Between Thought and Expression: How Generative AI and Brain Data Shape the Future of Creative Practice

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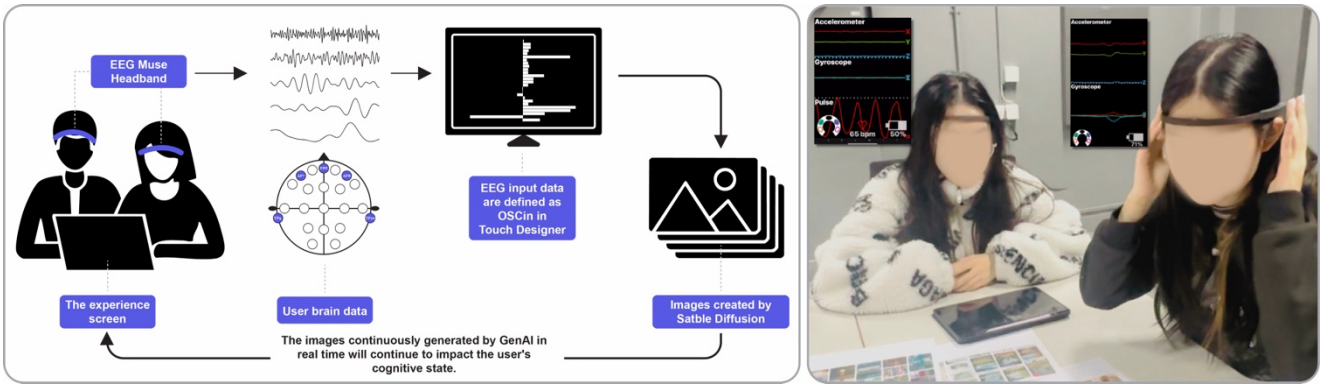


Figure 1: *Shared Neural Streams concept - Overview of the proposed EEG-based emotion recognition pipeline and real-time experimental setup (left); experience participants (right).*

This paper investigates an exploratory approach to EEG-derived Generative AI (GenAI) co-creation, focusing on how EEG-derived signal variation can be used as low-level modulation input for generative visual output. We performed three studies: Study 1 used co-design workshops to elicit expectations and concerns among early-career creative practitioners. Study 2 used expert interviews to contextualise GenAI within established creative practice. Study 3 implemented and evaluated an EEG-modulated prototype generative system in a pilot study. The first two studies informed design requirements; only the third study evaluated the prototype interaction. Our findings from three studies reveal variations in participants' experiences but show that shared creative perspectives can strengthen the robustness of AI-driven creative experiences through a Shared Neural Streams concept. We identify design opportunities and methodological constraints for using EEG-derived signals transparently within GenAI-supported co-creative interaction.

Generative Artificial Intelligence. Real-time brain data. Co-design. Creative practitioner.

1. INTRODUCTION

In recent years, the interest in how Generative Artificial Intelligence (GenAI) can shape and impact human creativity has been growing. In particular, GenAI has expanded opportunities for co-creative interaction with human [8] . This work focuses on how implicit physiological input, such as EEG brain data, can be incorporated into GenAI-supported co-creative interaction, in particular based on concepts from self-discrepancy theory [10] .

In this study, GenAI is treated as a co-creative material that can support ideation, variation and reflection, while creative judgement remains situated in human interpretation [8] . We conducted co-design workshops, expert interviews, and a pilot study to explore user requirements and evaluate an EEG-derived generative system. Through the prototype, we investigated how real-time EEG-derived signals can be used as low-level modulation input in a generative AI co-creative system, and how users interpret the resulting visual outputs.

We organised the research as a sequential design inquiry in which each study served a distinct function. Study 1 elicited expectations, concerns, and imagined interaction qualities among early-career creative practitioners. Study 2 examined how experienced practitioners understood creative

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intention, accumulated knowledge, biographical experience, evaluation, and ethical responsibility in relation to GenAI. We synthesised these findings into design tensions and requirements rather than treating the two datasets as equivalent. Study 3 implemented a selected subset of these requirements in an exploratory EEG-modulated prototype and examined how participants interpreted and evaluated the resulting interaction.

This sequence does not imply that the prototype resolves every concern raised in Studies 1 and 2. Instead, the earlier studies established both design commitments and boundaries. The prototype addressed semantic authorship, participant-defined personalisation, output evaluation, and transparency concerning the role of EEG. Concerns relating to knowledge accumulation, content provenance, and the wider sociopolitical consequences of GenAI were not fully implemented and are retained as limitations and directions for future design.

Accordingly, this paper addresses the following research questions:

- What expectations, concerns, and forms of creative judgement do early-career and experienced practitioners identify in relation to GenAI-supported creative practice?
- How can these findings be translated into design commitments concerning semantic authorship, participant-defined personalisation, output evaluation, and physiological-data transparency?
- How are selected design requirements instantiated and interpreted in a paired EEG-modulated generative prototype?

This paper makes three contributions to Human–Computer Interaction. First, it provides an integrated account of how prospective user concerns and experienced practitioner knowledge produce distinct but complementary design commitments for EEG–GenAI co-creation. Second, it presents a traceable artifact rationale that separates participant-authored semantic content, GenAI transformation, EEG-derived modulation, and human evaluation. This separation allows the system to respond to participant-linked physiological variation without presenting EEG as direct access to thought, emotion, identity, intention, or the ideal self. Third, it reports exploratory findings concerning how participants interpreted, evaluated, and sometimes rejected the evolving visual output, including moments of perceived connection, aesthetic alienation, and AI-mediated interference.

2. RELATED WORK

2.1 Theoretical Background: Self-Discrepancy Theory

Self-discrepancy theory conceptualises the self not as a single, stable entity but as a set of self-state representations organised by domain and standpoint. Higgins distinguishes the actual self as attributes that individuals believe they currently possess; the ideal self, which comprises hopes, wishes, and aspirations; and the ought self, which comprises perceived duties, obligations, and responsibilities [10] . Each self-guide may reflect either an individual's own standpoint or that attributed to a significant other. Moreover, 'ideal self' is a concept derived from self-discrepancy theory which refers to the psychological distress people feel when what they expect to express is the ideal self, but what compels them to express in life is the ought self and the actual self [10] . It is defined by participants through keywords and short descriptions that express aspects of the self they wish to explore. In this study, the ideal self was not inferred from EEG, but rather from a variety of user-personalised prompts provided to the system. GenAI renders these participant-defined inputs into visual form, while EEG-derived values modulate aspects of the generative process. Ideal self is therefore treated as an interpretive process of how participants make sense of generated images in relation to their own descriptions, rather than whether brain data can reveal hidden identity, emotion or intention. In this study, GenAI is treated as a co-creative material that can support ideation, variation and reflection, while creative judgement remains situated in human interpretation [8] .

2.2 GenAI as creative support, not creative replacement

GenAI supports creative practice by enabling ideation, variation and rapid material exploration. Its contribution, however, depends on how practitioners steer, evaluate and reinterpret generated outputs within specific contexts [12] . In this sense, GenAI is more appropriately conceptualised as co-creative material rather than an autonomous source of creative judgement, extending opportunities for reflection and exploration beyond conventional workflows [8] . Empirical studies further show that GenAI can facilitate idea generation and support practical design applications across domains [26] [6]

A recent meta-analysis indicates that although GenAI performs comparably to humans on certain creative tasks, its use in collaborative settings yields only modest improvements and is associated with reduced idea diversity, reflecting a tendency to recombine existing patterns rather than expand the solution space [9] .

