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Imagination meets algorithm: redefining design practices in the coming AI age

Mario Ciaramitaro
Università Iuav di Venezia, Italy

Pietro Costa
Università Iuav di Venezia, Italy

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Imagination meets algorithm: Redefining design practices in the coming AI age

Mario Ciaramitaro, Pietro Costa*

Università Iuav di Venezia, Italy

*Corresponding e-mail: pcosta@iuav.it

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Abstract: The summer of 2022 marked the advent of accessible text-to-image tools, revolutionizing image rendering with distinctive styles swiftly. This generated a creative shift among designers, generally addressed as 'prompt design', although this expression scarcely captures the profound interaction between design and digital tools. This paper elucidates the potential synergy between designers and AI through one pragmatic workshop engaged by university students. Our approach was focused on an exercise to foster a rich imaginative process before the text-to-image creation. The result is a discussion over the relevance of structured imaginative process and the capabilities of generative AI technologies, supporting an enriched dialogic interaction between design and dataset-based imagery: insights on the different conceptual layers between AI and narrative, a discussion for the development of improved narrative & AI tools, and reflections on conceptual aspects of co-creativity in the context of scenario design practice and AI.

Keywords: scenario design, imagery production; generative AI; designing futures

1. Introduction

In 2022, new tools based on language models related to image production were opened to the public. These are so-called 'text-to-anything' (Calmettes et al., 2023) tools, based on trained neural networks that from textual prompts can return content such as images, videos, three-dimensional models, and music tracks. For example, text-to-image models represent a rapidly developing technology and are receiving particular attention among practitioners and others precisely because of their amazing ability to generate images in seconds using only written text.

Generally, the image generation process begins with a text prompt, a description provided to the model to generate the image in which the subject and other qualitative specifications useful for framing the context, atmosphere, mood, and artistic style are generally included; at the end of this rapid process the algorithm returns images almost instantaneously. At this

point the user can change the dimensions, ask the model to produce variations on each, or refine the prompt by initiating a new series of images that take advantage of the algorithm's uncertainty. The consequence of the introductions of these tools were a great media debate, a greater speed in rendering concepts of images of any kind and an immediate evolution in the user-friendliness of AI engines' interfaces.

Beyond the quality of the results generated, what stands out is the emergence of a new metaphor of interaction with artificial intelligence, which further enriches the relational model with algorithms (Armstrong, 2021). This metaphor revolves around the ability to convert textual descriptions, making the tools accessible to non-expert designers due to their initial ease of use. However, when juxtaposed with the capabilities of specialized tools such as parametric three-dimensional design software, this text-to-image process does not offer a precise technical solution.

Although in popular online discussions the terms 'prompt designer' and 'prompt engineering' are frequently mentioned to describe the skills necessary to interact with and generate aesthetically pleasing images aligned with the intended concept, the presence of these terms in scientific literature and their associated experiments remain limited (Liu and Chilton, 2022; Zamfirescu-Pereira et al, 2023). The prompt designer is generally defined as a professional with the necessary skills and the right mindset to dialogue with generative Artificial Intelligence technologies through the writing of prompt texts. This is a profession that essentially requires expertise in understanding the logic of how datasets are composed, but also how to visually translate an idea using the tags that embedded in the datasets themselves. This technical knowledge, although relevant for the future of AI-based industry and economy, is not the focus of this investigation because it is specialized knowledge that frames the designer as an operator.

In the panorama of quickly developing technologies and AI playgrounds, our mission was to test, back in September-December 2022 in collaboration with design university students from the Università Iuav di Venezia (Italy), the relationship between the creation of imaginaries and the use of AI as tool to support future scenarios. The focus wasn't on specific technology but rather on the clash of designer imagination (Tversky & Suwa, 2009), on the capacity to elaborate scenarios and on the way AI engines trained on billions of images were suddenly influencing not only the outcome of the requests but even the future scenario.

The selected approach to these AI technologies was to use them to sketch different future scenarios, following Bill Buxton's conceptual definition of sketching (Buxton, 2007) through the key characteristics of a sketch he identified: evocative; suggest; explore; question; propose; provoke; tentative; non-committal. Using these key words and the feedback loop between mind and sketch we asked how AI could help designers in processing scenarios, producing images to represent them, and how to visualize the direct or indirect interferences that occur during this relationship. An initial proposed addition to Buxton's conceptualization (Figure 1), is that the feed-back loop is extended and expanded, with the Ai influencing both in imagining and sketching, including through the datasets with which it was trained.

