

ART IN THE MACHINE: SPECULATIVE DESIGN OF A FUTURE VISUAL CREATIVITY SUPPORT TOOL

How can Speculative UX Design and Visual Media be used to explore the future possibility of creativity support?

XIE HE TENG, SHERRY

Student ID 1555259

Principal Supervisor

Daniel Wagner

Associate Supervisor

Dr. Leon Tan

Date of Submission

31 October 2022

"This Research Project entitled **Art in the Machine: Speculative Design of A Future Visual Creativity Support Tool. How can Speculative UX Design and Visual Media be used to explore the future possibility of creativity support?** is submitted in partial fulfillment of the requirements for the degree of Master of Creative Practice in the Unitec Institute of Technology."

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to my supervisors, Daniel Wagner and Leon Tan for their guidance and advice at every stage of my research project. I have benefited from their immense knowledge throughout the research journey. They have guided me with critical thinking skills and open-mindedness from the outset to improve my research outcomes. Being in such a supportive environment stimulated my creative mindset, leading me to achieve better quality research.

I would like to extend my sincere thanks to Unitec School of Creative Industries for allowing me to access to facilities, equipment and shooting location for my project needs. Special thanks to Unitec Screen Arts students Tiani Keane, Lloyd Lising and my colleagues Eugenie Zhang, Jia Qi Tang who put their effort in assisting me in the video production.

I am also thankful for my family who provided me with continued encouragement. Their belief in me has kept me motivated and made me feel confident in my abilities. Lastly, I wish to acknowledge the unfailing love, support and understanding of my partner, Chun who endured the entire process with me. He has been a constant source of support during my years of study.

TABLE OF CONTENTS

| | |
|--|-----------|
| ACKNOWLEDGMENTS | 2 |
| ABSTRACT | 4 |
| 1. INTRODUCTION | 5 |
| 1.1 BACKGROUND | 5 |
| 1.2 RESEARCH QUESTION | 5 |
| 1.3 RESEARCH AIM AND OBJECTIVES | 6 |
| 1.4 RESEARCH METHODOLOGY AND METHODS | 6 |
| 2. LITERATURE REVIEW | 8 |
| 2.1 CREATIVITY AND ARTIFICIAL INTELLIGENCE | 8 |
| 2.2 AI AS A TOOL FOR VISUAL CREATIVITY SUPPORT | 9 |
| 2.3 TECHNOLOGY TRENDS | 14 |
| 2.4 SPECULATING THROUGH DESIGN | 16 |
| 3. DISCUSSION | 19 |
| 3.1 FUTURE SCENARIO DEFINITION | 21 |
| 3.2 PROTO-PERSONAS | 22 |
| 3.3 FUTURE USERS NEEDS | 24 |
| 3.4 FUTURE USER EXPERIENCE | 24 |
| 3.5 STORYTELLING | 26 |
| 3.6 REFLECTION | 28 |
| 4. CONCLUSION | 29 |
| REFERENCES | 31 |
| APPENDIX I | 38 |
| APPENDIX II | 47 |

ABSTRACT

This practice-based research is an investigation of how to get visual creativity support by collaborating with technological advancements such as artificial intelligence connected to the user through a brain-computer interface. It explores the potential and possibilities of a creativity support tool to facilitate visualization and ideation to unleash the potential for visual creativity. This project is positioned in the field of speculative design, focusing on imagining a future creativity support tool for visual creation. This design practice involves developing a video of the designed artefact as a storytelling device to effectively explain the implications of my work and encourage a broader conversation around the future of human creativity and technology. The idea and design of speculation, including the application of technology, interaction, and function of the designed artefact will be discussed in this exegesis. It is hoped that the result of this research serves the purpose of enabling audiences to think about future scenarios on using emerging technologies to enhance human visual creativity.

KEYWORDS

Speculative Design // Creativity Support Tool // Visual Creativity // User Experience // Artificial Intelligence // Mental Imagery // Mind's Eye

1. INTRODUCTION

1.1 BACKGROUND

Creativity, being essential for innovation, self-expression, and divergent thinking has been highlighted as a 21st Century Skill (Piirto, 2011). I believe gaining new capability in creativity through assisted creation systems can be highly empowering. My experiences working in the creative field fuel my research interests in finding methods for facilitating the creative process in visual creation. I am referring to “creativity” as a term more closely related to “visual artistic creativity”.

My initial entry point into the research landscape is to promote collaborative creativity for visual creation by the support of digital technologies. The vision for promoting collaborative creativity responds to several studies that have indicated that social interaction, communication, and collaboration are key elements in creativity (Glăveanu, 2010; Miell & Littleton, 2004). Furthermore, there is a growing literature base exploring the role of digital tools in supporting creativity through collaboration (Zhao et al., 2014; Piya et al., 2017).

With recent advances in emerging technology, human-AI collaboration challenges the limitations of the human-human collaborative model because of its untapped potential to augment human abilities including creative activities. As we enter the Fourth Industrial Revolution, the nature of work will continuously change with technological development such as artificial intelligence, human-brain interface and augmented-reality smart glasses (Schwab, 2016). The potential of this transition has inspired many future imaginaries, including evolutions in the creative industries. The study of how future technologies integrate into the creative process to assist human visual creativity interests me. I decided to land my research direction on speculative design, combined with a UX design approach, to explore the possible future of a visual creativity support tool. Throughout this project, the term ‘creativity support’ is used to refer to the support given in the ideation phase of the visual creation process.

1.2 RESEARCH QUESTION

How can speculative UX design and visual media be used to explore the future possibility of creativity support?

My research also addresses three following sub-questions to answer the key directed question:

- What kind of assistance can we get from creativity support tools in the creative process?
- How might we facilitate creativity through an assisted creation system?
- What implications will a future creativity support tool have on society?

1.3 RESEARCH AIM AND OBJECTIVES

The aim of this project is to explore the possibilities of how humans may receive visual creativity support in the future. This research project thrives on imagination, operates on a conceptual level, and aims to reveal new perspectives on future creative processes in visual creation. My work in the field of speculative design aims to provoke thought around our current world and our possible future through the lens of technology. My goal in this research is to investigate how we might augment human visual creativity by collaborating with emerging technologies in the future.

In this research, I will experiment with speculative design, UX, and video creation skills to inspire and encourage audiences to think about possible future scenarios of providing support within the creative process of visual creation. The main objectives of the project are the following:

- Create a scenario that describes a potential, alternative sociotechnical structure of the future
- Contextualize the future of creativity support through a speculative design setting
- Create a video to demonstrate the user experience based on the future scenario
- Produce a written exegesis to interpret the process of my work produced, and discuss its value as research

1.4 RESEARCH METHODOLOGY AND METHODS

In this research project, I take the methodological stance of practice-based research, in which the creative artefact constitutes a form of research and generates research outputs that provide answers to the research question (Smith & Dean, 2009, p.5). In line with Skains' discussion (2018), I deem my creative act in this practice-based research as an experiment designed to answer the directed research question. In practice-based research, the creative artefact as the basis of a contribution to knowledge (Candy, 2006) can only be fully understood with a critical exegesis (Skains, 2018). Therefore, a cohesive presentation of a creative artefact and exegesis are essential in this research.

To convey the results of technological investigations into the future, I have applied a speculative design approach to this research. Speculative design is an emerging practice-based research methodology where design artefacts serve as tools for critical reflection (Mitter, 2005). To illustrate how developing technologies may emerge, real-world situations should be used, along with tangible evidence like artefacts, movies, photos, scenarios, and tales. Through these, viewers can imagine what life may be like in the imagined future or alternate present (Auger, 2014).

In addition, I have combined my prior knowledge of UX design and video production techniques to develop and present plausible futures. A multidisciplinary approach is being undertaken to conduct this research because the creative outcome reaches beyond the borders of speculative UX design to the fields of video creation. By combining different design perspectives and practices, multidisciplinary design optimizes my ability to examine a broader spectrum of possible solutions to the problems which are not limited to the extent of my disciplines. Drew (2019) states that "a multidisciplinary approach means drawing from multiple disciplines to redefine problems and reach solutions based on

a new understanding of complex problems”. The methods of problem-solving will be approached differently based on individuals’ backgrounds, experiences, and disciplines.

Having settled on a practice-based research methodology and design approaches, my research methods started with employing literature review to analyse the relevant textual content on the foundation of creativity support, and researching the methods for facilitating visual creativity. I tried to examine the complex requirements of the creativity support tool by reviewing the related literature with the aim to understand the domain of creativity. Snyder (2019) claims that “literature reviews are useful when the aim is to provide an overview of a certain issue or research problem. Typically, this type of literature review is conducted to evaluate the state of knowledge on a particular topic. It can be used, for example, to create research agendas, identify gaps in research, or simply discuss a particular matter” (Snyder, 2019, p. 334).

My study is designed with relevance to the fast-emerging digital era and the developments of advanced technologies. It is important to engage in research on the current technological progress and upcoming innovations because future technological advancements can be informed by current paradigms. After learning about the latest technological developments, I crafted my speculation based on logical trajectories. By extrapolating the contemporary systems and products, I was able to evaluate the implications of the possible products and services before they happen.

My research question is “How can speculative UX design and visual media be used to explore the future possibilities of creativity support?”. To answer this, I used UX methodology, which includes the board of the ‘world building’, proto personas, user needs, and task flow to imagine the user experience.

Finally, a video as part of my creative artefact is also included in this project to present one future scenario. It will be used as a tool for storytelling to present my speculation engagingly. By leveraging storytelling techniques, it is my hope that the video will provide the audience with a visual understanding of my conception. There are increasing possibilities for video to play a significant part in research as a tool for presenting findings (Walker & Boyer, 2018).

2. LITERATURE REVIEW

This literature review is to gain an understanding of the existing research on creativity along with the current trends of how artificial intelligence is growing in the creative industries. In the first section of the literature review, the relationship between creativity and artificial intelligence is discussed. The second section examines the current use of artificial intelligence as an assistive tool for creativity in the creative industries. The technology trends are further investigated with a brief discussion of the potential offered by advanced technologies for future creativity support tools. The last section concludes with the literature on the application of speculative design to this project.

2.1 CREATIVITY AND ARTIFICIAL INTELLIGENCE

The term “creativity” has been defined in various ways, but one definition that seems to encompass all aspects of creativity is that it is “the production of novel, appropriate ideas in any realm of human activity, from science, to the arts, to education, to business, to everyday life” (Amabile, 1997, p.40). The ideas must be novel and appropriate to the problem or opportunity presented (Amabile, 1997, p.40). This view is supported by Kaufman and Sternberg (2010), who suggest that creativity is one’s ability to generate novel, surprising, and compelling ideas.

Similarly, visual creativity refers to the generation of novel and useful visual forms (Dake, 1991). It is a crucial element in many fields, including architecture, sculpture, photography, and painting. In artistic disciplines, Boden (2009) states that: “Creativity is the ability to come up with ideas or artifacts that are new, surprising and valuable”. According to Boden, creativity is not limited to a higher rank of talents but resides in all human beings from different fields in life. She suggests that the novel or the new can be distinguished through two different aspects: psychological creativity (P-creativity) and historical creativity (H-creativity). These refer to either something new for a specific individual or something new for all human history. A new discovery from a specific individual (P-creativity) is most helpful in comprehending the processes of creative surprise (Boden, 2009, p.2).

Boden (2012) further identifies ‘three roads to surprise’ as three different forms of creativity. The first form generates a combination of unfamiliar patterns from familiar ideas. The other two forms explore and transform the conceptual spaces of the human mind and the categorical styles of aesthetic possibility. Respectively, she specifies these forms of creativity as combinational, exploratory, and transformational. In the context of artificial intelligence (AI), the creativity generated from the computer models include examples of all three types (Boden, 1998). Artificial intelligence was defined as “the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence” (McCarthy, 2007). The term “artificial intelligence” usually refers to the stimulation of human intelligence processes by machine that enables it to imitate human capacity (Xu et al., 2021).

Anantrasirichai and Bull (2021) assert that creativity, triggered by curiosity and experimentation, has always unavoidably combined different ideas, often in an abstract yet coherent way, from different domains or multiple experiences. Artificial creativity can be defined as the process of using computers or other artificial means to generate new ideas or solutions. Boden (1998) suggests that AI should mainly focus on P-creativity. If it is able to model this in a powerful way, then artificial H-creativity will automatically appear in some of the cases, which, as we shall see, has already happened. For example, Google DeepMind's *AlphaGo* defeated Lee Sedol, the greatest 'Go' player of the past decade who is famed for his creativity in a series of matches in 2016. DeepMind claims that AlphaGo has performed a number of highly revolutionary and groundbreaking moves that contradicted centuries of known Go knowledge.

