

Generative AI in Collaborative Ideation: Effects on Design Fixation and Divergence

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Abstract: Generative AI (GenAI) is rapidly entering design practice still its concrete impact on human ideation (for example using it as inspirational stimuli and design fixation) remains insufficiently understood. This research investigates how GenAI influences creative performance and experience in early-stage design and how it can be integrated with traditional ideation techniques rather than using it as a stand-alone idea generator. The study employs both quantitative and Qualitative methods to collect data from a structured design exercise conducted with 14 students from a course on the use of AI in design creativity in university settings. Techniques such as Brainstorming, Brainwriting, Negative Ideation, and Prompt Engineering were employed in the design process to investigate how AI tools function as team members during collaborative design ideation. Creativity outcomes were evaluated on fluency, novelty, feasibility, surprise and then it was complemented by fixation scores. The results show that GenAI consistently increased perceived inspiration and helped participants reframe problems by providing new and fresh perspectives. The GenAI was widely experienced as an active “team-mate” rather than a simple tool. However, human-only conditions often produced comparable or higher idea fluency and AI-generated examples sometimes introduced new anchors that shifted the focus of design fixation rather than removing it. Negative Ideation coupled with decorated prompts, helped participants transform AI suggestions instead of copying them directly. The insights offer strategies for integrating GenAI into professional work and design education so that it grows without restricting the range of potential solutions.

Keywords: Human AI Ideation, AI Augmented Design, Generative AI, Design Fixation, Prompt Engineering

1 Introduction

Ideation, otherwise known as conceptual design, is one of the vital steps of the design process. It includes the creation and development of concepts that lead to innovative solutions (Gong et al., 2024). In the ideation phase, designers seek inspiration or external stimuli to maintain the design space and possible directions of approach (Goldschmidt, 1997). Finding the right stimuli for a specific context can be challenging due to the versatility of endless possible sources (Goncalves et al., 2016). This is something design experts also often struggle with (Fricke, 1996). Generative AI (GenAI) has emerged as a very important and powerful tool in the area of designing, in that it provides novel sources of inspiration and rapid prototyping for different alternatives of designs. GenAI acts as an important co-creator that helps designers explore wider design spaces. Studies have shown that GenAI can enhance the quality of design outcomes and reduce cognitive load with the support of this iterative idea refinement (Chandrasekera et al., 2024).

However, the role of GenAI remains complicated due to its potential for inducing effects such as design fixation or cognitive biases (Chandrasekera et al., 2024). In this case, it means that both the human and artificial intelligence systems may be limited by pre-existing notions or patterns (Wadinambiarachchi et al., 2024). Interacting GenAI in the design process may limit creative exploration because of the existing cognitive biases from training data. On the other hand, designers can also introduce new biases while writing the prompt (Popescu, 2023). Over-reliance on AI can have a negative impact on standardizing designs, including raising questions about design identity, meaning and authorship (Schneider et al., 2024). People who are new to GenAI find it extremely divergent, while others may not see significant improvements in overall creative thinking (Fu et al., 2024). So, the effectiveness of those AI tools depends on how they are used and the context of their application (Lai et al., 2023).

Despite the increasing use of GenAI in the design process, there is limited literature about the impact of GenAI on creativity and fixation in the design phase. The majority of existing literature focuses on productivity and efficiency (Lai et al., 2023; Schneider et al., 2024). Hence, it is important to understand the interaction between GenAI and designers to foster proper human-AI collaboration for creativity and innovation in the future. This study aims to explore the impact that GenAI has on the human design ideation process in relation to: The mitigation of design fixation during problem solving by using Negative Ideation. Understanding the role of GenAI in human creativity and problem-solving capacity can help to optimize the collaboration potential between humans and GenAI in the design process.

2 Related Work

2.1 Ideation in Design Process

Ideation is identified as an integral process in the early stages of design, in which designers explore a broad solution space before focusing on a range of convergent and divergent concepts (Gong et al., 2024). In the divergent stages, designers are required to develop a range of novel ideas, in contrast to the convergent stages, in which designers select and develop a range of those concepts into potential solutions (Lai et al., 2023). In this case, the quality of idea generation can be measured in terms of fluency (the number of generated ideas), variety (the extent of distribution of ideas in different categories), novelty (originality of content), and quality (appropriateness or feasibility of generated ideas), taking into account the well-known literature on creativity (Gong et al., 2024). However, several authors argue that the early ideation stages remain poorly supported by conventional tools, which mainly assist documentation and analysis rather than creative exploration (Berni et al., 2024). Recent work examines how computational tools, in particular GenAI, can act as co-ideators, inspiration engines, or critical partners in the ideation process (Gong et al., 2024).