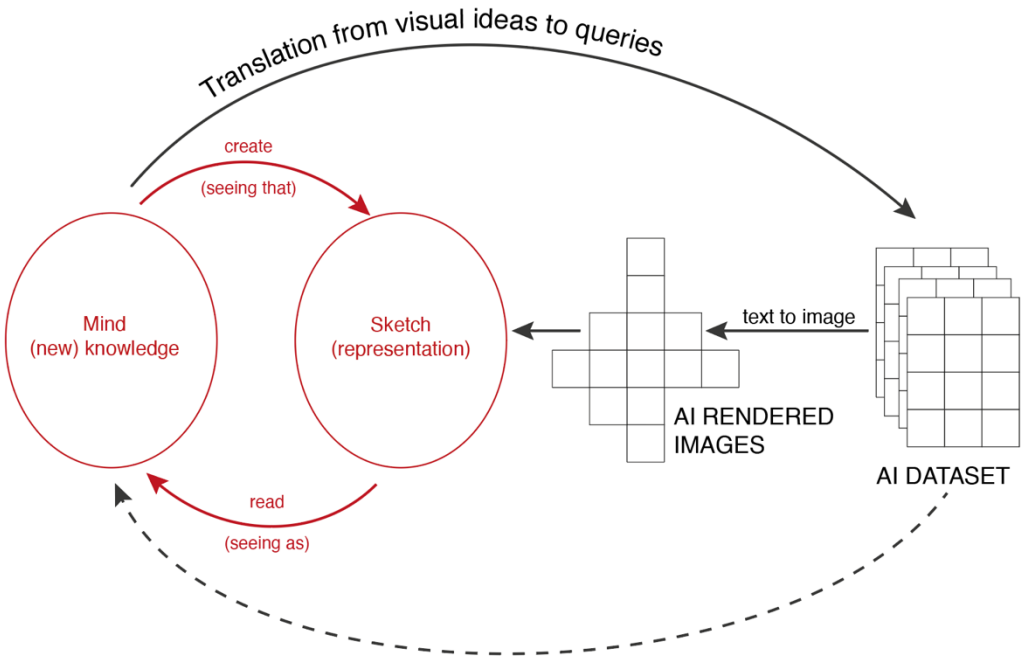

Figure 1 In red, on the left, the original scheme by Bill Buxton about how mind and sketching are activity interlinked. We added to the scheme the newfound condition where AI DATASET both influence rendered images, the sketching activity and, subsequently, how the mind thinks of ideas, decoding the dataset and the possibility of make ideas understandable to the text-to-image engines.

Much of this work focuses on rendering capabilities by AI for complex scenarios and design fiction and workflow management for relevant research-through design outcomes. For example, a designer can be influenced by generative images and might need to understand how to check the workflow for qualitative results. With AI tools becoming more available to designers, we were interested in examining how narrative can be a tool to tests the limits of such tools and the strategies to overcome them. To do this, we conducted one workshop with 52 design students, assigning them to the same design task and using AI to render their visions of the future for producing a detailed oriented narrative. The analysis of the collected materials resulted in three contributions detailed in this paper: a) insights on the different conceptual layers between AI and narrative; b) a discussion for the development of improved narrative & AI tools, and c) reflections on conceptual aspects of co-creativity in the context of scenario design practice and AI.

2. Background

The genesis of contemporary text-to-image models can be traced back to 2015 with the introduction of alignDRAW by a team of researchers from the University of Toronto (Mansimov et al., 2015). This model was revolutionary in its ability to function based on textual input sequences. While the images it produced didn't fully achieve photorealism, they showcased an impressive ability to generate content beyond its training data.

In the subsequent years, various research teams explored and combined traditional methods with cutting-edge algorithms to refine text-to-image synthesis. A pivotal evolution was the incorporation of generative adversarial networks in crafting images from textual descriptions (Frolov et al., 2021), resulting in increasingly convincing visual representations. Additionally, diffusion models started to gain traction (Steinfeld, 2023), offering a different approach to image synthesis by iteratively refining images over multiple steps, which further enhanced the quality and intricacy of the generated visuals.