The concept of creativity best expresses the potential of human ability. Sawyer (2012) addressed creativity as a "part of what makes us human" (p.3). Creative tasks often need some level of unique thought as well as vast expertise (Anantrasirichai & Bull, 2021). For some people, art, aesthetics and the power of creativity is the peak of human ability, and therefore represents the last frontier for humans to fight against the unstoppable advancement of AI. As du Sautoy (2019) states, "Yet there is still one realm of human endeavor that most people believe the machines will never be able to touch. We have this extraordinary ability to imagine, to innovate and create. Our code, the creativity code, is one we have long felt that no programmer could ever crack. This is a code that we believe depends on being human" (p.2). Conversely, Manovich and Arielli (2022) asserted, "calling something creative is often a measure of our lack of understanding: what we know is ordinary, what we do not know is deemed extraordinary." They argue that creativity may be overvalued as a human faculty simply because we do not understand its workings.

If we believe that humans are more creative than AI, it is because we have a greater understanding of how AI operates, but we still do not understand how people do. AI is fundamentally changing our definition of human creativity, which once was considered a solely human trait. Its advancement has already changed and assisted us in the process of creativity, and it has also challenged the "creative thinking" that humans have long held.

2.2 AI AS A TOOL FOR VISUAL CREATIVITY SUPPORT

According to Shneiderman (2007), the early discoveries of creativity often suggested that creative individuals who held maximally abstract and completely new ideas were rare occurrences in the domain. The modern notion proposes that creativity can be taught and that every person can become creative (Schneiderman, 2007, p.24). Similarly, some writers share the same belief that everyone is a creative being who can train their own creativity; creative muscles can enhance their flexibility with practice (Pavan, 2019). Creativity is not inherent in everyone. Like any other ability, individuals can learn creativity to grow with the right kind of practice (Walz et al., 2016). Robinson, in his book *Out of Our Minds: Learning to be Creative* (2011), notes that "Everybody has tremendous creative capacities."

There are a variety of approaches to using digital devices to support creativity. In the literature, digital tools for creativity support are frequently referred to as creativity support tools. Significant research has been undertaken into the development of creativity support tools, which are designed to enhance human creativity in the arts, sciences, and design fields. Sanders and William (2002) hold the view that "everyday people are creative when given appropriate tools." Computing professionals are now focusing on providing creative support tools that help users to "explore, discover, imagine, innovate, compose, and collaborate" (Shneiderman, 2002). Creativity support tools aim to help users overcome challenges in the arts, sciences, and design fields (Latulipe & Terry, 2008). According to Shneiderman (2002, p.116), creativity support tools are designed with the aim of making "more people more creative more often, enabling them to successfully cope with a wider variety of challenges and even straddle domains". In addition, creativity support tools have the potential to assist people on their own personal creative journeys to support creative work. A new generation of AI-powered Creativity Support Tools (AI-CSTs) has been introduced using novel AI algorithms. These technologies have the ability to inspire users with unexpected algorithmic results. For example, InspireMe assists artists with conceptual 3D design by offering data-driven suggestions in 3D modeling (Chaudhuri & Koltun, 2010). CreativeSVG aims to increase design efficiency and augment creativity (Jin et al., 2021). These programmes fall under the category of creativity support tools, interfaces that foster creativity by incorporating features like encouragement of exploration.

Technology is the development of tools that help extend the range and power beyond our reach. Anantrasirichai and Bull (2021) believe that human capabilities are limited, whether in physiology, visual acuity, or cognitive skills. We have managed to overcome these limitations through the development and use of technology. Microscopes and telescopes, for example, allow us to magnify the field that is visible; Calculators and computers have enhanced our skills of calculation and memory. According to Anantrasirichai and Bull's line of argument, "one could suggest that aesthetic capacity has human limits as well, that there could be a point at which peak creativity, or peak aesthetic sensibility, is reached" (Anantrasirichai and Bull, 2021).

In a study from 2010, an interview was conducted with fifty artists from fields ranging from performing, literary to visual arts regarding their experience of becoming stuck at any stage of their creative process. The study found that most of the participants had experienced creative blocks (Telfer, 2010). Artists experiencing creative blocks refer to a condition in which they are unable to work creatively due to internal or external circumstances (Telfer, 2010, p.172). The artists' descriptions of the emotions connected to being creatively blocked included "fear, self-doubt, depression, frustration, and desperation" (Hirst, 1992). Creative block, in which idea stall for a while, is a common problem for most of the creatives. It might feel like an uphill fight as artists' self-confidence can feel as though it is being jeopardized by these stalls (Levinson, 1997, p.453). Even the famous filmmaker Hayao Miyazaki has gone through periods of inspiration and frustration during his creative process. A documentary chronicling the creative process of filmmaker Hayao Miyazaki during production for his film (*10 Years with Hayao Miyazaki*, Arakawa, 2019), brings to light his difficult moments of struggling with creative block (Figure1).

Figure 1
Hayao Miyazaki stuck in a creative rut



Note. From *10 Years with Hayao Miyazaki* [Documentary], by Arakawa, K., 2019, NHK World TV.

Suppose aesthetic capacity has human limits. In this case, technologies might have the potential to offer new kinds of possibilities for enabling creators to punch through creative blocks and spark novel ideas hidden in their imagination. Anantrasirichai & Bull (2021) foresee that AI will soon be widely used as a tool, or “collaborative assistant”, in the realm of creativity. They explain that the maximum benefit of AI will come from the human-centered arena, aiming to consolidate human creativity, rather than replacing it, in the context of creative industries (p.639).

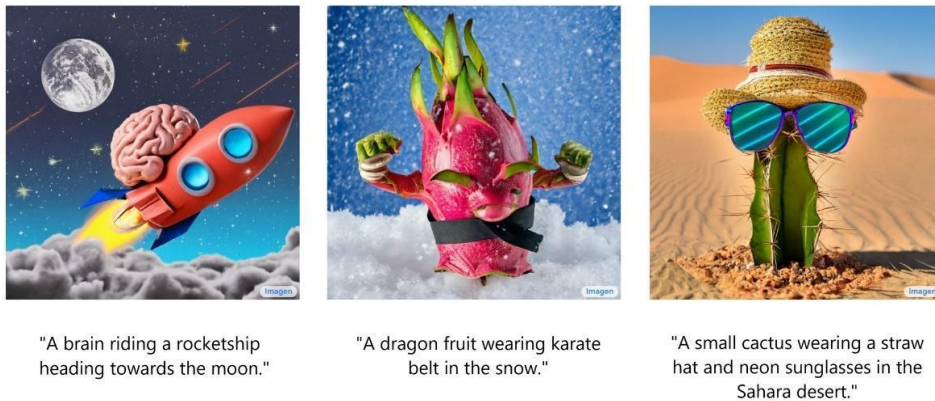
Over recent years, the use of AI assistance, or AI augmentation of the human creative process, is rapidly growing through a variety of creative disciplines. Several creators have explored the use of artificial intelligence techniques for creative tasks such as music composition, story creation, and movie generation. For instance, Flow Machines Project released the first studio album that is composed with the aid of AI technology (*Hello World Album the First Album Composed with an Artificial Intelligence*, 2018). ‘*Sunspring*’ (Sharp, 2016) is the first fictional short film written entirely by an AI bot. ‘*Zone Out*’ (Sharp, 2018), an AI-generated film pieced together by selecting from thousands of hours of movie scenes from the past and green-screen footage of professional actors, was created in 48 hours. These studies suggest that human and AI complementarity in the arts is a rich and continually evolving process, with modern artists constantly investigating and developing technical

capacities to create artworks (Ploin et al., 2022, p.6). Artificial creativity may have a role to play in a range of areas.

The creative process is one area where AI may be especially useful because it can generate a wide variety of ideas to choose from. For example, the text-to-image AI model such as Google's *Imagen* (Saharia et al., 2022) (Figure 2); OpenAI's *Dalle-2* (Ramesh et al., 2022) (Figure 3) and the independently-run *Midjourney* can create surprising variations of existing images or organize totally different or unrelated image objects and generate a brand-new image employing semantically rational methods by using only a textual prompt given by the user. These AI generation tools can adapt to a wide variety of styles, from oil paintings to CGI rendering, and even photographs, in response to a line of text or an uploaded image by employing a neural network.

Figure 2

Imagen samples for various text inputs



Note. From "Photorealistic Text-to-Image Diffusion Models with Deep Language Understanding", by Saharia, C., Chan, W., Saxena, S., Li, L., Whang, J., Denton, E.L., Ghasemipour, S.K., Ayan, B.K., Mahdavi, S.S., Lopes, R.G., Salimans, T., Ho, J., Fleet, D., & Norouzi, M., 2022, *ArXiv*, [abs/2205.11487](https://arxiv.org/abs/2205.11487).

Figure 3

Samples from Dalle-2 for prompt "Vibrant portrait painting of Salvador Dali with a robotic half face"



Note. From "Hierarchical Text-Conditional Image Generation with CLIP Latents", by Ramesh, A., Dhariwal, P., Nichol, A., Chu, C., & Chen, M., 2022, [arXiv:2204.06125](https://arxiv.org/abs/2204.06125)

By exploring a larger space of possibilities, AI can help humans find new and interesting ideas that they may not have thought of on their own. However, these image-generation systems lack any real understanding of the world as we know it. Recent methods of natural language prompt-based input would enable users to approximately convey intentions, but they also have drawbacks, such as the possibility that the user may disagree with the tool over how verbal concepts are interpreted. The outcome of text-to-image could be difficult to predict. The text input might not accurately represent what users had imagined. The task of translating imaginative thoughts into words might be difficult. Feedback from one visual director, for example, is that the algorithm is irritating, since his creative vision is difficult to express in words, and even more challenging to comprehend and render for AI (Kamps, 2022).

Meta showcased an exploratory AI research concept called *Make-A-Scene* that demonstrates AI's potential for empowering the creativity of artists and non-artists alike and bringing their imagination to life (Gafni et al., 2022). The multimodal generative AI method offers greater creative control for AI image generation by allowing users to describe and illustrate their vision through both text descriptions and freeform sketches (Figure 4). Anantrasirichai and Bull (2021) claim that creatives can draw on a lifetime of experiences to think "outside the box" and pose "what if" questions that are difficult for limited learning algorithms to answer. Still, these kinds of artificial intelligence art generators give creators endless creative possibilities as they do not require much expertise.

Figure 4

Samples generated by Make-A-Sense from text and segmentation inputs



Note. From “*Make-a-scene: Scene-based text-to-image generation with human priors*”, by Gafni, O., Polyak, A., Ashual, O., Sheynin, S., Parikh, D., & Taigman, Y., 2022, *arXiv preprint arXiv:2203.13131*.

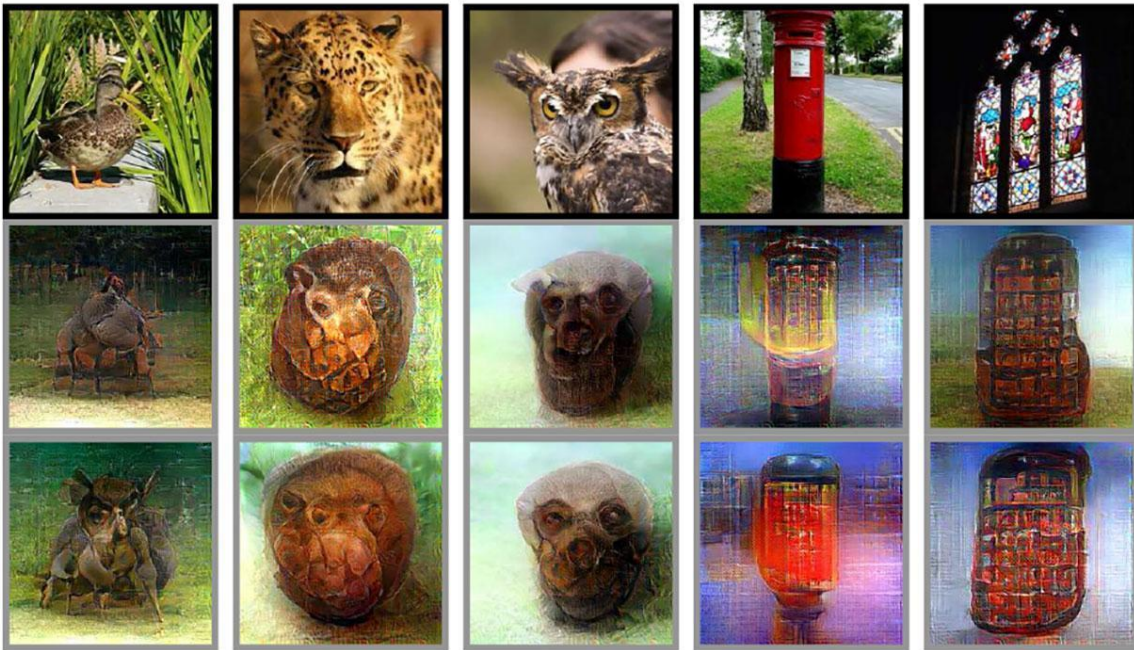
The ability to create and experiment with art and illustration will become far more accessible thanks to AI image generators. Such technologies allow anyone, regardless of creative ability, to convey a story in a captivating visual manner that sparks the imagination. AI might completely free human beings to obtain a certain degree of "creative liberation". AI is already being generally accepted as a tool in the creative industries. It is reasonable to speculate that this trend will continue to develop, and that AI will grow increasingly more prevalent and sophisticated in the future.