From a human-computer interaction perspective, system design shapes these dynamics. A synthesis

of interactive GenAI research shows that creative work with such systems typically involves producing, editing and refining outputs through user–system interaction [11] . However, current systems primarily support isolated stages, most commonly evaluation, and seldom address multiple phases of the creative process within a unified workflow [11] . In addition, the prevalence of delegate-manager interaction models, in which users specify high-level directives and systems perform generative tasks, raises ongoing questions about user agency and control in human–AI creative work [11] .

2.3 Human control and agency in AI co-creation

Collaboration between humans and GenAI is an important area of research to mark the increasing embedding of AI applications into specific tasks such as experience design [16] . Many researchers hold the belief that AI can boost human creativity by providing fresh viewpoints and inspiration, in a reciprocal process of communication and collaboration [14] [30] [27] . Human agency remains central in AI co-creation, as users guide and evaluate outputs [29] [17] . Stable intentions and mental state are necessary for the user to maintain complete control. Users can maintain a high focus on the original request and diverse ideas, which can adjust the level of control to refine the experience when they interact with GenAI [36] .

In creative applications, there is an increasing need for GenAI to support in expressing users' visions and shaping information to increase creativity in response is necessary. In this sense, empowering GenAI to create experiences is one of the way to optimise the performance of AI [31] . For custom GenAI, users can perform empowerment of it through training, providing specific contextual knowledge at an early stage for the AI to recognise information and perform subsequent tasks [33] .

In the context of this study, participants provide semantic prompts and live EEG-derived data; GenAI transforms the prompts, while EEG modulates a bounded visual parameter. What is shared is therefore the evolving data-mediated artefact and its interpretation, not a decoded or merged neural state.

2.4 EEG as implicit input in interactive systems

An alternative HCI tradition approaches biosignals as interactional materials. Research involving children has further expanded this design space. Antle et al.'s Mind-Full system incorporated live EEG into an interactive neurofeedback experience designed to support children's self-regulation [2] . Their subsequent framework for neurofeedback BCI design demonstrates how brain activity may be incorporated into embodied interaction through carefully designed mappings, feedback modalities, and opportunities for user control [2] .

Potapov et al.'s concept of *'responsive ambiguity'* describes interactions in which feedback remains contingently responsive to users' activity while semantically open to interpretation [19] . We extend this perspective from voluntary movement sonification to partially controllable EEG-modulated generative imagery: participant-authored prompts determine semantic content, while live EEG modulates a bounded visual parameter.

Schurger et al. [25] suggested that BCI (brain-computer interface) could enable subjects to perform tracking tasks without explicit body movements, showing that personalised feedback for brain activity-based performance is feasible, with the potential to be further developed. EEG has been explored as implicit input in interactive systems. However, consumer-grade devices such as Muse 2 have limited reliability and cannot support strong claims about mental states [34] . For example, the Phase Locking Value (PLV) [34] and Coherence [37] explain how consistently two brain regions synchronise over time based on the connections shown in their EEG data [1] .

Researchers define the opportunities for integration of EEG data with GenAI as: (1) the ability to enhance the generality of AI models through diversity and differences among participants [4] ; (2) the ability to provide personalised experiences in human-machine interaction through varying real-world user data [20] [34] . At the intersection of human-machine interaction, we use EEG data as input for meaningful interactive activities. Many types of EEG headbands with high setup complexity are gradually being replaced by compact EEG headbands to make them easier for a diverse range of users to access. Consumer devices such as Muse 2 make EEG-supported interaction more accessible because they are portable and comparatively quick to configure. These practical advantages are accompanied by restricted electrode coverage and sensitivity to movement, contact quality, and environmental conditions. Accordingly, the present study uses Muse 2 as a source of participant-linked modulation data rather than as a diagnostic instrument. EEG-derived values affect selected visual parameters but do not determine semantic content or provide evidence of participants' identities, emotions, creativity, or ideal selves.

3. EXPLORATORY DESIGN-LED STUDY

In our study, we sought to highlight contrasting viewpoints by collecting and analysing samples of participants at two different career stages: (1) early-stage creative practitioners, (2) expert creative practitioners. This user investigation research has been approved by the university's research

committee. This approach allows us to examine the same problem of the current use of GenAI in creativity through multi-dimensional experiences, thereby revealing the expectations and potential of designing AI-inclusive art creation experiences. We proposed design assumptions for this study:

- Creative practitioners' expectations, concerns and working practices should inform the design of GenAI-supported creative systems.
- GenAI should be understood as a co-creative material that supports ideation, variation and reflection, while creative judgement remains situated in human interpretation.
- User agency is central to meaningful AI co-creation; users should be able to guide, evaluate and redirect generated outputs.
- Personalisation should be based on participant-defined self-representations and reflective interpretation, not on claims that the system can infer identity or intention from EEG.
- EEG-derived signals can be used as low-level implicit modulation input for generative behaviour, provided that their limits, privacy implications and interpretive uncertainty are made explicit.

4. STUDY 1: CO-DESIGN WORKSHOP

4.1 Procedure

Table 1: *Process of co-design workshop*

Step	Time	Session	Focus
1	*15 mins*	*Overview*	*GenAI, metaverse, EEG data, and ideal self*
2	*20 mins*	*Interview*	*Expectations, concerns and ideal self in metaverse*
3	*10 mins*	*Co-design*	*Real-time interaction scenarios and adaptive mental-state design*
Output		*Participant-informed design requirements for brain-responsive GenAI interaction*	

To carry out this study, we took examples from the research results and works of Canet Sola & Guljajeva [5] , Puiac et al. [21] , Leonkreeh [15] , and Olegchomp [18] . It is precisely because of the specific illustrative examples taken from the studies above that we provided comprehensive background information to control the baseline level of participant data collected by the study.

4.2 Demographics

Data collection from participants took place in three workshops: in-person interviews, group interviews, and co-design with total 29 participants (18 female, 11 male). Participants in this study were identified as creative practitioners in the early stages of their careers (Table 5, Appendix A.1.1).

4.3 Co-design workshop process

At the beginning of each workshop, participants were introduced to the research context, including GenAI-supported creativity, immersive interaction, EEG as a possible input source, and the concept of the ideal self. The examples were used to establish a common baseline for discussion rather than to present a functioning system. Participants then responded individually to interview questions (Table 8, Appendix A.2.1) and took part in group discussion and co-design activities. Through drawings, written descriptions, and discussion, they articulated expectations and concerns concerning agency, personalisation, responsiveness, privacy, and the use of physiological data. When participants encountered confusion, the researcher provided explanations related to the definition to prevent them from not understanding the requirements of the topic question (Table 9, Appendix A.2.1). These materials informed the preliminary design requirements for the subsequent prototype.

4.4 Results:

Analysis of the workshop materials identified three recurring expectations: control over the interaction, personally relevant and diverse outputs, and transparent management of EEG data. The following sections present these findings using participants' drawings, written responses, and interview quotations (Figure 2 and Appendix A.3).