January 2021 was a landmark month as OpenAI launched DALL-E, a transformer-based system that garnered immense public interest. This release was a watershed moment in text-to-image synthesis. Building on this momentum, DALL-E 2 was introduced in April 2022, boasting the ability to produce even more detailed and lifelike images. The evolution continued with the debut of Midjourney in July 2022 and Stable Diffusion in August 2022, further enhancing the realm of text-to-image generation.

Although these tools are relatively new, the academic community is increasingly interested in their application. Numerous studies have explored the potential of collaborative co-creation between AI and humans in design (Tholander & Jonsson, 2023), as well as the integration of AI into the design process through image generators (Chiou et al., 2023). Further research suggests potential directions for future AI-assisted design tools and methodologies for image generation (Zhang et al., 2023).

Collectively, these studies indicate the significant impact of generative AI and collaboration with designers in the design field and the urgent need to further investigate this topic.

3. Research and methodology

3.1 Background research

The need for conducting background research was to prepare for how text-to-image tools could be used within a heterogeneous group of designers. Convinced that the methodological setting and the framework would determine the interaction between designers and AI, we chose a field of action that would give the opportunity to produce very different images, but which, as anticipated, would emphasize the interaction between human imagination and AI rendering. For this reason, it seemed important to propose to the 52 workshop participants to work on the construction of a video scenario on possible evolutions of society in the future. The video scenario was to be animated through simple compositing animations between objects, background, and main characters in order to put the designers in front of the possibility of experimenting through very different demands on AI. A further point was to focus on how to use the tools critically, so the aim was not just to learn how to describe a design textually to obtain aesthetically pleasing images, but to observe and comment on the limits of this new design condition. The use of a design fiction video scenario provided several opportunities:

1. Playground and freedom to explore AI capabilities in the visualization of objects, people, and environments. As this research context stems from a direct experimentation made in September – December 2022, it was interesting to explore the various capabilities of AI in a very different range of prompts, trying to actively decode the datasets logics.
2. Designing fictional objects and fictional worlds is quite different from designing an industrial object variation. Usually, an industrial object or architecture has constraints, functions, ergonomics, established usage, and AI is actually built over the topology of established objects, translated into its dataset. Instead, the design fiction scenario must respond to the possibility of observing from a critical point of view not how an object works, but how the world in which it is embedded works. A further complexity within this relationship between AI and designer is that within the process of creating scenarios, the devices and their functions are not given, do not yet exist, and the different design options are not tied to precise constraints. Instead, there are some narrative qualities to be designed in order to make the observer to understand the specific question of that imagined future and to come closer conceptually and emotionally to the consequences and implications it envisages. Using scenarios would have engaged a field of tension between invention and established objects simultaneously fueled by three factors: the imagination of the designer, the status quo known to the designer, and the mimetic ability of AI to reproduce objects and spaces as they were described in their dataset. This meant that the designer, imagining an object that did not yet exist, would have to learn how to describe it to the AI using metaphors and pieces of existing imagery to achieve the desired visual result.
3. Understanding how to reach relevant details to visualize the fictional world through AI: in the creation of fictions, details are crucial to make both the context and the story plausible and believable. The designer would have found himself in a new dimension where instead of pen and pencil he uses words, and where it was not possible to immediately understand how to imagine and describe textually the key details that could guide the creation of a scenario. This could have brought up possible difficulties to be recorded.
4. Confronted by the limitations of the dataset, the designer would probably have engaged a process of negotiating the future scenario, thus beginning to directly experience how AI can influence the future narrative and their vision.

The result of defining these research opportunities allowed us to frame AI not as the author of the images but as a concept designer of a science fiction film where through individual drawings it helps the director arrive at an overall vision. The AI would provide rapid renderings of different objects, people, and environments and through skillful creative direction

and curatorial work, the designer would assemble different results in the telling of a complex and visually articulated world.