2.3 TECHNOLOGY TRENDS

To date, creating a digital painting doesn't get any easier than typing a text prompt as input. Humans obtain their desired results through the process of selection, adjustment, and alteration, to operate a generated network. However, text prompting, composition-controlled image generations are still constrained in some sense for creative expression as we discussed in the last section. This raises an interesting question: what is the next step after text-to-image models? What would it be like to create art and design by using human thoughts as direct input? Is being able to access our mind's eye a practicable extension to convey our vision? If neural networks are able to be trained on brain data, will a future creativity support tool that employs it gain the understanding and usage of artists globally?

A wide range of emerging technologies—including brain-computer interfaces (BCI), augmented reality (AR), virtual reality (VR), and deep learning—have converged in recent years, expanding, and accelerating the capabilities of AI and transforming it into a novel tool for expression. By looking at current technology trends, we can speculate about future possibilities. A decade from now, the ability to decipher mental imagery directly from our brains may become an acceptable practice. Not long ago, this sounded fictional, but now it is within our reach. Several studies have shown that it is possible to decode mental imagery from brain signals acquired via electroencephalography (EEG) (Rashkov et al., 2019) or functional magnetic resonance imaging (fMRI) (Shen et al., 2019). For instance, the researchers from Kamitani Laboratory in Kyoto University used a neural network based on the obtained data using fMRI scan to create images. By using the data, the machine was able to recreate the images of objects from the minds of three volunteers who stared at images of those objects (Figure 5). The technology was also able to recreate visual image generated by a person pondering some memory-related images. Although the accuracy depended on the testers, this groundbreaking result opened a "unique window to access to our inner world" (Shen et al., 2019). And as the accuracy of the technology increases over time, its potential practicality seems limitless. In the future, BCIs will become increasingly sophisticated and will be able to read mental imagery with greater accuracy. The visualization technology may let you draw or create artworks by simply imagining something.

Figure 5
Examples of natural image reconstructions



Note. From “Deep image reconstruction from human brain activity”, by Shen, G., Horikawa, T., Majima, K., & Kamitani, Y., 2019, *PLOS Computational Biology*, 15(1), e1006633. <https://doi.org/10.1371/journal.pcbi.1006633>

There have also been experiments conducted with artists on musical composition, fine art, and other creative applications that required brain activity patterns as input (Nijholt & Nam, 2015). Currently there is an artistic BCI environment that allows users to play and edit animation and compose music (Matthias et al., 2007), and also BCI control samples that are used in instruments and tools for artistic expression and exploration (Todd et al., 2012; Münßinger et al., 2010) (Figure 6). Non-invasive and wearable new brain technologies are used for new artistic expressions enabling researchers to study how brains create and comprehend art real-time in the ecological system (Folgeri et al., 2016).

Two central themes in the next generation of human interaction with technology might be smart glasses and brain-computer interfaces (BCIs). Snap’s recent acquisition of *NextMind* is a fascinating bet on the possibilities of a BCI in our future smart glasses (*Welcome NextMind*, 2022). The use of BCIs in smart glasses for visual creativity support is a particularly promising technology to create a new landscape of creative opportunity.

Figure 6

Brain painting created by the artist Liane Krauss with paralysis



Note. From “Brain painting: first evaluation of a new brain–computer interface application with ALS-patients and healthy volunteers”, by Münßinger, J. I., Halder, S., Kleih, S. C., Furdea, A., Raco, V., Höhle, A., & Kübler, A., 2010, *Frontiers in neuroscience*, 4, 182.

2.4 SPECULATING THROUGH DESIGN

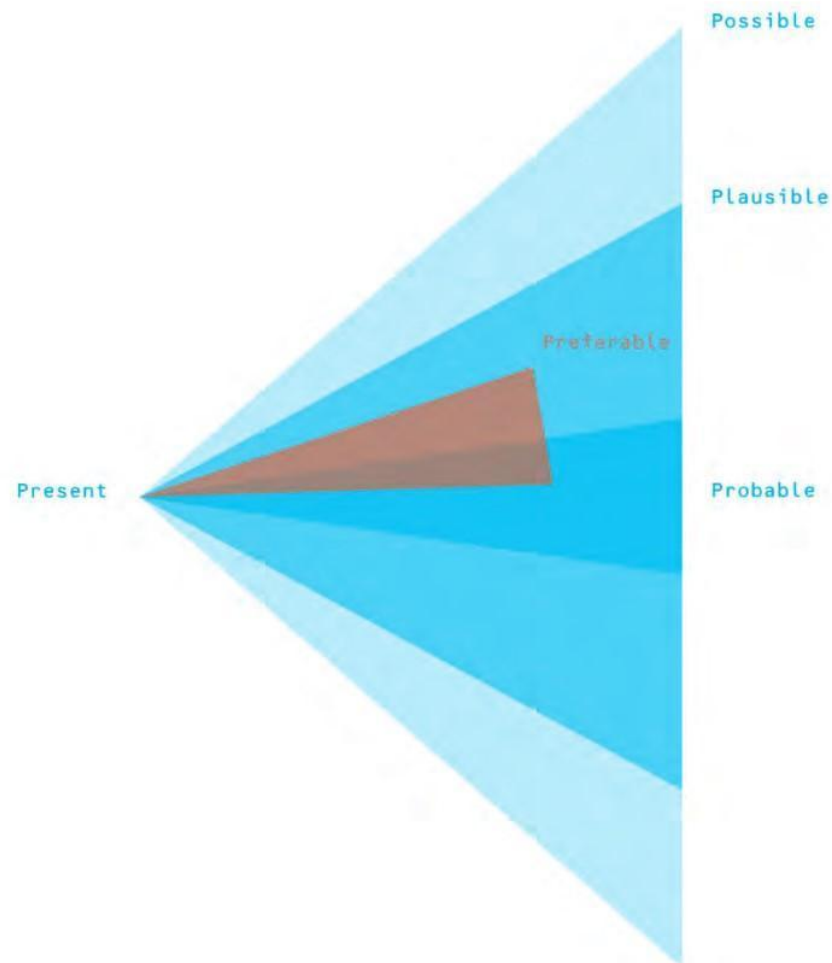
Speculative design is a methodology for design that envisions human future and pathways. The term “speculative design” was coined by Anthony Dunne in the 1990s and, alongside Fiona Raby, pioneered this approach to “act as a catalyst for collectively redefining our relationship to reality” (Dunne & Raby, 2013, p.2). This form of design is concerned with the ideas of possible futures as one way to better understand the present. Speculative design encourages people to think about what it might be like if a given imagined future transpires; to consider how human values might change; and to question whether it would be the future they want. Speculative design is a valuable tool for design research as it uses fiction, and speculates on future products, services, systems and the world, so as to reflectively interrogate the effect and influence the new technology brings towards our daily life (Auger, 2013).

Speculative design as an appendant accessory of critical design is often compared to science fiction as both deal with future scenarios and explore the potential implications of new technologies. However, Mitrović (2015) distinguished speculative design from science fiction as the former is not as separated from reality as scifi tends to be. Speculative design is linked between the present and an imaginary future based on current technologies and trends to explore how these might be used in the future. In contrast, science fiction is based on completely imaginary technologies and often takes place in entirely fictional worlds.

As noted by Dunne and Raby, speculative design “usually takes the form of scenarios, often starting with a what-if question, and are intended to open up spaces of debate and discussion” about the relation between possible transformation in technological development and social relations (2013, p.3). The scenarios should be conceivable from a scientific perspective. It should be a route from our current situation to the situation in the scenario. Audiences can link the scenarios to their own life and use them as a tool for critical reflection when the events that led to the current position are plausible (Dunne & Raby, 2013, p.4). As Auger (2013) suggests, if speculative design veers too far into the future to convey improbable notions, the audience will be unable to build a relation with the proposal, causing the loss of engagement and connection. In essence, a design speculation must establish a connection between the audience's view of their own world and the fictitious component of the concept (p.2). The credibility of the designed artefacts and potential future scenarios is important to the effectiveness and impact of the speculative approach that the target audience feels. To materialize and communicate the concepts of possible future, methods such as fictional narratives, cinematic languages, scripts, storyboards, user testing, interviews/surveys are often used in a speculative approach. Mitrović (2015) points out speculative designers will use any method that is accessible and applicable in speculative design because these forms of design will interact with other related practices, fields and disciplines continuously. In the context of UX design, speculative design normally limits itself to mocking up prototypes, building a good user experience for human-machine interaction, and emerging with a design work in the end. It provides a space for aggressive creativity, but it's based on practical data, with the reason that it doesn't operate in the fictional world (Ibekwe, 2022).

In *Speculative Everything* (2013), Dunne and Raby adapted Stuart Candy's diagram to illustrate four classes of potential alternative futures that were suggested by Joseph Voros (2001). Taking Joseph Voros's definition of potential future types to the design field, most design methods and processes are applicable to the probable future fields that the majority of the designers will find themselves in. The plausible future depicts alternative futures and the possibilities of 'what could happen' and the possible future extends beyond the realm of extreme scenarios of what is scientifically possible. Speculative design is seen to be in between probable and plausible futures (Figure 7), which considers prediction for the future and scenario planning (Dunne & Raby, 2013). Preferable future is defined as what we “want to” happen. Voros (2001) claims that preferable future is subjective because it derives from value judgments, and values differ so markedly between people.

Figure 7
The Future Cones



Note. From “Speculative Everything: Design, Fiction, and Social Dreaming (The MIT Press) (Illustrated ed.)”, by Dunne, A., & Raby, F., 2013, The MIT Press.

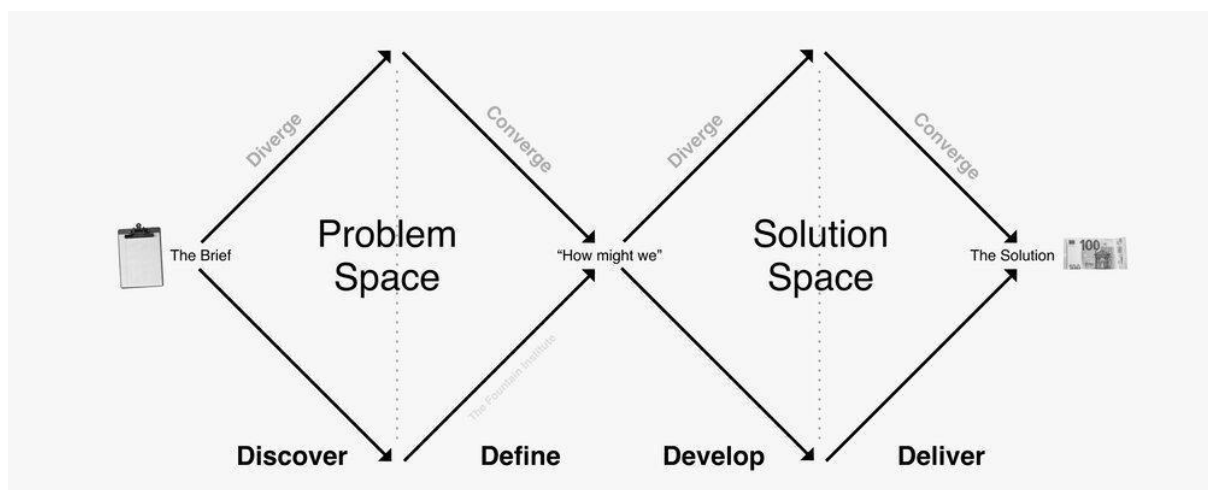
Dunne and Raby (2013) point out there are neither solutions nor answers in speculative design projects, but only questions, thoughts, ideas and possibilities, all of which are expressed through design language. As James Auger (2013) writes: “speculative design proposals are essentially tools for questioning”. The speculative design approach offers a provocative beginning point from which a design process evolves but does not necessarily define a specific problem to solve. The outcome is a fluid development of reflection and iteration employing designed objects to provoke queries and encourage discussion (Mitter, 2005). To conclude, this research project encourages people to think about what if such a future would come, how human values would change, and whether it would be the future we want.

3. DISCUSSION

James Auger (2013) reminds us that “a vital factor in the success of a Speculative Design proposal is the careful management of the speculation, specifically what informs the use of technology, aesthetics, behaviour, interaction and function of the designed artefact”. In this section, I will further discuss the use of technology and function of the designed artefact based on the research carried out on trends in new technologies. Developments of advanced technology are the key triggers of my speculative inspirations and prompt me to explore what is offered by speculative innovation right now. Rather than solving problems, I used this design project as a medium to ask questions about the possibility of a future creativity support application and open issues to discussion. I will describe how to combine the application of techniques borrowed from UX design and movies with intelligent extrapolations of emerging technology, so as to imagine a plausible future design.