How participants approach AI as a tool that paves the way for future diverse interactions
Findings from the co-design workshops revealed three key expectations. First, participants envisioned GenAI as a system that supports user agency through flexible interaction modes, including user-controlled, user-empowered, and co-design-driven approaches. Second, participants expected personalised experiences, with systems adapting to individual preferences and generating diverse outputs. Responsiveness was considered critical for maintaining engagement. Third, most participants (27/29) expressed concerns about privacy and the risks associated with sharing EEG data, emphasising the need for transparency and user control.

Expectations for diverse experiences from GenAI
Participants expected GenAI to generate diverse options and provide personalised responses tailored

to their needs. Many emphasised the importance of responsiveness, noting that systems should deliver outputs quickly to maintain engagement:

> "For me, it's about getting solutions. I want a lot of options because I'm very indecisive. I can't choose just one; I need 10 options." (P25)

Personalising the context
Personalisation emerged as a key expectation, with participants envisioning systems that adapt to individual preferences and respond to user-specific contexts.

Some participants anticipated that future EEG-enabled systems might respond directly to thoughts or emotions. We treat these statements as expectations and concerns about imagined future systems, not as descriptions of the capabilities of the present prototype. For example, P28 imagined a system that could provide changing and personally responsive experiences:

> "I think it'd be interesting if it could respond to what's going on in the user's mind and make the environment more exciting for them. So that each time they come in, it's different, and they're not experiencing the same thing again." (P28)

P28 expressed an expectation of responsiveness and experiential variation. It does not demonstrate that EEG can reveal what is occurring in a participant's mind. Therefore, in the next study of this paper, we translated this expectation into time-varying visual modulation rather than into a requirement for mental-state recognition.

Speed and Accuracy are key of user-AI interaction
When participants faced with a choice between the level of accuracy, personalization, and speed of GenAI, some of them chose speed. Because the experience should be responded to quickly so as not to interrupt the emotions, immersion, and excitement that the player is having:

> "Speed is crucial, it shouldn't take days; it should generate results within minutes so users can adjust and optimise quickly." (P14, P27)

P16 set an above-average expectation for the accuracy of the experiences created by GenAI. This was formed based on the current experiences when users use GenAI to generate images and videos:

> "If AI receives the right data and prompts, I think it can generate about 70-80% of good-quality images. And if everything is structured correctly, it can also produce high-quality videos. You don't have to write complicated things." (P16)

Privacy Protection - Keeps personal information safe.
The concern comes from whether GenAI will generate responses based on negative emotions from participants, or whether GenAI will share users' personal data indiscriminately without users having control over it.

Sharing the same opinion as P29, P2 in this interview clearly stated the case when users did not want to share their feelings and thoughts. But if the context of EEG data is widely shared, it posed a barrier to reliability for participants. This greatly affects the overall user experience in the Immersive co-creative environment:

> "It's scary to use AI to track brain activity, as it could lead to privacy issues. Sometimes you don't want to reveal your feelings or inner thoughts, but AI could do that even if you don't want it, which breaches privacy, security, and emotional safety." (P2)

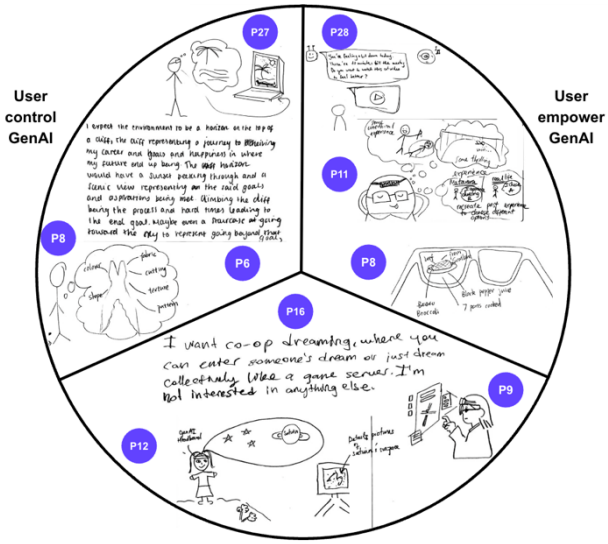


Figure 2: *Participants drew and wrote about their expectations for experiencing their ideal self in a virtual interactive environment.*

5. STUDY 2: EXPERT INTERVIEWS

We built on the foundation of Study 1, by gathering perspectives from professionals working in the creative field. This study aimed to deepen understanding of how technology's impact over time has affected their creative process.

5.1 Procedure

Table 2: *Interviews expert process*

Step	Time	Session	Focus
1	*10 mins*	*Contextualising participants' background*	*Professional role definition; creative identity; hybrid roles; career positioning*

2	*30 mins*	*Experiences with GenAI*	*Experience with GenAI in art creation; expert guidance for student creativity*
3	*20 mins*	*Envisioning GenAI as a cognitive partner*	*Critical thinking, new ideas and interaction loop between brain data and GenAI*
Output		*Interview-informed themes on GenAI-mediated creativity and cognitive partnership*	

We conducted semi-structured interviews to explore how experienced practitioners integrate GenAI into their creative workflows and how they evaluate its role in practice. Table 10 and table 11 in Appendix A.2.2 provides research questions for this section.

The questions in this section are highly requested regarding the personalisation of each participant, so that each participant's perspective can be clearly explored. Table 12 in Appendix A.2.2 shows each question for each participant.

5.2 Demographics

We contacted and selected 4 participants (Table 6, Appendix A.1.2) with over 20 years of experience in the creative and artistic fields, including a professional photographer, a lecturer in multimedia design and communication, an owner of a studio and teacher of product design, and an artistic director of the museum (two female, two male). These experts can provide research with professional and insightful perspectives on AI.

5.3 Results

The expert interviews generated three analytically relevant themes: GenAI as support for practitioner-led workflows; creative evaluation as a form of accumulated professional knowledge; and personal representation as a selective, biographical construction. Together, these themes showed that the value of generated material depended on practitioners' prior intentions and situated judgement rather than on the system independently identifying what was meaningful.

How experts understand GenAI's applicability
First, we focused on seeing GenAI as an enabler that helps users reach their potential in all aspects of life and work, not just the arts. Because photography is referred to in EP1's words as originally seen as evidence of the physical world:

> "Some time before the advent of digital photography, cameras stopped producing latent images on negatives and began to generate captured data. And when they started capturing data, the cameras first produced a JPEG photo. […] 60% of your pixels are fake and what it says is that when an image is taken digitally, 60% of the information is generated. Only 40% of them are representative of the traces that Fred Richard describes as 100% "

EP2 used AI to create images, facilitating intersection with various creative industries. From her personal perspective, AI is a tool that helps her work faster, not an overwhelming factor. Everything in AI's work is taken from the life materials she has read. EP2 strongly asserted that AI has never replaced humans in the creative process by describing her work process:

> "A lot of my work has been powered by AI, but I either write a script myself first or write a storyboard first or map out what I want first and then I build this into something much bigger using a variety of AI assets."