3.2 Methodology and workflow

Table 1 Workshop's general structure

Observe		**Interpret**		**Create**	
Trends	What if	Futures Wheel	Mood board	AI prompts	Video scenario

The methodology suggested to the students consisted of three distinct phases of observation, interpretation, and creation. This operational sequence was adopted in order to guide the students through the design process, paying particular attention to how and when to introduce artificial intelligence-based tools and how to use them critically. The primary goal of this methodology was to allow students to immerse themselves in a 'world building' workshop, facilitating the creation of a built imaginary (Coulton et al., 2017).

For a full explanation of this methodology, it may be useful to outline each constituent phase of the workflow (Table 1).

The 'Observe' section highlights the basic steps of data collection and insight generation. This section focuses on two main design fiction techniques (Knutz & Markussen, 2014): 'Trends' and 'What if'. While 'Trends' provides insight into the prevailing signals in a specific domain (Smil, 2008), 'What if' is an invitation to think about speculative questions, promoting new perspectives and discussions (Dunne & Raby, 2013).

Passing to the 'Interpret' phase, a more in-depth analysis is undertaken to decode and contextualize initial observations. Here, the 'Futures Wheel' is used as a visual method to explore and represent the possible consequences, both direct and indirect, of a particular change or trend (Bengston, 2016). In addition, a 'Mood board' is introduced, a visual collection that captures the essence of certain styles, emotions, or themes.

Finally, the 'Create' phase emphasises the transformative action of implementing insights. In this segment, the use of 'AI prompts' allowed students to use text-to-image AI capabilities to generate images based on the information and interpretations captured, and finally the 'Video scenario' proposed a visual storytelling approach to specifically illustrate a potential future narrative in the year 2050, based on the constructed storyline.

One of the main features of the scenario video construction was the process of revisions, introducing creative direction methods to highlight the scenarios' latent qualities identified by the students. The methodological choice in this area involved having the students describe the future world they had imagined, its characteristics that diverged from the contemporary world, and the lifestyles and events that had created radical change. After this first descriptive phase, which took place through some textual descriptions and mood boards of the first

interactions with the AI, each working group moved on to a second level of in-depth analysis. They were asked to select a narrative unit within their envisioned world to develop further, identifying key protagonists and crucial details. They also had to choose the narrative perspective that would best capture the events of their story.

Alongside the path taken by the students, a framework was built to observe the development of projects and the relationship with text-to-image engines. Deliverables were structured on a weekly basis, organizing activities into 'Explore', 'Interpret', and 'Create' phases to provide coherence. Early interaction with the text-to-image engines was encouraged by having students document their prompts for two main reasons: enhancing their understanding of language as a project tool and tracking the variability of outcomes within the working groups.

During weekly sessions with each group, informal questions were asked about their experiences with the text-to-image generators. This dialogue helped create a feedback form, which was shared at the course's end. The form centered on four key themes that frequently emerged in discussions with students: the impact of AI on design and imagination, AI's role in storytelling, suggestions for improving interactions, and AI's influence on imagery and creativity. The feedback form included specific questions aimed at deepening the understanding of these themes.

3.3 Report of design process and activities

After defining the workflow, we spread the activities over a 7-week period (Table 2). Special attention was given to the preliminary research phase, to ensure that the images selected were the result of the designer's reflections rather than the AI's imagination.

Table 2 Weekly tasks.

Week	**Observe**		**Interpret**		**Create**	
1	Trends & What if	What if implications				
2	Future Wheel	Mood board	Future scenario	AI prompts results		
3		Mood board	Worldbuilding	Story and characters		
4				AI prompts Storyboard	AI prompts AI Images	
5				Imagery selection	AI prompts AI Images	AI Images cut-outs

6			Video compositing	Scene animation
7			Scene animation	Final Editing

The design strategy involved the use of AI in combination with specific motion design software to assist in the creation of the immersive video scenarios for the project. Several prompts were used to produce a wide range of images, which, after being combined, created the different scenes of the video (Figure 2, Figure 3).

Figure 2 A series of AI images generated from textual prompts.