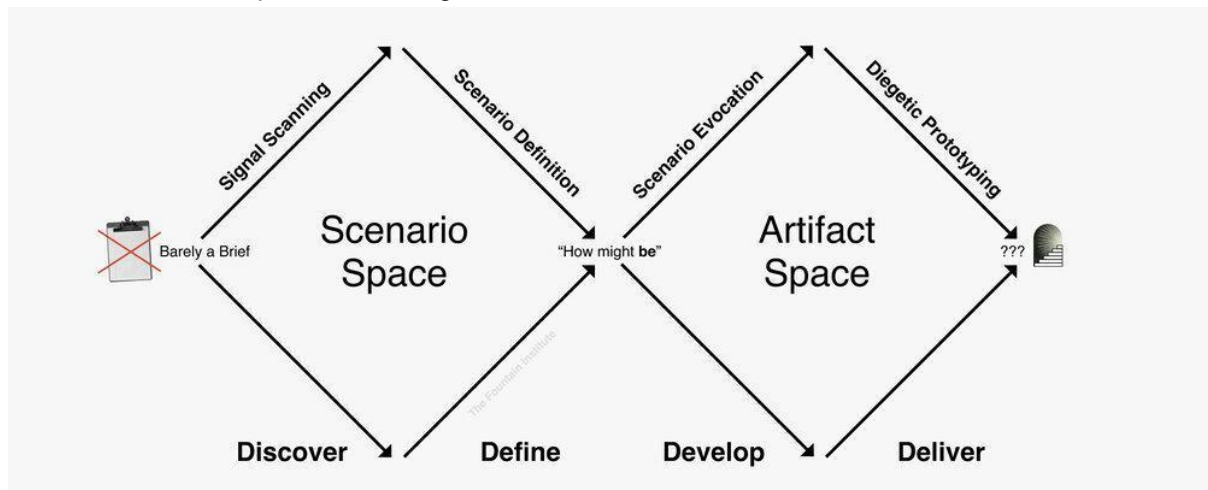
In my design process, I use the Double Diamond model to position myself in the field of Speculative Design. This approach is useful for me to not get lost in the exploration and to orient myself along with projects. The term “Double Diamond” is a design thinking framework to map the divergent and convergent stages of a design process. The classic Double Diamond (Figure 8) shows that there are two totally different activities in design: problem-finding and problem-solving (2005). However, Speculative Design doesn’t work on problems and solutions. Therefore, Colosi (2021) suggests that the two diamonds should be represented differently in Speculative Design: a scenario space and an artifact space (Figure 9).

Figure 8
Classic Double Diamonds



Note. From “The Double Diamond of Speculative Design”, by Colosi, C., 2021, The Fountain Institute. <https://www.thefountaininstitute.com/blog/the-double-diamond-of-speculative-design>

Figure 9
Double Diamond of Speculative Design



Note. From “The Double Diamond of Speculative Design”, by Colosi, C., 2021, The Fountain Institute. <https://www.thefountaininstitute.com/blog/the-double-diamond-of-speculative-design>

Like the traditional Double Diamond, the first diamond in Speculative Design is designed to collect, analyse and integrate data, during which the steps of signal-scanning and scenario-defining are involved. In the divergent step of signal-scanning, the traces of an emerging future are gathered through research. As mentioned in the literature review, I have researched the groundbreaking and revolutionary technologies that could pivot our future. These findings inspire me to imagine the possible direction of our sociotechnical evolution.

The next phase is the converging steps of scenario definition, where the information is combined to create a scenario that describes a potential, alternative sociotechnical structure of the future. I have selected and combined the data that was collected in the previous phase, to provide a framework for the imagined future. In the divergent phase of the second diamond, I start to imagine life in the ‘what if’ scenario. In this step, I imagine user cases and stories and extend the reality to the possible limitations. The technologies that are unavailable today will be parts of our life tomorrow. Lastly, there will be a convergent phase of narrative prototype, in which I execute the prototype on the concept of design to narrate and reflect the key aspects of the imagined world.

In the Double Diamond model, the process of design is comprised of four steps: Discover, Define, Develop and Deliver. I have discussed the Discover process by exploring emerging technologies and trends in the literature review. The following phases of Define, Develop and Deliver will be described in this section.

3.1 FUTURE SCENARIO DEFINITION

Through research, spectacles/glasses in the future could rely on mind reading as I discussed earlier in the literature review. I imagine how the technologies will be used in the future and set the time frame at 2050. By the year 2050, smartphones, tablets, and computers are expected to be replaced by new form devices. With the continuous fine-tuning of technology, the future of smart glasses looks promising. Tech giants like Meta (2021), Xiaomi (2021) and Google (2022) are leading the charge toward widespread adoption. There is the possibility that the development of brain-computer interfaces will have reached a point where they will become a cloud-based extension of each person's brain, much like our smartphones are today, except all the information will be seamlessly integrated into our conscious awareness of the world around us (Hoffman, 2018).

It is worthwhile acknowledging that as both thinking and technological developments continue to evolve, existing paradigms will also evolve. We will be likely operating under assumptions that are yet to take shape. Therefore, I propose some assumptions of features used in 2050 when discussing my speculative future landscape.

- Brain-Computer Interfaces (BCI) are largely usable for everyday purposes. Non-invasive sensors have become the choice of mainstream BCI use.
- There is a wide range of adoption and application of smart glasses in our daily lives. They connect our vision with the virtual world through display screens, sensors, software and the internet.
- A non-invasive wearable BCI that features the function to read the user's mind has been realized.

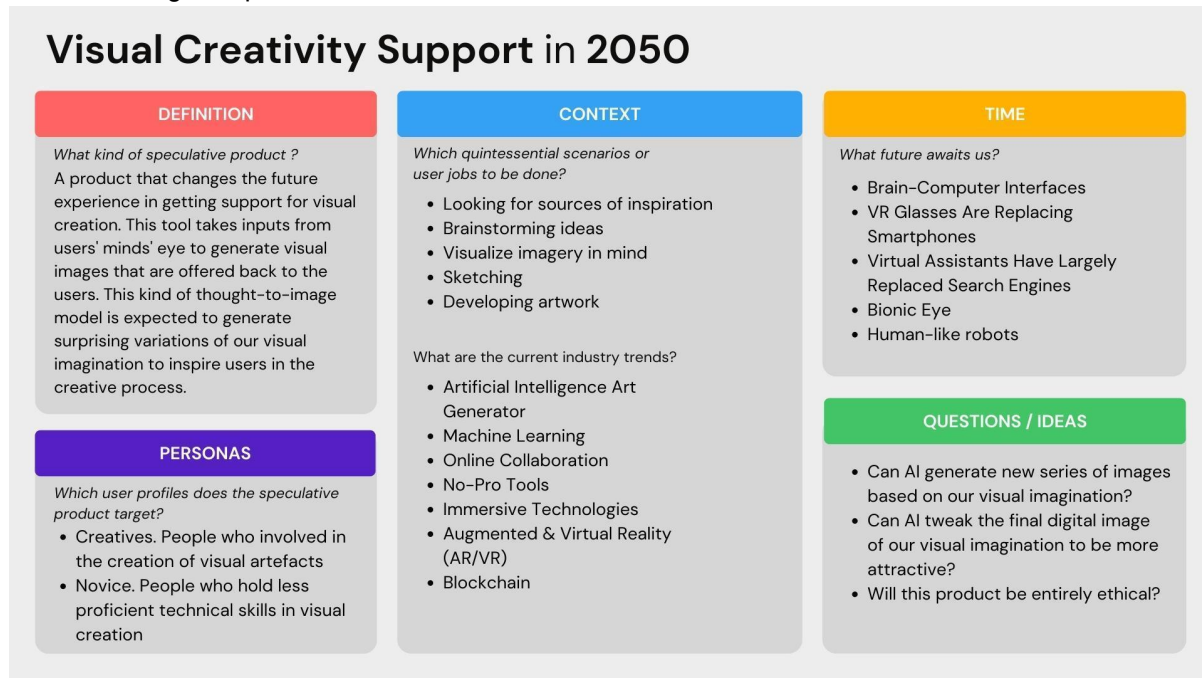
Figure 10

Illustration of future scenario generated by Dalle-2 for prompt “an illustration of an artist using high tech glasses to read mental imagery for creating art”



I am inspired by Nadia Piet's speculative UX design methodology (Piet, 2019) in using a structured template to begin constructing the future world. The objective of this template is to map out a clear overview of the future world by laying out the definition of the context, the time frame, industry trends etc. These elements are useful for the force fit in the next design step.

Figure 11
'World Building' Template



3.2 PROTO-PERSONAS

To imagine human-centered speculations, personas play an essential role as a tool to answer the question "who is this product being designed for?" in detail. Personas are fictional characters created to represent different types of people who might use the product. I embraced Leah Buley's research methods suggested in his book: *The User Experience Team of One* (2013), to use proto-personas instead of classic personas in this research. The development of proto-personas is a kind of technique that provokes empathy and is a customer-oriented way of thinking. It doesn't have to undergo detailed customer research or to have voluminous statistical data to support the designer's way of thinking. (Buley, 2013, p.132). In this project, I ideated the proto-personas inhabiting the futures based on my domain expertise in the creative field, assumptions, and insights. Although proto-personas are less "scientific" and rigorous than traditional personas, they can be equally effective in helping me to speculatively model the users' expectations, needs, and goals.

Figure 12
Proto-Personas



3.3 FUTURE USERS NEEDS

Proto-personas gave me a starting point from which to begin evaluating the future application and to create some early design hypotheses. With the aim to fulfill the future users' needs in participating visual creation, I expected the application should act as:

- A visualization tool to unleash users' inner creativity. Visualization through visual images is an effective way to convey abstract and concrete ideas, enabling users to output their visual imagination, and allowing them to create any form of visual art to express themselves without the restriction of technical skill level.
- An inspiring tool to facilitate ideation, offering inspiration material and assisting in idea generation. Providing more flashes of creative thoughts impede the ideation.

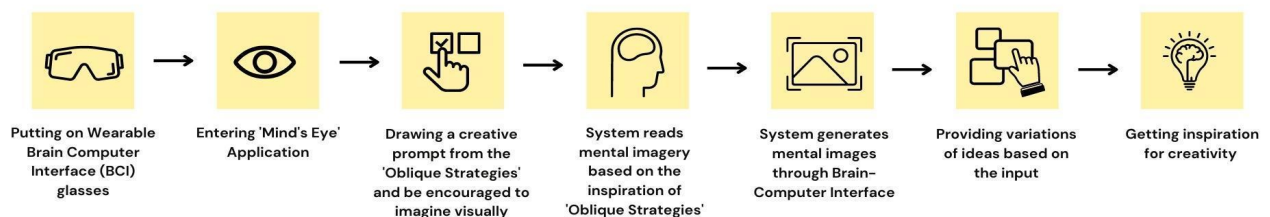
3.4 FUTURE USER EXPERIENCE

For better communication of my speculation, I used a task flow to present the general process of interaction with the future creativity support tool, called 'Mind's Eye' in this project. Mind's Eye was speculatively designed based on the secondary research carried out on trends in new technologies, my definition of a future scenario, assumptions of features used in the future, and the hypotheses of future users' needs. This user experience task flow (Figure 13) represents the step-by-step sequence of how a general user might accomplish the task of getting visual creativity support in 'Mind's Eye'.

A creative process is commonly assumed to have different stages or phases (Amabile, 1996; Gabriel et al., 2016; Wallas, 1926). Among different types of support from creativity support tools, I focus on intelligent support that brings in inspiring ideas, such as ideation or generative support. The stage of this system to support is mainly focusing on idea finding in creative work.

Figure 13

Task Flow: Getting Inspiration for Creativity



The task flow (Figure 13) illustrates the paths the users might be taken to get support for inspiration in their creative process when using 'Mind's Eye'.

Step 1: Users put on wearable brain computer interface (BCI)

Step 2: Users enter the start page of 'Mind's Eye'

Step 3: Users draw a creative prompt and be encouraged to imagine visually

Step 4: Brain computer interface device reads the users' mental imagery by decoding neural signals in the parts of the brain where visual imagination occurs

Step 5: 'Mind's Eye' uses artificial intelligence machine learning to interpret those neural signals to provide the users with visual stimuli that originated deep in their own brain

Step 6: 'Mind's Eye' helps users find new and interesting ideas that they may not have thought of on their own by providing variations of images based on the input.