EP4 situated creative technologies within a wider media environment in which representation can contribute to social and political harm. Using the 2024 Southport incident as an example, EP4 emphasises that generative AI influences not only creative expression but also the interpretation of information and representations, raising concerns about trust and human agency:

> "What we read, what we see in galleries, what we see on social media doesn't really reflect us. It was a big explosion last summer of riots, this backlash against the Southport killers, was horrible."

The contrast between the worry about the risks of using GenAI and the ability to co-design among artists and the potential of GenAI to participate in the process
Instead of the former, they need experts to comment on what they do; AI now can help users recognise many problems that they need to improve more easily through the vast knowledge it is trained on:

> "Before generative AI, I would have to work with a video editor and a filmmaker [...] after generative AI, I can do 90% of it myself." (EP2)

EP3 has more experience than his students to be exposed to a wide range of knowledge and art genres from humanity and can easily understand whether an AI-generated product is effective or not, He shared:

> "I think one of the big challenges that we face is around evaluating that outcome and not just being attracted to the real thing."

The need for individualization and ideal self
An interesting point of view that we gathered through feedback from participants is that the ideal self-expressed by people in various aspects of their lives:

> "There were never any bad images in the family album, there was never a holiday where someone hated it and there was a rubbish time. They just said 'happy birthday, great holiday, and here I am'. Therefore, we are always correcting our lives to reinforce positive memories. […] And when you create that positive memory, then you create that positive virtual self. So my virtual self, my family, my kids, their virtual history are all positive because they're always smiling and happy." (EP1)

This study helped us find new ideas for our reseach through the application of brain data to connect human non-verbal thinking into a personalised tangible response:

> "A thought of something you hear, something you look at is a series of ridiculous processes for me to put this original thought into the computer. […] I can imagine that one can get to a point where one won't have to say that anymore because the computer is fast enough to read what you're thinking." (EP1)

6. DESIGN CONSDERATION

Table 3: *Insights from co-design workshop and expert interviews inform the design of the prototype in Pilot study.*

Source	*Insight*	*Condensed meaning*
Co-design	*Inclusive experience*	*Personal background, identity and ideal self*
Co-design	*Ethics and EEG data*	*Responsible mining and analysis of brain data*
Co-design	*Real-time feedback*	*GenAI responses during creative interaction*
Expert	*Knowledge support*	*Extends ideas rather than replacing users*
Expert	*Creative prompt*	*Offers unexpected or unorthodox information*
Expert	*Ethics and transparency*	*AI responses require careful interpretation*
Experience-design concepts		*• Connect mental state, personal values and expectations* *• Provide rapid GenAI feedback during interaction* *• Use real-time EEG input for adaptive experience design*

6.1 The Possibility of EEG Data as Personalised Input - Co-design workshop

We used co-design workshops to better understand users' perceptions and better understand their expectations and ideal selves. The workshop resulted in people realising their expectations are based on the information they have been given about the current technology model. The diversity of these answers enables us to shape a pilot study that must incorporate all three factors: (1) the inclusive experience, (2) ethical compliance when mining and analysing EEG data, and (3) the real-time feedback generated by GenAI.

Findings from the co-design workshops highlight the importance of user agency, personalisation, and transparent use of EEG data in shaping co-creative interaction. These distinct values can be understood in two aspects: (4) The participants are from the creative and artistic fields, so there will always be abundant expectations; (5) Everyone has a different adult background and living environment, which significantly affects their personal concept of the ideal self.

6.2 Experts' insight into GenAI's influence on creativity and how they shape the use of GenAI as a co-creation tool

We base the value of GenAI in this research's application on: (1) GenAI assists users in adding knowledge to their initial arguments, rather than being defined as a tool that users must depend on; (2) The concrete illustrations in text-to-images for ideas or the ideal self and make the difference that user cannot be expressed in words.

Contrary to the recognition from designers and the media, those who pursue fine art see: (3) AI as a tool for providing unorthodox information; (4) The responses from AI become a deep consideration for the ethics and transparency of a work of art. We found that this difference further enhances the diversity of users receiving a new tool from different fields of design and artistic creation.

6.3 Practitioner-derived design requirements

Across studies 1 and 2, we translated practitioner findings into four design requirements. Study 1 foregrounded user control, personally relevant content, responsiveness, and concerns about physiological-data privacy. Study 2 showed that creative meaning depended on prior intention, biographical experience, and experienced human evaluation. These findings jointly informed the following requirements:

DR1: Preserve participant agency. Participants should define semantic input and retain the ability to evaluate or reject generated outputs.

DR2: Ground personalisation in participant-authored material. Personal meaning should

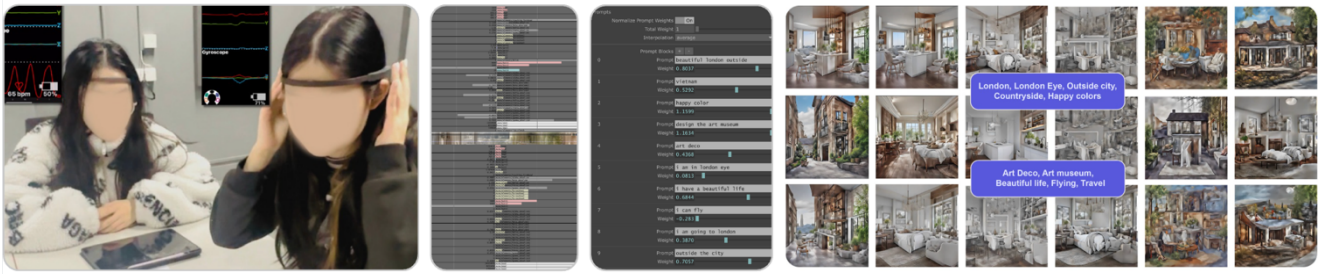
originate from participants' descriptions rather than being inferred from EEG.

DR3: Treat GenAI output as material for interpretation. Generated images should support reflection and evaluation rather than be presented as authoritative representations.

DR4: Restrict and explain physiological modulation. EEG-derived values should affect only specified system parameters, and the system should communicate the limits of psychological interpretation.

an experience that provides quick feedback; and (3) using real-time input EEG data.

Material:
The system separates two input channels. First, participants provide keywords describing aspects of their ideal self, which serve as semantic input for visual generation (supporting DR1 and DR2). Second, EEG-derived values are captured via Muse 2 and used as modulation parameters that affect visual dynamics such as variation, pace, and stability (supporting DR4).



(a) (b) (c) (d)

Figure 3: *Figure (a) shows two participants wearing the EEG Muse 2 device for the experience. Figure (b) shows the connected EEG data of the two participants displayed on Touch Designer. Figure (c) shows the prompts provided by the two participants (participants have the right to adjust the prompts throughout the experience), 'weight' is the location where the reference from the EEG data will be received. Figure (d) shows visual outputs based on participant-defined prompts; EEG-derived values modulated aspects of the visual generation process but did not define the semantic prompt content.*

7. STUDY 3: PILOT EXPERIMENT

7.1 Method

This pilot study evaluates a prototype system designed based on the four design requirements (DR1–DR4) [1] . The system preserves user agency (DR1) by maintaining participant-defined semantic input, while EEG-derived signals are used only as low-level modulation parameters (DR4). Personalisation is grounded in participant-defined representations (DR2), and GenAI outputs are treated as material for interpretation rather than as authoritative representations of mental states (DR3).