2.2 Design Fixation

“Design fixation” is the phenomenon of being stuck on a small number of ideas or on certain example, which in turn reduces the generation of novel and diverse solutions (Goldschmidt, 2011). Based on past theories of “functional fixedness” in psychology, Jansson and Smith were able to verify that designers who are exposed to solutions in the form of examples tend to replicate those very pieces of work, despite flaws in the solutions (Hu et al., 2020). Design fixation is problematic for several reasons. It can reduce variety by channelling designers towards a narrow region of the solution space, suppress originality by encouraging derivative adaptations of known concepts, and even deteriorate quality when non-functional aspects of examples are copied (Howard et al., 2013). Fixation can be caused by exposure to examples, dominant design patterns, individual experience, or in some instances, the formulation of the design brief. However, the introduction of GenAI has raised additional concerns that AI-generated outputs can act as powerful anchors (Cardoso and Badke-Schaub, 2011).

2.3 Design Inspiration, Creativity and Fixation

The dual role of examples as both sources of inspiration and triggers of fixation has been well documented. Designers routinely use inspirational material such as precedents, analogies, mood boards and sketches to broaden their search beyond obvious solutions (Berni et al., 2024). Early work on functional fixedness showed how prior knowledge about an object’s typical use can block alternative interpretations (Cardoso and Badke-Schaub, 2011). In design contexts, exposure to example solutions can cause designers to reproduce critical features, including non-functional or explicitly flawed ones, even when instructed not to do so. Later studies further unpacked how factors such as the abstraction level of stimuli, timing of exposure, and designer expertise modulate whether examples primarily inspire or constrain (Howard et al., 2013). Instead of retrieving existing artefacts from databases, GenAI systems synthesize novel images or texts from a latent space learned on large datasets (Wadinambiarachchi et al., 2024). These outputs can appear highly original yet remain statistically grounded in past data.

The impact of fixation on creativity has been well proven in several experimental studies. In classic experiments led by Jansson and Smith, it has been observed that people who were exposed to the designs of the exemplar generated solutions that were enriched with many overlapping features compared to those in the control group (Hu et al., 2020). Systematic reviews also emphasize that fixation can manifest regardless of expertise level, although experts may hide it more effectively behind local modifications (Wadinambiarachchi et al., 2024). Researchers found a negative correlation between the number of ideas produced and the fixation ratio in their study: groups that generated more ideas tended to exhibit fewer fixation elements, adding empirical weight to the “quantity breeds quality” argument in creativity research (Howard et al., 2013). Recent investigations with generative AI further show that fixation can be reinforced by AI-tools. Another observation was that AI-generated imagery when used as inspiration, increased participants’ fixation scores relative to online image search or no inspiration, even though participants believed AI would help them be more creative. This highlights the need to treat AI tools not as neutral amplifiers of creativity, but as active elements that shape the dynamics of fixation (Wadinambiarachchi et al., 2024).

2.4 Types of Design Fixation

Extensive research has been done to identify fixation into different types based on cognitive mechanisms, where researchers identified four types of fixation effects. Figure 1 highlights each measured on two important factors: designers’ awareness of being influenced by prior design solutions (unconscious to conscious) and designers’ ability to overcome this prior influence (blocked to resistant). Unconscious adherence refers to designers unknowingly imitating past design solutions and perceiving them as original, which is often related to cognitive priming. Conscious blocking refers to designers being aware that they are locked into their design solution or framework. Intentional resistance, on the other hand, entails designers being aware of other design solutions and consciously choosing not to adopt them because of their

personal preference or lack of interest in change. Lastly, unconscious blocking represents a combination of both being aware and not being able to overcome the constraints set by an example or solution. (Youmans and Arciszewski, 2012).