Step 7: Users get inspiration for visual creativity

As discussed earlier, one area where AI technologies are anticipated to be valuable is the creation of art (Chung et al., 2022). However, the ease of the existing automated AI art generator that automatically generates a final work rather than helping users in the creative often comes at a price of lacking creative support. These systems normally get rid of the complicated parts of the creation of art, but never encourage the exploration of creativity. This is crucial because discussions about how to balance automation and control in human-AI systems have raged for years amongst designers of AI tools (Heer, 2019). Researchers have identified three requirements for designing user expression in artificial intelligence creativity support tools (AI-CSTs) for inspiration after implementing extensive research regarding the support models in the field of the creation of art (Chung, 2022):

1. Allow users to express intentions that are under-constrained. The level of under-constraints would need to be controlled by the users and matched to the algorithmic unpredictability
2. Enable co-learning between users and AI-CSTs through iterative interactions. Users should be able to comprehend how AI-CSTs would react with their inputs while AI-CSTs would need to learn the users' style and values
3. Make input iterations simple and expressive for users. Iterative expressions should make it easier for users to quickly explore different concepts

I have referred to these requirements when thinking about the user experience of a future visual creativity support tool. It is crucial to encourage users to express "under-constrained intentions". However, to assist in overcoming creative blocks, it is helpful to introduce the features of prompting suggestions or parameters into the early process. I have employed a disruptive method known as *Oblique Strategies* in the design of 'Mind's Eye' to encourage lateral thinking. *Oblique Strategies* is a practical tool developed by artists Brian Eno and Peter Schmidt. It was created with the intention of supporting artists to generate ideas, to break through creative blocks, and to get rid of obsolete thought models. It was originally a series of cards, each with a random suggestion or phrase which can be used as a prompt to break a deadlock or a dilemma situation. Researchers found that these cards benefit users through providing "forced inspiration in a decidedly provocative and allusive manner as a vehicle of divergence" (Biskjaer et al., 2010). In 'Mind's Eye', users incorporate creative prompts from *Oblique Strategies* into their early process as a jumpstart to spark inspiration and re-ignite visual imagination. Introducing a creative prompt such as *Oblique Strategies* into the process adds an element of randomness that has the power to break mental habits that might be holding the user back.

Following the creative prompts from *Oblique Strategies*, the user is encouraged to let their visual imagination flow and cultivate the fields of their feelings. The development of a wearable non-invasive brain-computer interface looks promising to decode neural signals in the parts of the brain where visual imagination occurs. Through the wearable non-invasive brain-computer interface, the system analyzes users' brain activity in the occipital cortex to access their mind's eye and generate visual images that are offered back to the artist through the smart glasses. And then, using artificial intelligence machine learning, Mind's Eye interprets those neural signals to provide users with visual stimuli that originated deep in their own brain.

'Mind's Eye' is conceived to offer users varying algorithmic outputs by using artificial intelligence machine learning residing in its system. The user can benefit from rapid exploration of varying algorithmic outputs. By leveraging random algorithmic AI behavior, 'Mind's Eye' can help the user to find creative inspiration in the unexpected images placed before them; images with origins in the user's own visual imagination. The intention of this creativity support tool is to encourage creative exploration. By introducing unexpected external elements into the creative process, the user is supported to stretch the boundaries of their imagination in ways that they would never have thought previously.

3.5 STORYTELLING

One of the core motivations of this method is to transfer the discussion of technology from the professional field to a wider range of target audience. I tried to visualize and express my concept using short clips. In order to make the future more believable, I decided to use a clear and easy-to-understand method to tell this story. This method is closely related to our daily experiences. Extending everyday life to the future is what makes speculative design fiction powerful and attractive. (Mitrović, 2015). In my video scenario (Figure 14), I choose a familiar art studio scene: a backdrop with many paintings; a table full of tools such as paints, brushes, paint pallets; a studio easel with canvas. The unusual element is the appearance of a pair of wearable BCI glasses (Figure 15). The character in the scene wears the glasses, looking for inspiration to paint. Through the familiar elements, the video places the creativity support mode of the future in a believable daily life. One of the main goals of speculation is to allow the public to be involved in the re-thinking and conversation on new technological realization and new social relations. I hope the individual's fictional scenario portrayed in the video finds its way to a larger audience and opens a space for discussion. It is hoped that the viewers are able to imagine the designed artefact as being in his or her own life, and, through identifying with the protagonist, that they envision themselves within the narrative. It is their responses that end up being the real outcomes of this type of design research. To convey an extraordinary experience, it is crucial to have an appealing and well-composed narrative to explain how the world will become its future form (Garduño García & Gaziulusoy, 2021).

Figure 14
Screenshot from video



Figure 15
Screenshot from video



The reason I feature the painting medium in the user experience scenario in the video is because painting is considered the earliest form of art (McDermott, 2021). Drawing, composition, narration, and abstraction are some of the aspects paintings incorporate, making it a significant form in the visual arts. Despite the fact that there might be questions about the existence of painting in the future, painting as an art form has endured over the millennia through all technological improvements. No

matter how far technology advances, it's probable that humans will continue to express themselves through painting. Paul Delaroche exclaimed "painting is dead" around 180 years ago (Bann, 1997, p.9), yet there are plenty of legitimate arguments about the importance of painting as an avant-garde art tool. The initial concept of Delaroche has been repurposed as new mediums have come and gone from the limelight, but painting isn't going anywhere anytime soon.

3.6 REFLECTION

Future speculation develops scenarios of the future that critically examine the notion of progress, the application and usage of new technology, and their broader societal ramifications. Ramia Mazé (2016) emphasizes that design practices have never been neutral, because they are always facing controversial and political issues and related options and futures. Therefore, Dunne and Raby (2013) emphasize the potential of speculative design when responding to critical social and political challenges such as democracy or sustainability, for example, or the options in the current economic paradigm. In this regard, Naomi Klein issues a warning that the current predominance of dystopian narratives in literature and cinema culminates in a belief that catastrophic scenarios are inescapable, which makes us passive rather than proactive (Kirtley, 2014). Therefore, what's important to note is that the objective of speculative designed fiction should not be creating utopian or dystopian science-fiction fantasies of the future, but rather proactively engaging yourself in the discussion of what it will be like in the future (Mitrović, 2015).

In this reflection section, I raise some questions and concerns around potential future experiences. For users who have Aphantasia, the inability to visualize mental images, 'Mind's Eye' may not bring benefits for their experience with visual creativity support. I tend to speculate 'Mind's Eye' as a universal design to include a broader range of people. However, users with accessibility needs, especially Aphantasia, might feel excluded from the discussion. Further features can be considered to enhance the experience for people with this and other disabilities.

In discussing the implications of 'Mind's Eye', it is appropriate to discuss possible unintended consequences this application might cause. This invites us to critically question the concept of development: Will users become excessively dependent on this kind of creativity support tool for idea generation? Might over-reliance on such a tool engender a sense of disempowerment and might that cause artists to feel less inspired? Might artists be sacrificing their own creative initiative by surrendering inspiration to an external tool? Will the users lose their imagination skills as 'Mind's Eye' is spoon-feeding them the source of inspiration? Will the user's ability to think creatively, and other cognitive skills, diminish? A consequence in a larger social context could be that less value is placed on inspiration, originality, and purity of form with this kind of support tool, encouraging users to favour being inspired by ideas generated from artificial intelligence. Therefore, rather than having originality of style or form, creativity may be more directly relegated to the process of the production, synthesis, and transformation of pre-existing ideas and imagery rather than engaging with the task of employing one's own imagination.

When creating this application in the future, there are a number of ethical concerns that must be taken into account. For instance, it is crucial to consider the issue of informed consent. People should be made aware of the risks and benefits of the technology before utilizing BCIs to interpret mental pictures. In addition, it is important to consider the issue of data privacy. The information gathered while utilizing BCIs to interpret mental images might be used to alter or profile individuals. As a result, it's critical to guarantee that user data is safeguarded.

To balance the discussion of ways in which 'Mind's Eye' might compromise our ability to be creative, it is also worthwhile to mention the potential positive outcomes that 'Mind's Eye' could bring to the world of creativity. This kind of advanced support tool might eradicate barriers to creative excellence. It is easier than ever before to tap into inspiration when more people are being provided creative ideas to facilitate their imagination. This project serves the purpose of evoking critical discussion in society that welcomes divided views on this speculation. As we get further down the road in the fourth industrial revolution, where might the relationship between human and AI creativity be headed? Where does the boundary between human and AI creativity lie? What type of future do we envision regarding crossing that boundary? What steps might we want to begin taking now to ensure that it's headed where we want it to go?

4. CONCLUSION

This research is promoted as a tool for critical reflection about collaboration with technologies to support human visual creativity. Applying speculative logic to my study enables me to view the broader picture and to gain a better understanding of my profession that I had before I began this journey. In the course of the process, I make speculations on future scenarios and reflectively examine the role of technology in everyday life whilst considering its implications with a larger social context. Through speculative design, I interrogate the possible results of technological applications before they become practical products in the future. Employing speculative design through this process has provided me with a chance to expand my imagination and encourage my creativity to flow unrestrictedly by moving away from the limitations of commercial practice that tends to focus on meeting the needs of the current user. As a result of this project, I have a better understanding of how to utilise speculative design as a method to develop fictional narratives about possible futures, and to generate story through creative artefacts to initiate dialogue with audiences. Rather than solving problems, my role in this project is to focus on developing concepts and offering visionary scenarios for the future. Through the use of storytelling, the outcome of this project intends to suspend people's disbelief by making the future comprehensible. I aim to provide a resource to understand ways in which technology can transform user experience in the process of gaining inspiration for creativity in the future.

In the context of the creative industries, there will always be debate relating to collaboration between intelligent algorithms and human creative capacity. This project has inspired me to explore more possibilities of collaboration between machines and humans in the field of visual creation. I believe

that evolving technological capabilities enable many different approaches to support visual creative works. As a speculative design practitioner, it excites me to critically think about alternative ways of being. I will continue paying close attention to the development of technology used in the creative industries. The topic of technology for creativity has become my main interest.

REFERENCES

- Amabile, T. M. (1996). *Creativity in context: Update to "The Social Psychology of Creativity."* Westview Press.
- Amabile, T. M. (1997). Motivating Creativity in Organizations: On Doing What You Love and Loving What You Do. *California Management Review*, 40(1), 39–58. <https://doi.org/10.2307/41165921>
- Anantrasirichai, N., & Bull, D. (2021). Artificial intelligence in the creative industries: a review. *Artificial Intelligence Review*, 55(1), 589–656. <https://doi.org/10.1007/s10462-021-10039-7>
- Arakawa, K. (Director). (2019). 10 Years with Hayao Miyazaki [Documentary]. NHK World TV.
- Auger, J. (2013). Speculative design: crafting the speculation. *Digital Creativity*, 24(1), 11–35. <https://doi.org/10.1080/14626268.2013.767276>
- Auger, J. H. (2014). Living With Robots: A Speculative Design Approach. *Journal of Human-Robot Interaction*, 3(1), 20. <https://doi.org/10.5898/jhri.3.1.auger>
- Bann, S. (1997). *Paul Delaroche: History Painted*. Reaktion Books.
- Biskjaer, M. M., Dalsgaard, P., & Halskov, K. (2010, January). Creativity Methods in Interaction Design. *Conference: Proceedings of the 1st DESIRE Network Conference on Creativity and Innovation in Design*.
- Boden, M. A. (1998). Creativity and artificial intelligence. *Artificial Intelligence*, 103(1–2), 347–356. [https://doi.org/10.1016/s0004-3702\(98\)00055-1](https://doi.org/10.1016/s0004-3702(98)00055-1)
- Boden, M. A. (2009). Creativity in a nutshell. *Think*, 5(15), 83–96. <https://doi.org/10.1017/s147717560000230x>
- Boden, M. A. (2012). *Creativity and Art: Three Roads to Surprise* (Reprint ed.). Oxford University Press.
- Buley, L. (2013). *The User Experience Team of One: A Research and Design Survival Guide* (1st ed.). Rosenfeld Media.
- Candy, L. (2006). *Practice Based Research: A Guide*. Creativity and Cognition Studios Report.
- Chaudhuri, S., & Koltun, V. (2010). Data-driven suggestions for creativity support in 3D modeling. *ACM Transactions on Graphics*, 29(6), 1–10. <https://doi.org/10.1145/1882261.1866205>

Chung, J. J. Y. (2022). Artistic User Expressions in AI-powered Creativity Support Tools. *UIST '22 Adjunct*. <https://doi.org/10.1145/3526114.3558531>

Chung, J. J. Y., He, S., & Adar, E. (2022, June 13). Artist Support Networks: Implications for Future Creativity Support Tools. *Designing Interactive Systems Conference*. <https://doi.org/10.1145/3532106.3533505>

Colosi, C. (2021, September 17). *The Double Diamond of Speculative Design*. The Fountain Institute. <https://www.thefountaininstitute.com/blog/the-double-diamond-of-speculative-design>

Dake, D.M. (1991). The visual definition of visual creativity. *Journal of Visual Literacy*, 1, 99–118.

Drew, C. (2019, February 7). *What is a multidisciplinary approach to design? - FutureGov*. Medium. <https://blog.wearefuturegov.com/what-is-a-multidisciplinary-approach-to-design-b5f62a28b804>

Dunne, A., & Raby, F. (2013). *Speculative Everything: Design, Fiction, and Social Dreaming* (The MIT Press) (Illustrated ed.). The MIT Press.

du Sautoy, M. (2019). *The Creativity Code: Art and Innovation in the Age of AI*. Harvard University Press.