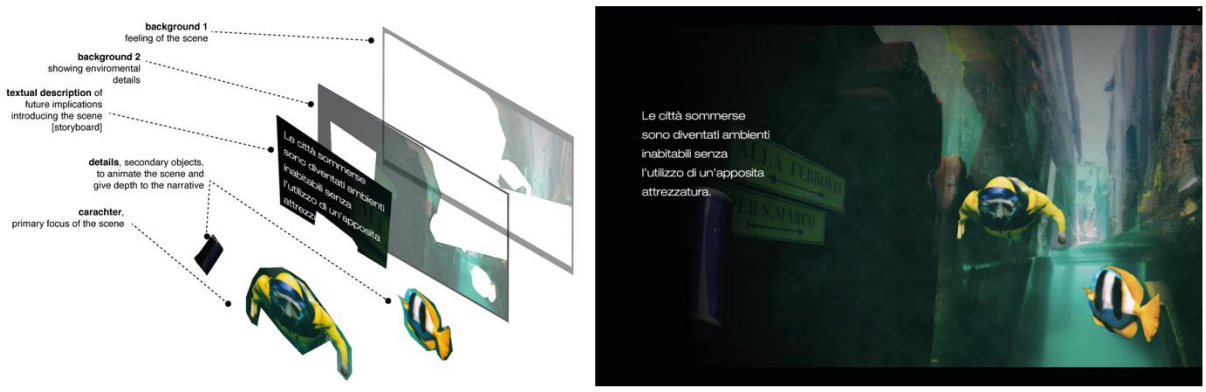

Figure 3 All the videos were made of several AI images animated with video compositing software. Details both in the foreground and in the background were introduced to create depth in the scenario's narrative. This scenario was addressing 'What if water will rise up to 5m in Venice?' and specifically framed the transition phase between 2022 and a fully submerged city.

Although there was a strong interest from the students in experimenting with AI image-generating tools, it soon became clear that they had limitations during project activities. One of the main restrictions was the algorithms' tendency to generate images based on their training, which can be limiting and difficult to control, highlighting the inherent uncertainty of the algorithm itself. However, this offered a stimulating opportunity, as the generated images raised new questions and reflections on the current project.

Furthermore, it has been observed that teams that use AI to develop images on a daily basis are the most effective. This suggests that the ability to translate imagination into text is closely related to the frequency with which ideas are transformed. Although this might seem a predictable result, as is the case with the regular use of any software, an important point emerges: the participants' interpretation of the datasets and the way in which the AI combines them do not always correspond to the playground effect found in the early stages of interaction with AI. Indeed, at this time, the AI's operations are so rapid that the process seems immediate, wrongly suggesting that it does not need to be used consistently.

Finally, it has become clear that although generative AI may have difficulty imagining autonomously, tending to produce trivial results, even humans find it challenging to interact with it. This is because interaction with these tools leads to a change in the relational model, making communication more dialogical.

A particularly fascinating pattern emerged from the results of the 'Video scenarios' (Figure 4). The images generated and the students' subsequent interpretations often gravitated toward representations of dystopian worlds. These dystopias were characterized by multifaceted problems such as warming oceans, severe food shortages, extinction of certain animal species, and absolute control by artificial entities. It makes the question whether the constraint of using artificial intelligence-generated images inadvertently steered the narrative in this direction. It would be an interesting area of investigation to find out whether the use of

artificial intelligence for image generation played a substantial role in influencing these dystopian narratives, but in this circumstance, the limited time available did not allow for further investigation of this potential correlation.