The study adopts an exploratory, design-led approach. The aim is not to infer cognitive or emotional states from EEG, but to examine how EEG-derived signal variation can shape generative behaviour and how users interpret the resulting outputs.

7.2 Shared Neural Streams Concept

Figure 1 provides the necessary insights for user experience design in this study based on the key findings about the needs and expectations of participants at different stages of creative practice with GenAI, which is based on the following criteria: (1) connecting the mental and personal values and expectations of the participants; (2) GenAI creating

This separation ensures that EEG is not used to infer meaning or generate prompts directly. Instead, EEG-derived variation introduces changes in the visual output that participants interpret in relation to their own descriptions (supporting DR3).

Shared neural streams: A paired interaction setting in which two participants simultaneously view the same generative visual output while their EEG-derived signals are recorded. It does not imply that neural signals are merged into a validated shared cognitive state. Instead, the paired format was used to explore how participants interpret a co-present EEG-mediated visual experience.

EEG headband and EEG data: Although the Muse 2 is not a highly reliable electroencephalogram (EEG) device, it is feature-rich enough for rapid measurements and use in non-clinical experiments [23] . We use Muse 2 because of its convenience and ease of use across a broader range of users, which perfectly aligns with the diversity in our user experience design. Muse 2 was selected not as a research-grade device for fine-grained neuroscientific inference, but as an accessible consumer EEG interface suitable for exploratory interaction design. Its use aligns with the aim of investigating how lightweight neural input might be incorporated into real-time creative systems. However, its limited spatial resolution, susceptibility to movement artefacts, and restricted electrode coverage mean that the EEG data cannot support strong claims about specific cognitive or affective

states. We therefore treat Muse 2 signals as interactional modulation data rather than diagnostic neural evidence. EEG data from Muse 2 is transmitted directly to OSCin - a real-time network data transmission protocol in Touch Designer, and displayed as a variability index based on the input data (Figure 1). EEG data were not used as textual input to a large language model. EEG-derived values were used locally within the interaction pipeline as modulation parameters for visual behaviour. Participant-defined keywords provided the semantic input for image generation.

Visual experience: Visual generation was based on participant-defined text prompts. In the original TouchDesigner pipeline, the selected visual parameter was driven by a procedurally generated noise value. For the prototype condition reported here, this source was replaced by a control trajectory computed from the live Muse 2 stream. The EEG-derived trajectory and the former noise source occupied the same functional position in the pipeline and influenced the same bounded visual parameter. The condition for this system to be activated is that the participant must be in a stable, undistracted state so that the EEG can function and connect with Touch Designer. The next source of input data is Text-to-Image, released by the team at the Ludwig Maximilian University of Munich and IWR, Heidelberg University, Germany in 2022 [24] We use this form to specify the text that describes the user's visual experience expectations.

7.3 The experience

In this pilot study, two participants viewed the same evolving generative visual display while their EEG-derived signals were recorded and used as low-level modulation input. Participants remained co-present during the session, allowing us to observe how they responded to common visual outputs while EEG-derived values modulated aspects of the visual stream (refer to Figure 3 and Appendix A.4). We designed the experience with a focus on tangible communication between participants; they don't need to chat or exchange but can still observe images of their ideal self-generated by GenAI in real time. At the same time, this is an inclusive experience, one that respects identity and cultural differences; users reflect on generated outputs in relation to self-description and aesthetic preference.

7.4 Demographics

The target group we prioritised recruiting from are people who have worked in creative and artistic fields for a long time. We conducted this study with 6 female participants (Table 7, Appendix A.1.3), divided into three pairs, who interacted with each other. This sample was appropriate for evaluating the feasibility and experiential qualities of the prototype, but it was not designed to support population-level generalisation or statistical inference. They need to be knowledgeable about AI and AI-generated visual products and have previously applied AI in their jobs. This study has been approved by the university's research committee.

7.5 Procedure

Participants took part in paired sessions in which they viewed the same evolving generative output. Before the interaction, each participant answered five questions and provided five keywords concerning aspects of their ideal self (Table 13, Appendix A.2.3). These keywords supplied the semantic content used for image generation.

The researcher fitted the Muse 2 headbands, checked the connection to the Mind Monitor application, and confirmed data transmission to TouchDesigner. EEG-derived values include alpha, beta, delta, gamma, theta, and screen activity was recorded throughout the session. Participants were asked to remain relatively still where possible to reduce movement artefacts, but they could pause or end the session at any time. Session duration was participant-led rather than fixed.

Although Muse 2 provides multiple frequency-band estimates, the present analysis focuses on frontal alpha asymmetry for computing the Approach–Withdrawal index. Other frequency bands were visualised during the session but were not used as primary evidence for interpreting engagement. To reduce the risk of over-interpreting noisy consumer EEG data, preprocessing was used to support interaction-level interpretation rather than clinical or neuroscientific diagnosis. We applied the Approach-Withdrawal index formula [22] [28] to determine the mental state of the brain that indicates whether the users want to move forward with or withdraw from an immersive and stimulating experience:

$$AW = (a_Front_right - a_Front_left) / (a_Front_right + a_Front_left)$$

The resulting AW values were summarised at 30-second intervals and used as an EEG-derived modulation index within the generative system. We analysed the EEG-derived control trajectories descriptively alongside screen recordings and participants' post-study responses. These trajectories were used to record changes in modulation values to understand how the human brain responds to visual experiences related to their ideal self and their partner. In addition, the qualitative data helped to understand how participants interpreted and evaluated the evolving visual output. EEG-derived values were not treated as direct measures of emotion, creativity, intention, engagement, or the ideal self.

7.6 Results

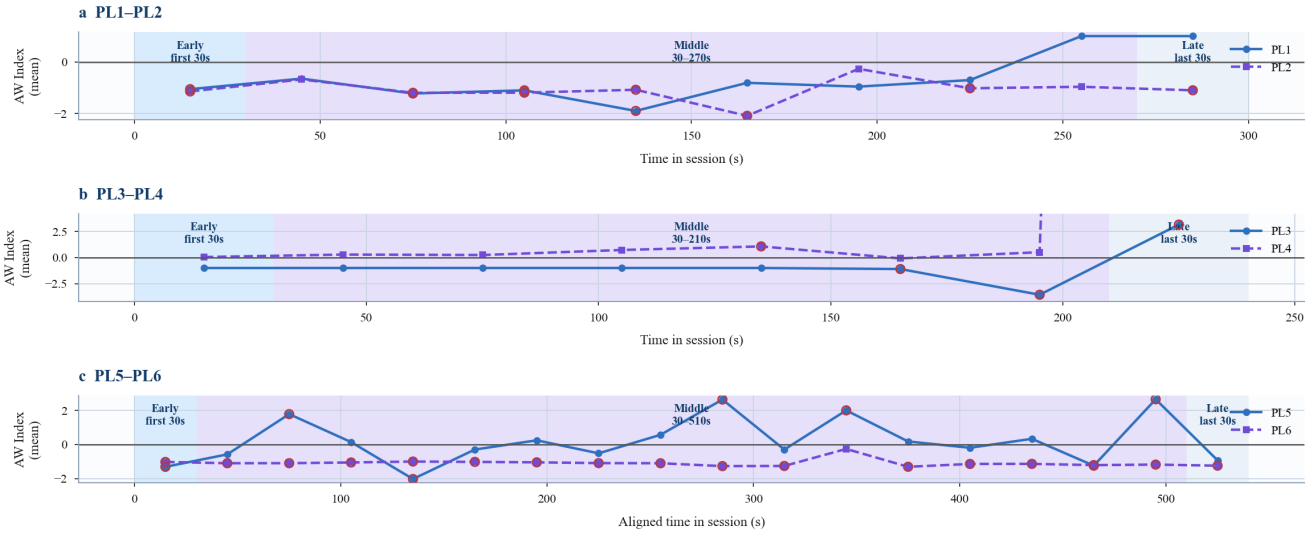


Figure 4: *Temporal variation of EEG-derived modulation indices across participant pairs during co-creative interaction.*