Folgieri, R., Soave, F., & Lucchiari, C. (2016). Creative thinking: a brain computer interface of art. *ICLI*, 74–79. <https://doi.org/10.13140/RG.2.2.31683.40489>

Gabriel, A., Monticolo, D., Camargo, M., & Bourgault, M. (2016). Creativity support systems: A systematic mapping study. *Thinking Skills and Creativity*, 21, 109-122.

Gafni, O., Polyak, A., Ashual, O., Sheynin, S., Parikh, D., & Taigman, Y. (2022). Make-a-scene: Scene-based text-to-image generation with human priors. *arXiv preprint arXiv:2203.13131*.

Garduño García, C., & Gaziulusoy, İ. (2021). Designing future experiences of the everyday: Pointers for methodical expansion of sustainability transitions research. *Futures*, 127, 102702. <https://doi.org/10.1016/j.futures.2021.102702>

Glăveanu, V. P. (2010). Paradigms in the study of creativity: Introducing the perspective of cultural psychology. *New Ideas in Psychology*, 28(1), 79–93. <https://doi.org/10.1016/j.newideapsych.2009.07.007>

Google. (2022, May 11). *Breaking down language barriers with augmented reality | Google* [Video]. YouTube. <https://www.youtube.com/watch?v=lj0bFX9HXeE>

Heer, J. (2019, February 4). Agency plus automation: Designing artificial intelligence into interactive systems. *Proceedings of the National Academy of Sciences*, 116(6), 1844–1850.

<https://doi.org/10.1073/pnas.1807184115>

Hello World album the first album composed with an artificial intelligence. (2018). SKYGGE.

<https://www.helloworldalbum.net/>

Hirst, B. (1992). How Artists Overcome Creative Blocks. *The Journal of Creative Behavior*, 26(2), 81–82. <https://doi.org/10.1002/j.2162-6057.1992.tb01163.x>

Hoffman, S. (2018, December 3). *The End of Smart Phones: Time for Advanced Brain-Computer Interfaces*. Earth 2050.

<https://2050.earth/predictions/the-end-of-smart-phones-time-for-advanced-brain-computer-interfaces>

Ibekwe, U. (2022, January 12). *Speculative design and the future*. Learn about UX Research, Design, and More. . . <https://blog.uxtweak.com/speculative-design-and-the-future/>

Jin, Y., Gao, G., Ong, T., & Su, X. (2021). CreativeSVG: A Creativity Support Tool for Abstract Background Design with Generative Vector Graphics. *CEUR Workshop Proceedings*, 2903.

Kamps, H. J. (2022, August 2). *It's paintbrushes at dawn as artists feel the pressure of AI-generated art*. TechCrunch. <https://techcrunch.com/2022/08/02/ai-art-generated/>

Kaufman, J. C., & Sternberg, R. J. (2010). *The Cambridge Handbook of Creativity (Cambridge Handbooks in Psychology)* (First Edition). Cambridge University Press.

Kirtley, D. B. (Host). (2014, December 20). Dystopian Fiction's Popularity Is a Warning Sign for the Future (No. 129) [Audio podcast episode]. In *Geek's Guide to the Galaxy*. Wired.

<https://www.wired.com/2014/12/geeks-guide-naomi-klein/>

Latulipe, C & Terry, M. A. (2008). Evaluation instruments for creativity support tools. 187-188. 10.1145/1531826.1531882.

Levinson, M. H. (1997). Mapping Creativity with a capital "C". *ETC: A Review of General Semantics*, 54(4), 447–453. <http://www.jstor.org/stable/42579793>

Manovich, L., & Arielli, E. (2022). *Artificial Aesthetics: A Critical Guide to AI, Media and Design*.

<https://manovich.net>

Matthias, J., & Ryan, N. (2007). Cortical songs: musical performance events triggered by artificial spiking neurons. *Body, Space & Technology*, 7(1).

Mazé, R. (2016). Design Practices are Not Neutral. In Mitrović, I. & Šuran, O. (Eds.), *Speculative – Post-Design Practice or New Utopia?* Ministry of Culture of the Republic of Croatia & Croatian Designers Association.

McDermott, A. (2021). What was the first “art”? How would we know? *Proceedings of the National Academy of Sciences*, 118(44). <https://doi.org/10.1073/pnas.2117561118>

McCarthy, J. (2007). What is artificial intelligence?.
<http://jmc.stanford.edu/articles/whatisai/whatisai.pdf>

Meta. (2021, September 9). *Ray-Ban Stories* [Video]. YouTube.
<https://www.youtube.com/watch?v=w328hm5KUKc>

Miell, D., & Littleton, K. (2004). *Collaborative Creativity: Contemporary Perspectives* (1st ed.). Free Association Books.

Mitter, N. (2005). *Speculative Design: Creative Possibilities and Critical Reflection*.
<https://speculativdesign.com>

Mitrović, I. (2015). Introduction to Speculative Design Practice – Eutropia, a Case Study. Croatian Designers Association, Arts Academy / University of Split

Münßinger, J. I., Halder, S., Kleih, S. C., Furdea, A., Raco, V., Höhle, A., & Kübler, A. (2010). Brain painting: first evaluation of a new brain–computer interface application with ALS-patients and healthy volunteers. *Frontiers in neuroscience*, 4, 182.

Nijholt, A., & Nam, C. S. (2015). Arts and Brain-Computer Interfaces (BCIs). *Brain-Computer Interfaces*, 2(2–3), 57–59. <https://doi.org/10.1080/2326263x.2015.1100514>

Pavan, D. (2019, May 10). *Can We Train Our Creative Muscles?* Forbes.
<https://www.forbes.com/sites/forbesagencycouncil/2019/05/10/can-we-train-our-creative-muscles/?sh=2e9fc0d92c8d>

Piet, N. (2019, June 28). *Exploring potential AI futures: Agenda, templates & learnings from my first Speculative Design workshop*. Medium.
<https://medium.com/mobgen/the-full-agenda-learnings-from-my-1st-experiment-in-facilitating-a-speculative-design-workshop-ec9f6daee9f8>

- Piirto, J. (2011). Creativity for 21st Century Skills. *Creativity for 21st Century Skills*, 1–12. https://doi.org/10.1007/978-94-6091-463-8_1
- Piya, C., Vinayak., Chandrasegaran, S., Elmqvist, N., & Ramani, K. (2017). Co-3Deator: A Team-First Collaborative 3D Design Ideation Tool. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. <https://doi.org/10.1145/3025453.3025825>
- Ploin, A., Eynon, R., Hjorth, I. & Osborne, M. A. (2022). AI and the Arts: How Machine Learning is Changing Artistic Work. Report from the Creative Algorithmic Intelligence Research Project. Oxford Internet Institute, University of Oxford, UK.
- Ramesh, A., Dhariwal, P., Nichol, A., Chu, C., & Chen, M. (2022). Hierarchical Text-Conditional Image Generation with CLIP Latents. *arXiv:2204.06125*
- Rashkov, G., Bobe, A., Fastovets, D., & Komarova, M. (2019). Natural image reconstruction from brain waves: a novel visual BCI system with native feedback. *bioRxiv*. <https://doi.org/10.1101/787101>
- Robinson, K. (2011). *Out of Our Minds: Learning to be Creative* (2nd ed.). Capstone.
- Saharia, C., Chan, W., Saxena, S., Li, L., Whang, J., Denton, E.L., Ghasemipour, S.K., Ayan, B.K., Mahdavi, S.S., Lopes, R.G., Salimans, T., Ho, J., Fleet, D., & Norouzi, M. (2022). Photorealistic Text-to-Image Diffusion Models with Deep Language Understanding. *ArXiv, abs/2205.11487*.
- Sanders, E., & William, C. (2002). *Harnessing People's Creativity: Ideation and Expression through Visual Communication*. *Focus Groups*, Ch.10 pp.145–156. <https://doi.org/10.1201/9780203302743>
- Sawyer, K. R. (2012). *Explaining Creativity: The Science of Human Innovation* (2nd ed.). Oxford University Press.
- Schwab, K. (2016, January 14). *The Fourth Industrial Revolution: what it means and how to respond*. World Economic Forum. <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>
- Skains, R. L. (2018). Creative Practice as Research: Discourse on Methodology. *Media Practice and Education*, 19(1), 82–97. <https://doi.org/10.1080/14682753.2017.1362175>
- Sharp, O. (Director). (2016). *Sunspring* [Film]. End Cue
- Sharp, O. (Director). (2018). *Zone Out* [Film]. End Cue

Shen, G., Horikawa, T., Majima, K., & Kamitani, Y. (2019). Deep image reconstruction from human brain activity. *PLOS Computational Biology*, *15*(1), e1006633.
<https://doi.org/10.1371/journal.pcbi.1006633>

Shneiderman, B. (2002). Creativity support tools. *Communications of the ACM*, *45*(10), 116–120.
<https://doi.org/10.1145/570907.570945>

Shneiderman, B. (2007). Creativity support tools: accelerating discovery and innovation. *Communications of the ACM*, *50*(12), 20–32. <https://doi.org/10.1145/1323688.1323689>

Smith, H., & Dean, R. T. (2009). Practice-led research, research-led practice in the creative arts. Edinburgh: Edinburgh University Press

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. <https://doi.org/10.1016/j.jbusres.2019.07.039>

Telfer, J. (2010). Towards an Understanding of Creative Block. In Raesch, M. (Ed.), *Mapping Minds* (pp. 171-180). Inter-Disciplinary Press.

Todd, D. A., McCullagh, P. J., Mulvenna, M. D., & Lightbody, G. (2012). Investigating the use of brain-computer interaction to facilitate creativity. In *Proceedings of the 3rd Augmented Human International Conference* (pp. 1-8).

Walker, E. B., & Boyer, D. M. (2018). Research as storytelling: the use of video for mixed methods research. *Video Journal of Education and Pedagogy*, *3*(1). <https://doi.org/10.1186/s40990-018-0020-4>
 Wallas, G. (1926). *The art of thought*. New York: Harcourt Brace.

Walz, E., Jahnke, K., Holinger, M., Gast, E., Elliott-Litchfield, B., & Ludeke, M. (2016). *Building Your Creativity: Tools For Having Ideas and Bringing Them to Be* (1st Ed.). Stipes Publishing Co.

Welcome NextMind (2022, March 24). Snap Newsroom.
<https://newsroom.snap.com/welcome-nextmind/>

Voros, J. (2001). A Primer on Futures Studies, Foresight and the Use of Scenarios. Prospect, the Foresight Bulletin, No. 6.

Xiaomi. (2021, September 14). *Xiaomi Smart Glasses | Showcase | A display in front of your eyes* [Video]. YouTube. <https://www.youtube.com/watch?v=I9bnmES7O74>

Xu, Y., Liu, X., Cao, X., Huang, C., Liu, E., Qian, S., Liu, X., Wu, Y., Dong, F., Qiu, C. W., Qiu, J., Hua, K., Su, W., Wu, J., Xu, H., Han, Y., Fu, C., Yin, Z., Liu, M., . . . Zhang, J. (2021). Artificial intelligence: A powerful paradigm for scientific research. *The Innovation*, 2(4), 100179.

<https://doi.org/10.1016/j.xinn.2021.100179>

Zhao, Z., Badam, S. K., Chandrasegaran, S., Park, D. G., Elmqvist, N. L., Kisselburgh, L., & Ramani, K. (2014). skWiki: A Multimedia Sketching System for Collaborative Creativity. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*.

<https://doi.org/10.1145/2556288.2557394>

APPENDIX I

Page 1 of 5

VOICE OVER SCRIPT

| | |
|------------------------|--|
| Working Title | MIND'S EYE |
| Project Title | Art in the Machine: Speculative Design for a Future Visual Creativity Support Tool |
| Video Length | 3 Minutes |
| Voiceover Guide | <ul style="list-style-type: none"> - Make Confusing Topic Simple and Digestible - Explainer Voice Style - Be Approachable, Friendly, Smart, Informative |

INTRO

HAVE YOU EVER TRIED TO FIND WAYS TO ENHANCE YOUR VISUAL CREATIVITY?

YOU MIGHT GET ADVICE SUCH AS:
GOING TO GALLERIES,
BROWSING ART BOOKS,
EVEN WATCHING VIDEOS.

STILL, SOMETIMES WE CAN'T HELP BUT GET STUCK IN A CREATIVE RUT,
NO MATTER HOW HARD WE TRY

BUT VISUAL CREATIVITY IS ACTUALLY ABOUT SEEING THINGS FROM A DIFFERENT
PERSPECTIVE.

IF YOU STRUGGLE TO FIND INSPIRATION, IT MIGHT BE APPROPRIATE TO LOOK
INTO NEW APPROACHES IN ORDER TO EXPAND YOUR VISION AND ENHANCE
CREATIVE FLOW.

A WIDE RANGE OF TECHNOLOGIES HAVE EVOLVED IN RECENT YEARS AND NEW
KINDS OF TOOLS HAVE EMERGED TO SUPPORT IDEATION IN THE CREATIVE
PROCESS.