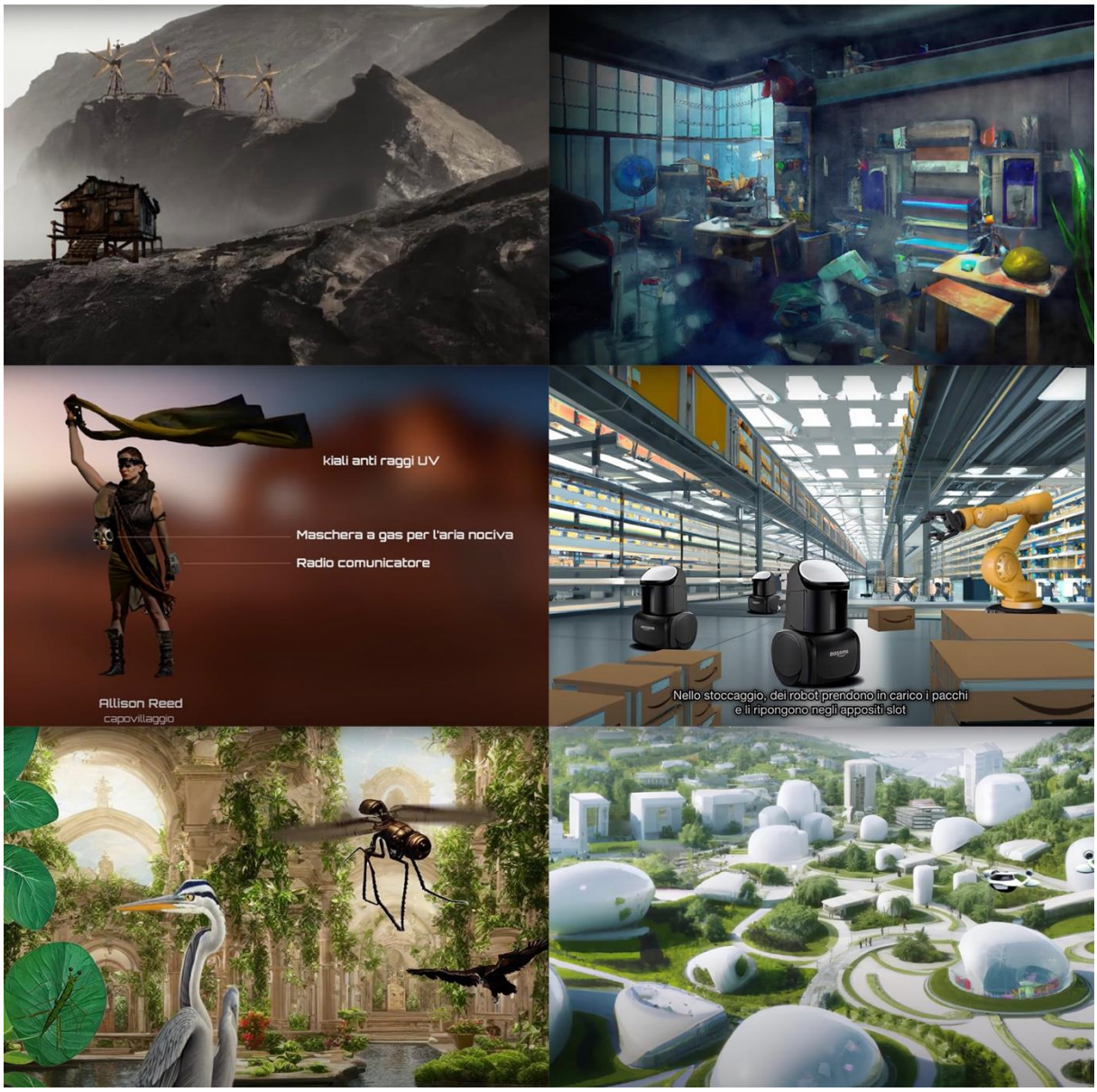

Figure 4 A selection of screenshots from the final video scenario outcomes.

4. Discussion

Our findings highlight, by the data collected with a feedback form at the end of the workshop, both opportunities and challenges for integrating AI in design fiction sketches for video scenarios. Here we will focus on three issues that we argue are of central importance for future developments of conceptual frameworks and narrative-based design: Firstly, we discuss world building and the different layers between AI and narrative.

Secondly, we highlight the development of improved design narrative & AI tools interactions and why that framing matter. Finally, we frame conceptual aspects of co-creativity in the context of scenario design practice.

4.1 Layering between narrative and AI

The process we tried to activate in the participants saw the construction of a plausible story in a future world as the red thread linking imagination, experimentation with the limits of text-to-image and the construction of an ongoing process of exchange between designer and AI.

One of the most obvious difficulties in creating future scenarios combined with the use of AI was the complex process of worldbuilding and experiment the dialogue with AI:

1. Imagine a future underlying problem
    - How society might develop;
    - How technology will play a role in it.
2. Imagine how to communicate it visually
    - With which story;
    - Which characters;
    - With which objects;
    - With what style;
    - With which images.
3. Exploring the potential of AI in visual translation
    - Quantity of objects in the image;
    - Quality of terms to be used;
    - Translating provisional storyboard into prompts;
    - Changing the language used to construct appropriate images;
    - Combining different images to construct relevant narratives;
    - Accept results that might differ from original ideas but that can still create an immersion in the future scenario.