Approach - Withdrawal
EEG-derived AW trajectories differed across the three participant pairs (Figure 4). Pair 1 showed relatively stable AW values over time, with only minor fluctuations across intervals. Pair 2 showed lower overall variation in AW values and ended the session earlier than the other pairs. Pair 3 showed higher variability in AW values across intervals.

These differences are reported as variations in signal behaviour across pairs and are not interpreted as indicators of specific cognitive or emotional states. The results indicate that EEG-derived signals can introduce temporal variation into the generative system, while their interpretation remains context-dependent.

Post-study results
Table 4 presents post-study results as answered by participants to the post-experience questions (Table 14, Appendix A.2.3).

Table 4: *Responses after participant experience*

Category	***Quote***
The connection to aesthetics created by GenAI or the aesthetic alienation?	*"But in the image that appears, it can also show things that people didn't think of, like bedrooms or other cultural aspects inside that house. So, I think things that don't belong to my answer might belong to yours. It's a way that when I look at it, exclude what is mine, then I can see what you're thinking about." (PL1)*
Abstraction isn't good?	*"And I guess as people who are working in design, the aesthetic of things is important, and I can get distracted from the content. by having this slightly cartoonish style. I thought the moments it was more abstract. Kind of visual representation make me fell a bit more playful or a bit surreal." (PL3)*
The paradox of intimacy: when AI hinders rather than supports	*"I think because AI was talking to each other, and then there's this extra thing, and it's trying to interpret its own idea of the prompts that we've given it. I think it's an extra layer that hinders rather than helps us getting to know each other." (PL4)*

8. DISCUSSION

8.1 Technical and cognitive grounding of the framework

The Shared Neural Streams concept distinguishes between semantic input and EEG-based modulation, ensuring that user-defined representations remain central while physiological data introduces variation without implying mental-state inference. This distinction prevents the system from claiming to decode thoughts or emotions, while still allowing neural signals to influence the temporal and visual behaviour of generated outputs.

8.2 "What users expect" and "what users provide" with GenAI to create meaningful experiences

From participant expectations to bounded responsiveness
Participants desired to take the lead in interactions to avoid reliance on technology [13] . Study 1 participants expected GenAI systems to provide rapid, diverse, and personally relevant responses. The prototype addressed these expectations by preserving participant-authored semantic input and introducing time-varying visual modulation. However, perceived responsiveness should not be confused with psychological recognition. The system changed in relation to an EEG-derived value but did not identify what that value meant for the

participant. Interpretation remained with the participants.

Study 3 translated these expectations into a prototype that preserved participant-authored semantic input and introduced time-varying EEG-derived visual modulation. However, implementing these design expectations does not demonstrate that the system fulfilled them. In particular, participant expectations concerning responsiveness, personalisation, or emotional relevance should not be interpreted as evidence that the prototype recognised participants' inner states or produced a superior experience.

Designing for perceived responsiveness without claiming mental-state inference.
The design challenge for computers to imitate is expressing the behaviour of GenAI real-time responses in the immersive co-creative environment; they expected it to help them interact emotionally [35] . Participants expected AI systems to feel responsive to their changing experience, but this expectation should not be interpreted as evidence that GenAI can understand users' inner states. In the present prototype, EEG-derived values were used only to modulate visual behaviour, while interpretation of meaning remained with the participants.

8.3 Experts' insight into GenAI's influence on creativity and how they shape the use of GenAI as a co-creation tool

Through the interviews, the participants emphasised that the value and essence of the art they apply come from the personal and unique materials, which they have accumulated over the years through their own knowledge and experiences [7] .

Accepting the value of GenAI in creative practice does not mean relying solely on AI; rather, it is a way for an artist to clearly expand the nature of the ideal in the aspects they seek [32] . Therefore, creativity is no longer limited to pre-programmed elements but also lies in the ideal selves of each artist, enabling them to convey a deeply personalised uniqueness.

8.4 Evaluation of participants' engagement experience in pilot study

The pilot study provides preliminary evidence concerning how participants interpreted a shared, signal-modulated visual stream. We assessed the images generated by GenAI-Stream Diffusion as continuously changing and diverse, based on prompts related to participants' ideal selves. PL1 used elements that did not correspond to their own prompt to speculate about the other participant's contribution. This response demonstrates interpretation through comparison but does not show that the system revealed the other participant's thoughts. PL3's dissatisfaction with the visual style shows that variation did not necessarily produce aesthetic relevance. PL4 described AI as an additional interpretive layer that hindered rather than supported interpersonal understanding.

The data shows that while this experience can grab attention and help the brain process information, it also needs to change to keep people interested over time, creating a strong mental link between the participants and their experiences, which helps them see their ideal selves more clearly.

8.5 Limitations and future works

Several limitations constrain the interpretation of this work. First, the Muse 2 is a consumer EEG device and cannot provide the fidelity required for strong neuroscientific claims. Second, the sample size in the pilot study was small and demographically homogeneous, limiting generalisability. Third, movement artefacts and the paired interaction setting may have influenced signal quality. Fourth, the AW index was used as a simplified modulation feature rather than a validated measure of emotion, motivation, or creativity. Finally, the mapping between EEG and generative output was intentionally exploratory and should be evaluated against non-EEG baselines in future controlled studies.

Future work should compare three conditions to test whether EEG-based modulation provides experiential value beyond visual variation or novelty alone: (1) Non-adaptive GenAI output using fixed prompts; (2) Randomly modulated GenAI output; (3) EEG-modulated GenAI output

9. CONCLUSION

Our research findings have opened the possibility of using responsive AI to meet user needs, demonstrating that personalised experiences in a social context require careful consideration of auditory, visual, and authentic elements that connect the real and virtual worlds to facilitate easy engagement. These elements serve as core values in user experience design when combined with the results of user investigation research. Based on this, we can propose future design recommendations to enhance engagement with experience while maintaining data security and privacy when using EEG as input data. What makes the distinction clear is that art and creative activity are rooted in inspiration which comes from personal experiences, knowledge accumulated by creative practitioners, and unique thinking developed through their perspective on life. The pilot study results are intended for use in future studies with larger sample sizes to understand individual diversity better and complement personalised user experience design.