FOR EXAMPLE,
TEXT-TO-IMAGE AI ART GENERATORS ALLOW USERS TO INPUT **WORDS** TO GET
ENDLESS CREATIVE VISUAL IDEAS.

SO, WHAT'S NEXT?

WHAT IF THERE WERE A VISUAL CREATIVITY SUPPORT TOOL THAT COULD TRANSFORM THOUGHTS TO IMAGES?

IN FACT, BRAIN-TO-IMAGE TECHNOLOGY IS ALREADY ON THE HORIZON.

MIGHT THIS BECOME A POPULAR PATHWAY FOR ARTISTS TO FIND INSPIRATION IN THE FUTURE?

IMAGINE
IN THE YEAR 2050,
WHAT THE USER EXPERIENCE MIGHT BE LIKE IN GETTING ASSISTANCE FOR CREATIVE IDEAS?

LIVE ACTION SCENE

THE FUTURE LOOKS PROMISING FOR THE DEVELOPMENT OF A WEARABLE NON-INVASIVE BRAIN-COMPUTER INTERFACE...

TO DECODE NEURAL SIGNALS IN THE PARTS OF THE BRAIN WHERE VISUAL IMAGINATION OCCURS...

AND THEN, USING ARTIFICIAL INTELLIGENCE MACHINE LEARNING,...

TO INTERPRET THOSE NEURAL SIGNALS...

TO PROVIDE THE USER WITH VISUAL STIMULI THAT ORIGINATED DEEP IN THEIR OWN BRAIN TO HELP SPARK THEIR CONSCIOUS IMAGINATION AND RE-IGNITE THEIR VISUAL INSPIRATION.

'MIND'S EYE', IS A CREATIVITY SUPPORT TOOL.

IT IS DESIGNED TO ASSIST OVERCOMING CREATIVE BLOCKS BY EMPLOYING A DISRUPTIVE METHOD KNOWN AS OBLIQUE STRATEGIES (DEVELOPED BY ARTISTS BRIAN ENO AND PETER SCHMITT) AS A JUMPSTART TO SPARK INSPIRATION AND ENCOURAGE LATERAL THINKING

OBLIQUE STRATEGIES WAS ORIGINALLY A SERIES OF CARDS,
EACH WITH A RANDOM SUGGESTION OR PHRASE WHICH CAN BE USED AS A
PROMPT TO BREAK A DEADLOCK OR A DILEMMA SITUATION.

FOLLOWING THE CREATIVE PROMPTS FROM OBLIQUE STRATEGIES,
THE USER IS ENCOURAGED TO LET THEIR VISUAL IMAGINATION FLOW AND
CULTIVATE THE FIELDS OF THEIR FEELINGS.

THROUGH THE WEARABLE NON-INVASIVE BRAIN-COMPUTER INTERFACE,
THE SYSTEM ANALYZES USERS' BRAIN ACTIVITY IN THE OCCIPITAL (ahk-SIPP-ih-tull)
CORTEX

TO ACCESS THEIR **MIND'S EYE**
AND GENERATE VISUAL IMAGES THAT ARE OFFERED BACK TO THE ARTIST
THROUGH THE SMART GLASSES

THE INTENTION HERE IS TO ENCOURAGE CREATIVE EXPLORATION.

'MIND'S EYE' ALLOWS USERS TO EXPLORE VARYING ALGORITHMIC OUTPUTS.

BY INTRODUCING UNEXPECTED EXTERNAL ELEMENTS INTO THE CREATIVE
PROCESS,

USERS ARE SUPPORTED TO STRETCH THE BOUNDARIES OF THEIR
IMAGINATIONS...

IN WAYS THAT THEY WOULD NEVER HAVE THOUGHT PREVIOUSLY.

'**MIND'S EYE**' IS DESIGNED TO SUPPORT LATERAL CREATIVE THINKING
AND ENABLE ARTISTS TO BREAK THROUGH CREATIVE BLOCKS.

INTRODUCING A CREATIVE PROMPT SUCH AS OBLIQUE STRATEGIES INTO THE
PROCESS ADDS AN ELEMENT OF RANDOMNESS THAT HAS THE POWER TO BREAK
MENTAL HABITS THAT MIGHT BE HOLDING THE ARTIST BACK.

ADDING AN ADDITIONAL LEVEL OF UNPREDICTABILITY, ...
THE APP LEVERAGES RANDOM ALGORITHMIC A-I BEHAVIOR...
TO HELP VISUAL ARTISTS FIND CREATIVE INSPIRATION, IN THE UNEXPECTED
IMAGES PLACED BEFORE THEM...
IMAGES WITH ORIGINS IN THE ARTIST'S OWN VISUAL IMAGINATION!

ALLOWING THEMSELVES TO BE OPEN TO THESE KINDS OF INSPIRATIONAL
ELEMENTS, THE ARTIST HAS THE POWER TO EXPLORE THEIR OWN ARTISTIC
INTENTIONS MORE DEEPLY, AND POSSIBLY GET PAST CREATIVE BLOCKS THAT
IMPEDE THEIR CREATIVE FLOW.

CONCLUSION

BUT MANY QUESTIONS EMERGE WHEN WE LOOK AT THE USE OF TECHNOLOGY TO
ENABLE CREATIVITY.

IS USING ARTIFICIAL INTELLIGENCE TO INSPIRE HUMAN CREATIVITY EVEN A GOOD
IDEA?

WHILST THE PROMISE OF SUCH A CREATIVITY SUPPORT TOOL IS EXCITING AND
PACKED WITH POSSIBILITY, WHAT MIGHT THE CONSEQUENCES BE?

MIGHT ARTISTS BE SACRIFICING THEIR OWN CREATIVE INITIATIVE BY
SURRENDERING INSPIRATION TO AN EXTERNAL TOOL?

MIGHT OVER-RELIANCE ON SUCH A TOOL ENGENDER A SENSE OF
DISEMPOWERMENT...

AND MIGHT THAT CAUSE ARTISTS TO FEEL LESS INSPIRED?

THERE ARE ALREADY EXAMPLES OF A-I BEING GIVEN CREATIVE TASKS.
IS "MIND'S EYE" ANOTHER STEP TOWARDS TRAINING A-I TO PERCEIVE ITSELF AS A
CREATIVE ENTITY?

WHERE DOES THE BOUNDARY BETWEEN HUMAN AND A-I CREATIVITY LIE?

AND WHAT TYPE OF FUTURE DO WE ENVISION WITH REGARD TO CROSSING THAT BOUNDARY?

WHAT MIGHT BE THE IMPLICATIONS OF A POSSIBLE CROSSOVER BETWEEN BRAIN-COMPUTER-INTERFACE AND A-I? PARTICULARLY WITH REGARD TO CREATIVITY?

AS WE GET FURTHER DOWN THE ROAD IN THE FOURTH INDUSTRIAL REVOLUTION, WHERE MIGHT THE RELATIONSHIP BETWEEN HUMAN AND A-I CREATIVITY BE HEADED?

AND WHAT STEPS MIGHT WE WANT TO BEGIN TAKING NOW TO ENSURE THAT IT'S HEADED WHERE WE WANT IT TO GO?

AUDIO / VISUAL SCRIPT

| | |
|----------------------|--|
| Working Title | MIND'S EYE |
| Project Title | Art in the Machine: Speculative Design for a Future Visual Creativity Support Tool |
| Video Length | 3 Minutes |

| Scene | Voice Over | Visual | Notes |
|-------|---|---|-----------------|
| 1 | Have you ever tried to find ways to enhance your visual creativity? | Typing a question: "How to enhance visual creativity?" on search bar | Motion Graphics |
| 2 | You might get advice such as: Going to galleries, browsing art books, even watching videos | Graphics of galleries, books and television | Motion Graphics |
| 3 | Still, sometimes we can't help but get stuck in a creative rut no matter how hard we try | Zoom out to a piece of white paper | Motion Graphics |
| 4 | But visual creativity is actually about seeing things from a different perspective | Zoom into the paper. Merge into a rectangle shape. Rotate the shape into different positions | Motion Graphics |
| 5 | If you struggle to find inspiration, it might be appropriate to look into new approaches in order to expand your vision and enhance creative flow | From the rectangle shape transits to a light bulb | Motion Graphics |
| 6 | A wide range of technologies have evolved in recent years, and new kinds of tools have emerged to support ideation in the creative process. | Camera position pan from left to right to show a timeline of those emerging technologies: AR, VR, Robotic | Motion Graphics |
| 7 | For example, text-to-image ai art generators allow users to input words to get endless creative visual ideas. | Typing a text prompt and an image appears following by the prompt | Motion Graphics |
| 8 | So what's next? What if there were a visual creativity support tool that could transform thoughts to images? | Turning from a graphics of brain to an image | Motion Graphics |
| 9 | In fact, brain-to-image technology is already on the horizon. | Photo of brain computer interface | Motion Graphics |
| 10 | Might this become a popular pathway for artists to find inspiration in the future? | | Motion Graphics |
| 11 | Imagine, in the year 2050, what the user experience might be like in getting assistance for creative ideas? | Rolling Text: 2050 | Motion Graphics |
| 12 | | W/S of an artist standing in front of a wall with drawings. An blank canvas and easel on her left side | Live Action |

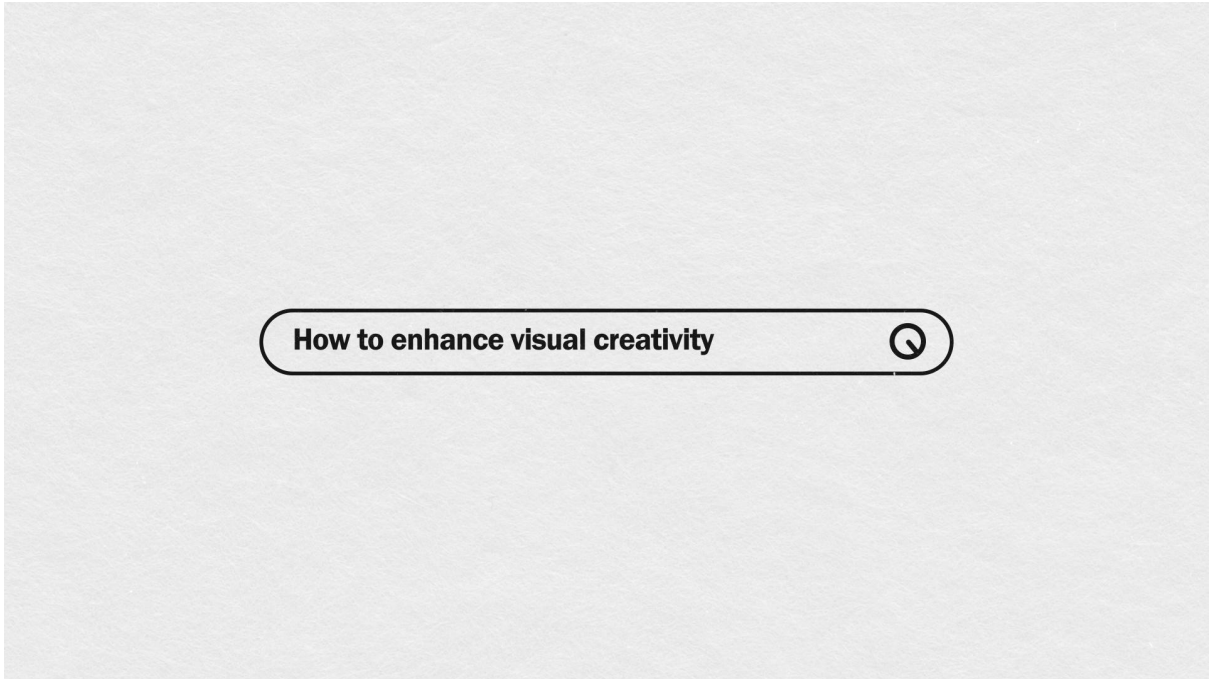
| | | | |
|----|---|---|-------------------|
| 13 | | M/S of the painting tools - brushes, paint pallets, paint etc. on a table with a blank canvas and easel at the side | Live Action |
| 14 | | M/S of the artist thinking | Live Action |
| 15 | | Low angle shot of the artist coming forward trying to grab the glasses on the table | Live Action |
| 16 | The future looks promising for the development of a wearable non-invasive brain-computer interface... to decode neural signals in the parts of the brain where visual imagination occurs | M/S of the artist putting on the futuristic glasses and turn it on C/U of the glasses' lights on and the artist's reaction when the glasses is activated | Live Action |
| 17 | And then, using artificial intelligence machine learning interpret those neural signals... to provide the user with visual stimuli that originated deep in their own brain to help spark their conscious imagination and re-ignite their visual inspiration. | Footages of neural networks POV of 'Minds Eyes' interface (LOCK OFF SHOT) | Live Action |
| 18 | 'Mind's eye', is a creativity support tool. It is designed to assist overcoming creative blocks by employing a disruptive method known as oblique strategies (developed by artists Brian Eno and peter Schmidt) as a jumpstart to spark inspiration and encourage lateral thinking | POV of the interface of 'Mind's Eye' (LOCK OFF SHOT) | Live Action & VFX |
| 19 | Oblique strategies was originally a series of cards, each with a random suggestion or phrase which can be used as a prompt to break a deadlock or a dilemma situation. | POV of the interface of 'Mind's Eye' (LOCK OFF SHOT) | Live Action & VFX |
| 20 | Following the creative prompts from oblique strategies, The user is encouraged to let their visual imagination flow and cultivate the fields of their feelings. | POV of the interface of 'Mind's Eye' (LOCK OFF SHOT) | Live Action & VFX |
| 21 | Through the wearable non-invasive brain-computer interface, The system analyzes users' brain activity in the occipital (ahk-sipp-ih-tull) cortex to access their mind's eye | M/S of the user get ready for mind reading with eyes closed Extreme C/U of the artist's eyes. Eyes close for a second and then open. Zoom in from the eye to the footages of neural network | Live Action & VFX |

