidelines regarding AI tool usage?
17. What is your general standpoint when it comes to using AI in design work?
18. (If the respondent uses AI tools) Are you open towards clients and/or colleagues about using AI tools? How come?
19. Do you perceive that you have the opportunity to explore and learn new tools at work? Please elaborate.
20. Do you perceive any risks or challenges when it comes to using AI tools for design work? Please elaborate.
21. Do you know what copyright rules apply to AI-generated material? Is it important to know? Why?

22. What is the role of accessibility in UX design? Is there potential for using AI tools for accessibility work?
23. Based on your own experiences, what recommendations would you give to other designers regarding the use of AI tools? What is important to consider?

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