While some elements of this list are common to any worldbuilding process, the continuous translation of ideas into prompts and understand text-to-image logics brought the process to a next level. A pivotal question in the feedback form was exploring the implications of this complexity: “How do you think the awareness of not having to draw has influenced the construction of your future scenario’s narrative?” Amongst the different answers emerged:

> "Knowing that I was not actively drawing the story I found myself having to carefully choose the terms in which I described the environment of the scenario first, which was usually easier than the description of the objects."

> "'Having in mind the process of continuous exchange with the AI I organized my research into lists of objects I wanted to see within the scenario, this greatly simplified the drafting of the prompts and helped me to mentally organize which details were significant.

> "Amazed by the speed of AI rendering, I started to spend more time collecting visual inspirational material and at the same time I paid more attention to the development of the storyboard by asking myself how to show things, from what point of view also because I knew I would have an assistant who would immediately understand what I meant if I wrote to frame an object with a wide lens."

The combination of AI and narrative leads the designer to think and visualize stories in a less direct way where the established practice of sketching by hand is replaced by sketching through fine-tuning prompts. At the same time, clearly the designer is able to gain a speed of visualization that allows him or her to traverse different worlds and modes of visualization and access, through the creation of lists, a more immersive form of worldbuilding, albeit a provisional one.

4.2 Discussion over the development of improved design narrative & AI tools

The feedback form also gave some insights about improved workflow of scenario design and AI. The first question addressing this issue was: "How would you improve the process of working with AI and storytelling of future scenarios?" Some of the most relevant answers were:

> "I would like to be able to have a whiteboard where I visually organize a hierarchy of visual and textual information in dialogue with the AI to keep control of the development of the scenario."

> "I wish I could have a timeline visualization of the prompts I used that was more explanatory of how the AI interprets the terms I use."

> "Sometimes is really difficult to describe a slight visual detail to be changed, there should be a visual tool of alternatives of a selected area."

The second question was "Do you think text is a good way to interface with AI?". Some insights that came from the answers were:

> "I think that starting from having to tell a story made it easier for me to think of a world through words, I usually only use text to highlight functions of objects that sketches cannot communicate such as visual feedback."

> "Right away I was happy to explore how from a series of words I could get a quick result, but I wasn't satisfied with having to keep looking up terms to translate what for me would mean taking an eraser and redrawing a face or a building."

> "As a group we spent a lot of time discussing how to describe an object while in day to day life we would simply exchange drawings and sketches, it was exhausting."

The feedback from users regarding the workflow of scenario design and AI integration is insightful. The first question addressed the process of working with AI in storytelling and garnered valuable suggestions. Users expressed a desire for a visual hierarchy tool to interact with AI on a virtual whiteboard, aiding in scenario development. Additionally, they wished for a more informative timeline visualization of AI prompts and the ability to designate a character as the story's protagonist, with the capacity to adapt clothing and expressions based on the context. Furthermore, users highlighted the challenge of conveying subtle visual details and proposed the need for a visual tool offering alternative choices for specific areas. The second question probed that text can be beneficial for conceptualizing and describing scenarios but expressed frustration when attempting to convey visual information that would be more easily communicated through sketches. This feedback underscores the importance of developing a more intuitive and efficient interface for working with AI in scenario and concept design.

4.3 Reflections on conceptual aspects of co-creativity in the context of scenario design practice and AI

The imagery component played a central role, offering a futuristic perspective that guided the entire design process. The imagery functioned as a thematic thread, providing a coherent and stimulating context in which to experiment and evaluate the contribution of AI tools to the design process. At the same time, precisely because it was a process that was not determined by immediate and real lists of functionalities, the imagery became a more complex topic to convey to a text-to-image engine and where designer could accept to be influenced while crafting images and visions of the future. The feedback form addressed specifically this with the question: “Have you felt influenced by AI visual imaginary in the sketching of this scenario?”. Some of the feedbacks described the AI as complementary to the vision of the scenario:

> “We were amazed by the quality of the images, and we felt we could accept the result as a plausible outcome of our description.”