| | | | |
|----|--|---|-------------------|
| 22 | And generate visual images that are offered back to the artist through the smart glasses | Zoom in from the neural network back to the glasses | |
| 23 | The intention here is to encourage creative exploration. 'Mind's Eye' allows users to explore varying algorithmic outputs. | W/S of Mind's Eye interface generates variations of images based on the original input thoughts (LOCK OFF SHOT) | Live Action & VFX |
| 24 | By introducing unexpected external elements into the creative process, Users are supported to stretch the boundaries of their imaginations... In ways that they would never have thought previously. | W/S of the artist browsing the images generated by Mind's Eye. M/S of the artist reaction | Live Action & VFX |
| 25 | 'Mind's eye' is designed to support lateral creative thinking and enable artists to break through creative blocks. | POV of the interface of 'Mind's Eye' (LOCK OFF SHOT) | Live Action & VFX |
| 26 | Introducing a creative prompt such as oblique strategies into the process adds an element of randomness that has the power to break mental habits that might be holding the artist block. | POV of the interface of 'Mind's Eye' (LOCK OFF SHOT) | Live Action & VFX |
| 27 | Adding an additional level of unpredictability, the app leverages random algorithmic AI behaviour to help visual artists find creative inspiration in the unexpected images placed before them... Images with origins in the artist's own visual imagination! | W/S of the artist browsing the images generated by Mind's Eye | Live Action & VFX |
| 28 | Allowing themselves to be open to these kinds of inspirational elements, the artist has the power to explore their own artistic intentions more deeply, and possibly get past creative blocks that impede their creative flow. | W/S of the artist browsing the images generated by Mind's Eye | Live Action & VFX |
| 29 | But many questions emerge when we look at the use of technology to enable creativity. | W/S of the artist browsing the images generated by Mind's Eye | Live Action & VFX |
| 30 | Is using artificial intelligence to inspire human creativity even a good idea? | W/S of the artist browsing the images generated by Mind's Eye | Live Action & VFX |
| 31 | Whilst the promise of such a creativity support tool is exciting and packed with promise, what might the consequences be? | C/S of the artist taking off the glasses | Live Action & VFX |
| 32 | Might artists be sacrificing their own creative initiative by surrendering inspiration to an external tool? | M/S of the artist picking up a painting brush | Live Action |

| | | | |
|----|---|---|-------------|
| 33 | Might over-reliance on such a tool engender a sense of disempowerment... And might that cause artists to feel less inspired? | M/S of the artist starting to paint | Live Action |
| 34 | There are already examples of A-I being given creative tasks. Is "mind's eye" another step towards training A-I to perceive itself as a creative entity? | M/S of the artist looks inspired | Live Action |
| 35 | Where does the boundary between human and A-I creativity lie? | W/S of the artist painting at the back with glasses as foreground | Live Action |
| 36 | And what type of future do we envision with regard to crossing that boundary? | W/S of the artist painting at the back with glasses as foreground | Live Action |
| 37 | What might be the implications of a possible crossover between brain-computer-interface and A-I? Particularly with regard to creativity? | W/S of the artist painting at the back with glasses as foreground | Live Action |
| 38 | As we get further down the road in the fourth industrial revolution, where might the relationship between human and A-I creativity be headed? And what steps might we want to begin taking now To ensure that it's headed where we want it to go? | W/S of the artist painting at the back with glasses as foreground | Live Action |


APPENDIX II

Screenshot from video

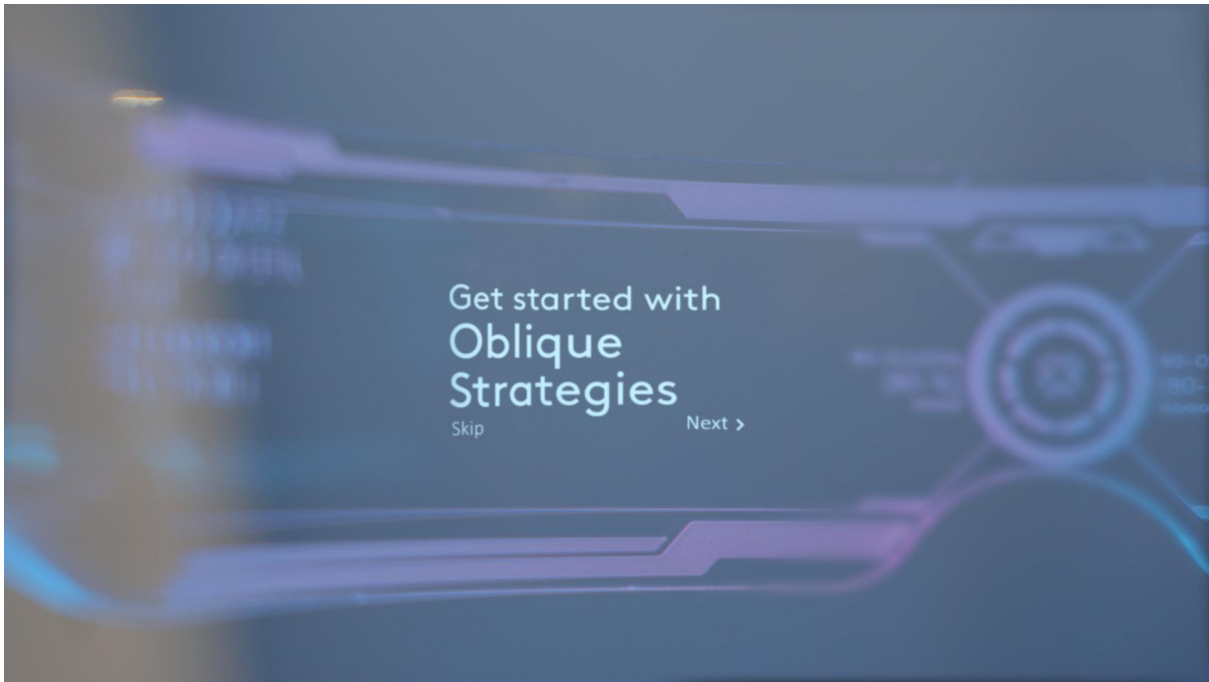


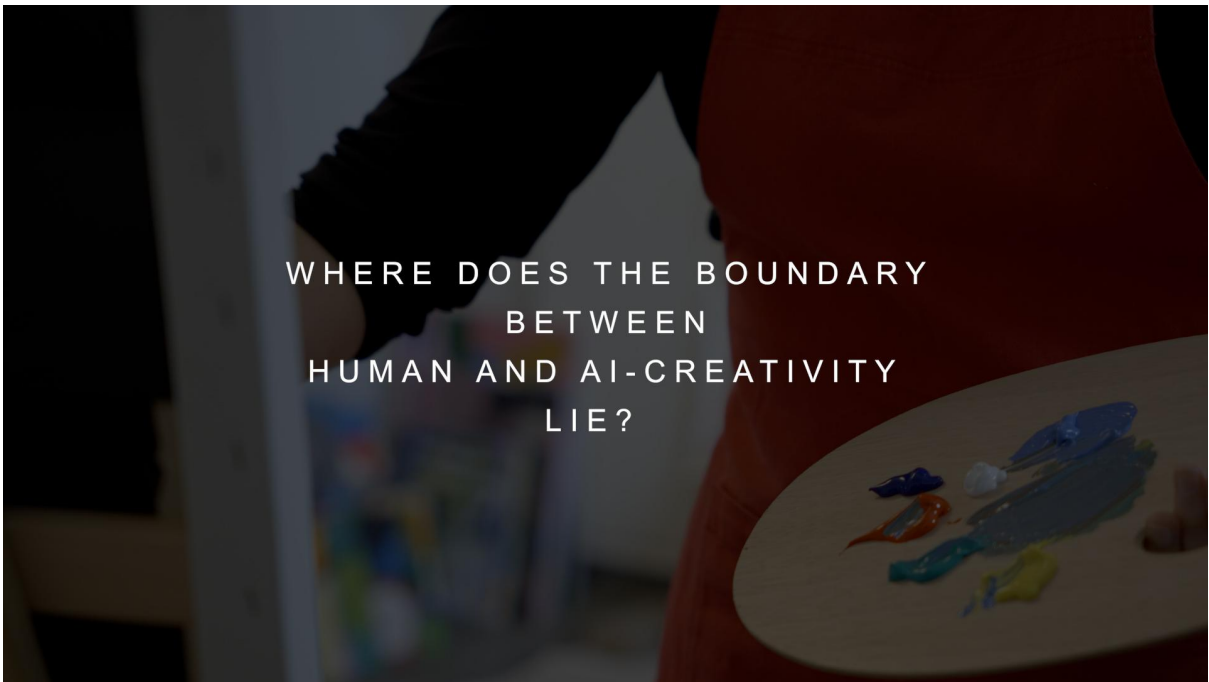


WEARABLE
NON-INVASIVE
BRAIN-COMPUTER
INTERFACE



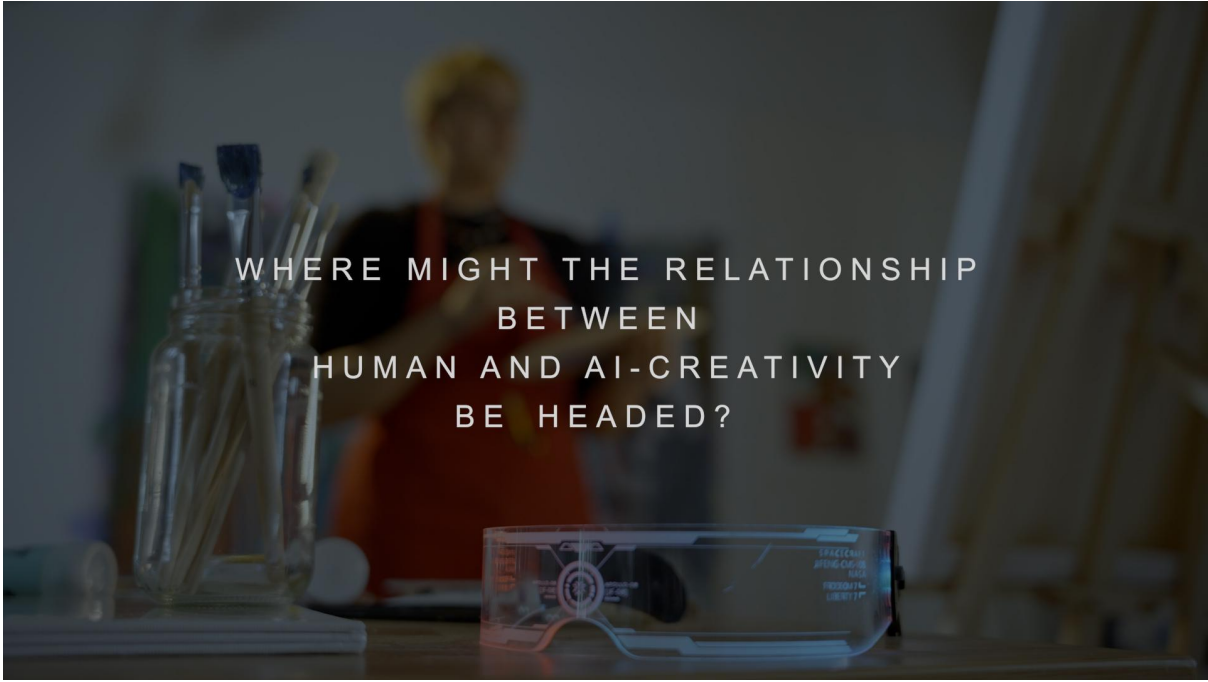
Welcome to
Mind's Eye







WHAT TYPE OF FUTURE
DO WE ENVISION WITH REGARD TO
CROSSING THAT BOUNDARY?



WHERE MIGHT THE RELATIONSHIP
BETWEEN
HUMAN AND AI-CREATIVITY
BE HEADED?