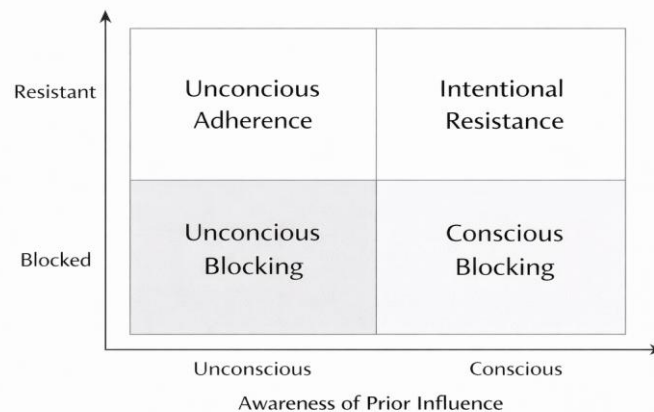


Figure 1. Typology of design fixation based on awareness and control

2.5 Measuring Design Fixation

Most empirical studies measure fixation through controlled experiments in which a “fixation group” receives example stimuli and a control group does not. The paradigm proposed by Jansson and Smith defines fixation in terms of the number of “fixation elements” in each problem solution, which can be objectively measured. Based on this theory, fixation ratio, calculated as fixation elements divided by the total number of concepts (Howard et al., 2013). The fixation ratio quantifies the extent of copying as well as idea generation, such that the higher the number of generated concepts and the lower the number of fixation elements, the lower the fixation ratio. Other work has combined fixation measures with pre-existing scales of creativity such as fluency, variety, originality, and quality in order to gain better insight into the effect of exemplars on idea generation (Howard et al., 2013).

More recently, Human–Computer Interaction (HCI) research has adapted these measures to AI-mediated tasks (Howard et al., 2013). For instance, researchers used fixation scores based on feature overlap between participants’ sketches and an example design, alongside creativity metrics to quantify how AI image generators affect both fixation and divergent thinking (Jansson & Smith, 1991; Shah et al., 2003). Such methodologies provide a foundation for studying how generative AI tools interact with human cognition in early-stage design activities.

2.6 Strategies to Overcome Design Fixation

Because of its negative effect on creativity, many approaches have been suggested to counter design fixation. Figure 2 summarizes key strategies proposed to mitigate design fixation, which are categorized into three main buckets: cognitive supports, workflow supports, and technology-based tools. With cognitive supports, the idea is to challenge the designer to expand their scope of exploration. This is achieved through constant reminders to reconsider, the use of lateral thinking tools such as Six Thinking Hats, and design-by-analogy to increase the scope of ideas. With process supports, the idea is to slow the design team’s decision-making by using physical prototyping and incubation periods. This is done to prevent mental locking. With technology, tools such as CAD and new AI agents can be employed to increase viewpoints. However, the effect of GenAI-generated stimuli is still unknown (Youmans and Arciszewski, 2012).

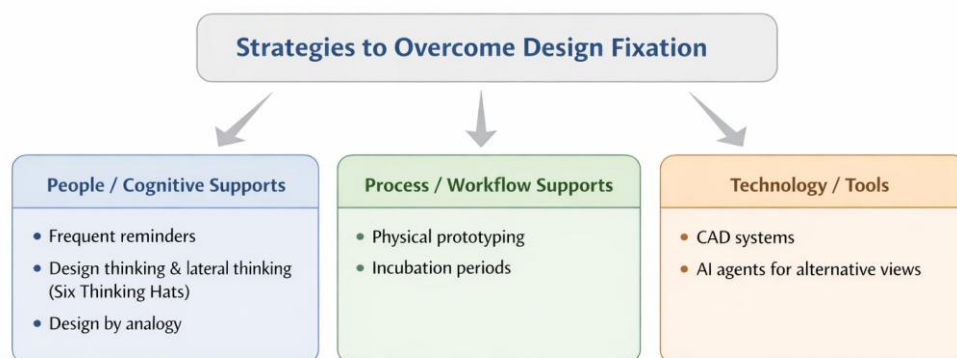


Figure 2. Strategies to overcome design fixation

3 Methods

3.1 Preferred Tools and Methodologies

This research employed both quantitative and Qualitative approaches to investigate the impact of different ideation techniques and tools on design outcomes within team settings. The study was conducted in the lab of the University of Oulu, Finland and the exercises was part of a course on use of AI in design creativity in university settings. The study included 14 participants from diverse demographic and academic backgrounds, including 9 men and 5 women across different age groups: 5 participants aged 18–24, 5 aged 25–32, 3 aged 33–40, and 1 aged 40+. Participants also represented varied educational levels, ranging from bachelor's and master's students to doctoral and postdoctoral researchers in areas such as Computer Science, Artificial Intelligence, Software Engineering, Business Analytics, and design creativity. Participants were informed of the study's purpose and procedures and provided informed consent before participating. The exercises were carefully designed so that participants would have the same timeframe and design challenges to test traditional ideation methods against ideation with GenAI. Participants were provided with access to use multiple GenAI tools to work on the design challenges like as ChatGPT (GPT-4, GPT 4o), and Midjourney (V7, V6.1). Data analysis includes both quantitative measures (e.g., number of ideas, creativity ratings) and qualitative analysis (e.g., reflection on the task, participant feedback) to provide a comprehensive understanding of GenAI's impact (Wadinambiarachchi et al., 2024). To holistically evaluate the cognitive and collaborative aspects of creativity, three ideation techniques were selected: Brainstorming, Brainwriting, and Negative Ideation. These were chosen due to their complementary cognitive mechanisms and frequent use in creativity research (Osborn, 1953).