Not all collaborations found an immediate result:

> “We tried to directly input the world we had in mind, but the results were either too vague or the visual structure of it wasn’t prioritizing our mindset, so we decided to visually describe what we wanted to see in the image and select the results that were more comparable to our scenario. In the end we felt obliged to accept the best possible result.”

One of the answers addressed the possibility to make the AI learn the stylistic choices that were made underway the scenario creation process:

> “Working with AI gave us the ability to quickly visualize some environments but in the end it felt like making a collage of different existing materials, maybe we didn’t find a way to teach the AI our style.”

and an answer confirms the use of AI as a research tool:

> "Surprisingly enough, we found that the limits of the AI gave us hints on how to better describe what we had in mind and ask ourselves what kind of visual quality we were looking for. Exceeding our own visual knowledge and rendering capabilities this gave us the opportunity to reach a new level of complexity."

At the same time, it is necessary to frame the strategy of constructing a complex world as a method of unlinking the potential of AI from its immediate result, which is the rendering of individual images. Instead, we should consider it within a nuanced process in which composition enables the results of individual visualization queries to be overcome. While Tholander and Jonsson (2023) noted in their results that the AI system was often perceived as fast, making it more suitable for broad explorations rather than in-depth investigations, through our methodological choice and the deconstruction and collage of the AI images we have defined a process for using images also to go deeper into a scenario. This is not a process, nor a result achieved by to the automatism of the AI, but to the quality of the relationship between designer and AI and that involves observing text-to-image systems within a more complex production ecosystem than just observing the direct capabilities of software.

5. Final remarks

The research presented attempted to present the conceptual complexity underlying a design experience dedicated to the development of future scenarios using text-to-image models. The discussion of the results led to the identification of how there is ample room for reflection and tools related to design practice.

One of the main contributions of this paper is questioning the relationship between sketching in the age of AI. This analysis was facilitated by reevaluating the dynamic between text-to-image technologies and the cognitive process of sketching, as originally framed by Bill Buxton. After addressing the research process and results in detail, some qualities can be identified that deepen the scheme proposed in Figure 1. Firstly, scenario building is a specific design case that belongs to a specific imaginative process that does not cover all the areas in which sketching can be used by a designer, e.g. problem finding and problem solving. Next, it is necessary to specify that sketching to study the realization of a product and, on the other hand, telling a story requires different types of processes related to details and design requirements. Finally, interviews with students revealed a perceived separation between them and AI tools, with many viewing these tools more as entities for conversation than as direct extensions of their creative process, unlike the immediate connection felt with pencil and paper. These observations warrant further investigation, including comparisons across disciplines, such as psychological studies of creative processes.

Exploring the new potential of AI leads us to draw a parallel with Benjamin Bratton's concept of the 'interfacial condition' (Bratton, 2016). The interfacial condition stems from an understanding of the intrinsic and extrinsic interfacing of objects, considering the effects and environments in which we comprehend this interfacing. It allows us to transfer and contemplate relationships among objects, signs, and interfaces through a process similar to a 'fantastic

transubstantiation' whereby everything can be transformed into a tactile technology available for personal micro-rhetorics. By extending this perspective of an intense relationship between software and reality, one can envisage the emergence of a design practice and ideation sketching condition termed the 'AI condition'. Within this condition, anything has the potential to be conceived as designable through a text that defines it in terms of its appearances and components. This concept raises profound implications for the field of design, as it underscores the transformative power of AI in shaping the way we conceptualize and create artifacts and experiences. It challenges conventional boundaries and introduces a paradigm shift in the design process, encouraging a more inclusive, versatile, and text-driven approach to design and creative ideation.

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About the Authors:

Mario Ciaramitaro collaborates with Università Iuav di Venezia since 2011 as tutor at visual arts and design classes. In 2019 he discussed his PhD at Iuav University of Venice focusing on Interface Critique. He is currently Post-Doc Research Fellow.

Pietro Costa is a researcher at Università Iuav di Venezia. Since 2010, he has carried out research activities on User Experience and interaction design, applied to the areas of design for social and environmental sustainability.