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A APPENDICES

A.1 Participants' information

A.1.1 Co-design workshop participants

Table 5: *Co-design workshop participants information*

Participants Identification	***Diploma***	***Knowledge of AI***
P1	*PhD in art and humanities*	*Know how to use GenAI to support content creation and analyze art trends.*
P2	*Master-psychology*	*Used AI to analyze user behavior, understand how AI supports psychological research.*
P3	*Bachelor-Architecture*	*Know the application of AI in 3D modeling and architectural design suggestions.*
P4	*Master-Marketing*	*Use GenAI to create advertising content, personalize marketing messages.*
P5	*Master-Marketing*	*Know how to leverage AI to optimise your customer outreach strategy.*
P6	*Master-art and humanities*	*Using AI as a creative enabler in art and media.*
P7	*Master-Marketing*	*Used GenAI to create digital content and optimise campaign performance.*
P8	*Bachelor-fashion design*	*Know how to use AI to create design concepts and predict fashion trends.*
P9	*Master-illustration*	*Understand how to use GenAI to support sketching and variation of illustration styles.*
P10	*Master-Marketing*	*Apply GenAI to create cross-platform media campaigns.*
P11	*Master-Marketing*	*Understand how AI analyzes customer data to improve marketing strategies.*
P12	*Master-Marketing*	*Use AI to generate content and test engagement.*
P13	*Master-Marketing*	*Familiar with GenAI tools to generate fast content for ads.*
P14	*Master-Law*	*Get to know AI in legal document analysis and big data processing.*
P15	*Bachelor-Fashion design*	*Used GenAI to create design sketches and fast color schemes.*
P16	*Bachelor-Architect*	*Use GenAI to create architectural design concepts and present ideas.*
P17	*Bachelor-Architect*	*Know the application of AI in architectural rendering and perspective creation.*
P18	*Bachelor-Architect*	*Understand how to use AI to test new design ideas.*
P19	*Bachelor-Architect*	*Get to know AI that supports prototyping, designing, and presenting spaces.*
P20	*Master-Illustration*	*Use AI to transform your illustration style and create new ideas.*
P21	*Master-Illustration*	*Know how to apply AI to create creative sketches and edits.*
P22	*Master-Illustration*	*Familiar with using GenAI to support quick idea sketching.*
P23	*Master-Animation*	*Tested AI in character creation and animation movements.*
P24	*Master-Fashion Management*	*Understand how AI analyzes trends and optimises fashion production processes.*
P25	*Master-Fashion Management*	*Know how to use AI to design product strategies and shape trends.*
P26	*Master-Fashion Management*	*Use GenAI to create design templates and predict market demand.*
P27	*PhD student in Sustainable design*	*Learn about AI in sustainable design and material optimization.*
P28	*Master student Interaction design*	*Know how to use GenAI to support user interface design and experience.*
P29	*PhD student in design*	*Discover how AI can be applied in creation, design, and process optimization.*

A.1.2 Expert interviews participants

Table 6: *Expert interviews participants information*

Participants Identification	Profession
EP1	Professional Photographer
EP2	Lecturer in Multimedia Design and Communication
EP3	Owner of a studio and teaching product design
EP4	Artistic director of the museum

A.1.3 Pilot study participants

Table 7: *Pilot study participants information*

Pairs of Participants	*Participants Identification*	*Work Background*
Pair 1	*PL1*	*PhD students have 5 years of experience working in the field of design. P1 regularly uses AI in research and poster design*
	PL2	*Postgrad students have experience working in the field of user experience design. P2 uses AI to design websites, develop website interfaces*
Pair 2	*PL3*	*Work in the field of design, creativity, design teaching*
	PL4	*Work in the field of design, creativity, design teaching*
Pairs 3	*PL5*	*PhD students have experience in applying AI in creativity and research*
	PL6	*PhD students with experience in applying AI in developing highly aesthetic products*

A.2 Procedure questions

A.2.1 Co-design workshop study

Table 8: *Interview Questions*

No.	*Question*
1	*What potential does Generative AI have in utilizing user EEG data?*
2	*Which aspect of feedback matters most to you: speed, accuracy, personalization? Why?*
3	*How does Generative AI using brain data for analysis and feedback impact your opinion on privacy and data security?*
4	*If you were designing a Generative AI system, what would you prioritize—creativity, speed, or security? Why?*
5	*Do you want AI to proactively suggest solutions for you, or just meet the requirements you set? Why?*

Table 9: *Co-design question*

No.	*Question*
1	*Please write or draw what you expect from real-time response interactions in the Metaverse created by GenAI using your EEG data.*
2	*How do you expect the Metaverse to allow you to achieve your ideal self when technology reads your thoughts?*

A.2.2 Expert interviews study

Table 10: *Interview questions for Conceptualising participants' backgrounds section*

No.	*Questions*
1	*Would you be able to give me an overview of your job?*
2	*What are your typical tasks in creating art and inspiring your students to be creative?*
3	*What is at the core of your artistic design or creation process?*
4	*Where do you usually find creative inspiration in your projects?*
5	*Can you tell me about the process of finding creative inspiration on the internet? If so, do you feel the difference between finding creative inspiration from things that belong to your real-life experience and living environment and finding creative inspiration from the internet? Can you describe the differences that you perceive?*

Table 11: *Interview questions for Experiences with GenAI section*

No.	*Questions*
1	*How has GenAI changed your creative process -from idea, sketch, to completion?*
2	*Can you describe the emotional experience you typically have when you use GenAI for creativity?*
3	*How can you guide students to understand the essence of creativity between "human creativity" and "AI-led creativity"?*
4	*Critical thinking is an important value for everyone in all professions. So, do you think your own critical thinking or your students critical thinking will be changed when using GenAI for artistic creation?*
5	***In your view, how does practicing art*** *contribute to developing self-understanding?*

Table 12: *Interview questions for Evisioning GenAI as a Cognitive Partner section*

Participant	*Questions*
1	*What do you think about GenAI continuously stimulating people's critical thinking through making the real-time response? Sound and video associated*

	with aspects of their ideal self in life and artistic creation?
2	*What do you think about GenAI being able to engage in some processes to provide inspiration for participants based on the input EEG data?*
3	*What do you think about GenAI being able to engage in some processes to provide inspiration for participants based on the input EEG data?*
4	*How do you think an artist will find inspiration for their designs through the use of GenAI?*

A.2.3 Pilot study

Table 13: Pre-study questions

No.	***Questions***
1	*What is a living space or environment that makes you feel like you belong and are free when you are there?*
2	*What is something that makes you happy and helps you relax when you are immersed in it?*
3	*What is a place or thing that makes you feel healed when you think about it?*
4	*What is a job or activity that makes you feel like you are performing at a high level?*
5	*What is a quality or definition of life that makes you happy?*

Table 14: Post-experience questions

No.	***Questions***
1	*How do you feel about the images that evoke your ideal selves in this study*
2	*Did the AI-generated images of your ideal selves based on your EEG data help you understand each other better and connect spiritually? Can you elaborate on that?*

A.3 Co-design workshop results

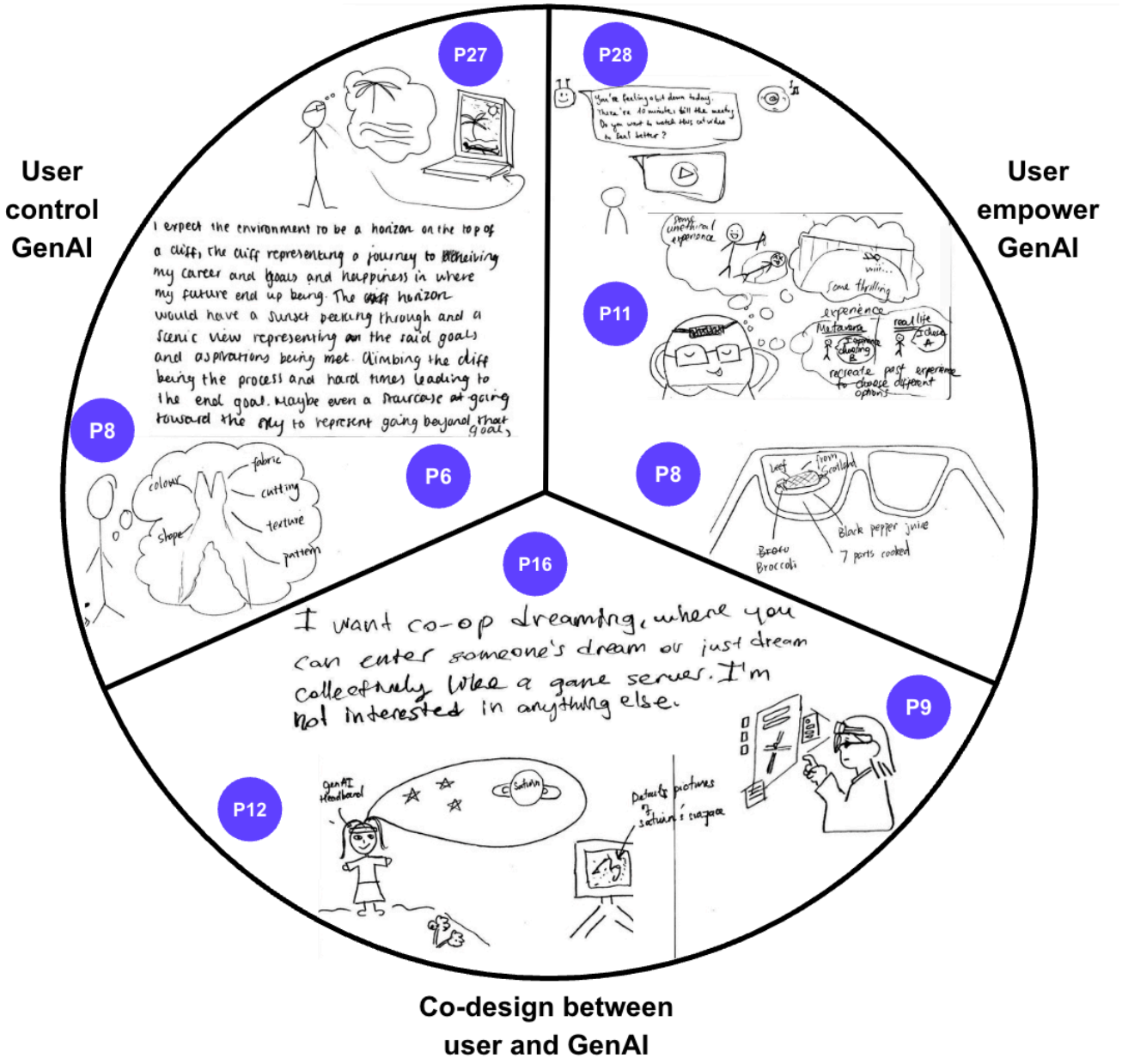


Figure 2: *Participants drew and wrote about their expectations for experiencing their ideal self in a virtual interactive environment.*

A.4 Co-design workshop results

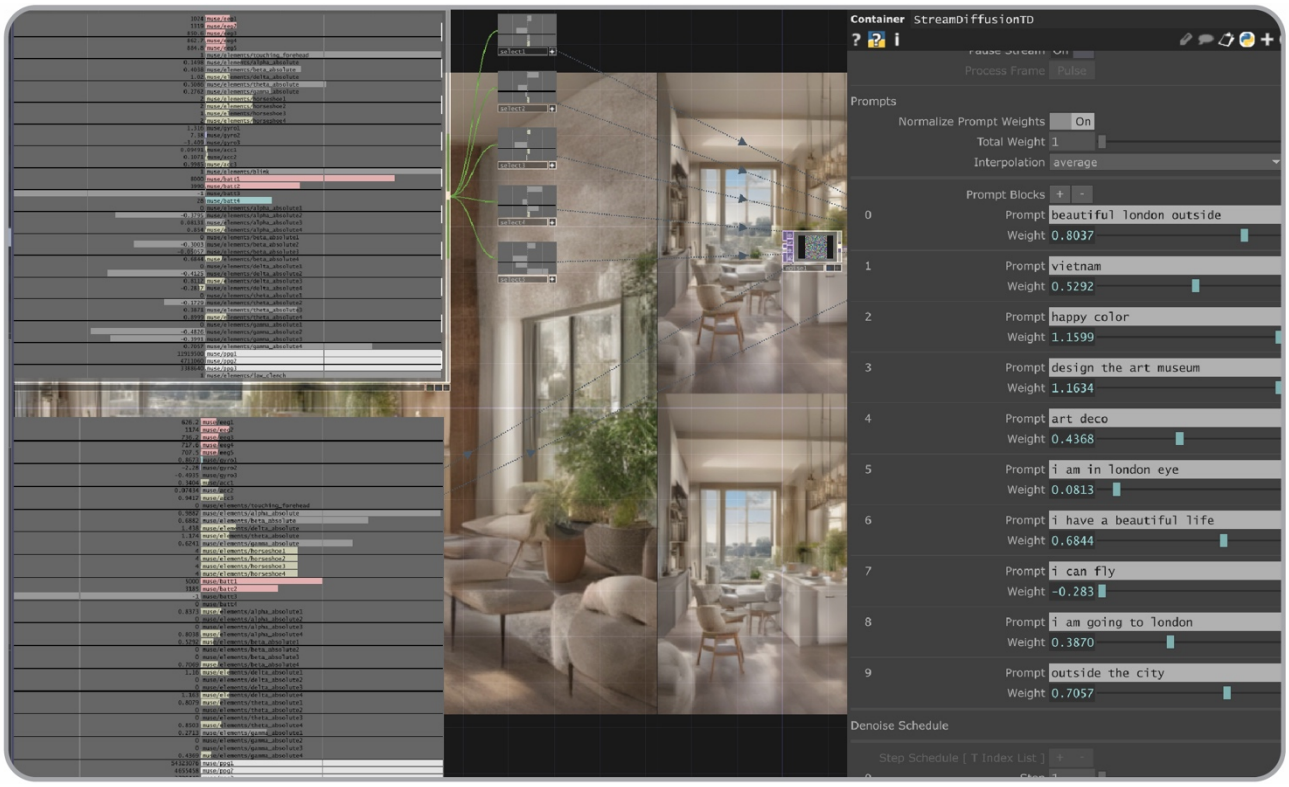


Figure 3b, c: *Prototype screen.*



Figure 3d: *Visual outputs based on participant-defined prompts.*