1. Brainstorming: Being one of the well-established methods of divergent thinking, brainstorming was chosen for its potential to quickly generate many ideas. Traditionally, it has been used as means for evaluating the fluency of ideation in the conceptual phase and serves as a baseline for evaluating the impact of external stimuli on the quantity of ideas (Berni et al., 2024).

2. Brainwriting: Some authors integrated this approach as a variant of brainstorming. In this approach, people write down their ideas and share them later. In contrast to brainstorming, this approach reduces the problems of evaluation apprehension and dominance during group idea generation (Borgianni et al., 2020).

3. Negative Ideation: This approach was selected due to its proven success at discouraging design fixation by requiring the participants to purposively conceptualize incorrect or counter-productive solutions for the problem that would later be re-framed into workable concepts (Youmans and Arciszewski, 2012).

3.2 Exercise Design

The design exercise investigated how AI tools function as team members during collaborative design ideation. Explore whether “Negative Ideation” with GenAI can reduce design fixation and spark divergent thinking. The design brief says, “Redesign a water bottle: Beyond just holding water, how can its functionality, portability, or sustainability be improved through redesign?” Required tools and techniques for the exercise were a pen, paper, brainstorming, brainwriting, negative ideation, GenAI tools, and a laptop.

This experiment compared collaborative ideation with and without GenAI integration. At first, participants worked in teams of two to complete the design task using traditional ideation methods. Then they spent the same amount of time (30 minutes) on GenAI tools in this collaborative design process. For task 1, participants were provided with an example figure of a standard water bottle, which also used to evaluate each design's fixation level. For task 2, they had access to GenAI tools to work on the same design brief. Teams undertook collaborative ideation in each condition, incorporating methods such as Brainstorming, Brainwriting, Sketching, and Prompt Design. Finally, the teams synthesized their generated ideas and created the final design artifact.

3.3 Data Collection

A combination of data collection methods is utilized to secure evidence of performance and perceptions of participants in relation to the ideation process. By employing this combination of methods, triangulation of observations of participant behaviour, participant perceptions, and the quality of designs created can be obtained in this type of creativity research (Raghunath, 2023).

1. Pre-Surveys: Before engaging in the tasks, pre-surveys were administered to gain data on participants' demographics, level of prior design experience, and familiarity with use of GenAI tools. This type of profiling is very commonly seen in ideation-based studies to shed light on performance insights and act as a moderator of factors such as prior exposure to AI (Berni et al., 2024).

2. **Observational Notes:** Participants' questions regarding the problem, approaches towards design tasks, attitudes and behaviour can lead to interesting findings. Taking small notes throughout the sessions can help to understand participant engagement with the task, collaboration patterns with the teammates, stimulus interpretation, and evidence of design fixation or divergence (Youmans and Arciszewski, 2012).

3. **Generated Artifacts:** All sketches, textual outputs, and AI-generated stimuli produced during the exercises were collected as design artifacts. These constituted the primary material for downstream creativity analysis, since the examination of tangible ideation outcomes is considered a core component of ideation assessment (Shah et al., 2003).

4. **Participant Reflections:** Participants were also invited to document brief reflections after each exercise, describing their process, strategies, perceived cognitive challenges, and interaction with GenAI. Reflective accounts are widely recognised as an important means of revealing tacit reasoning during ideation (Lawson, 2005).

5. **Post-Surveys:** participants were also required to fill out a post-survey concerning their experience with the techniques, the perceived use of the tools, and the satisfaction level of the generated ideas.

3.4 Evaluation Metrics

The creativity of the ideas and design outputs generated during the ideation sessions was evaluated using a combination of standardized rating instruments and quantitative ideation metrics. The use of multiple complementary measures is consistent with established approaches to evaluating ideation effectiveness, which have incorporated measures such as quantity, novelty, variety, and quality (Shah et al., 2003). Mixed-methods approaches have also combined quantitative and qualitative measures, participant perceptions, and expert evaluations of creative design outcomes (Raghunath, 2023).

3.4.1 Evaluation of Creativity

The Creative Product Semantic Scale (CPSS) was used to assess the creativity of the final design ideas. The use of CPSS was appropriate for this study because it has been widely applied in early-stage design assessment and allows evaluators to compare creativity across different ideation conditions using a standardized scale (Besemer and O'Quin, 1999). Two independent raters evaluated design ideas on the dimensions of Novelty (originality), Resolution (practicality), and Style (Surprise) [10,7,6]. Each dimension was rated on a 5-point Likert scale, where 1 = very low and 5 = very high. Once the evaluation was done, the average score for Novelty, Resolution, and Style was calculated for each reviewer separately. Later, the numbers for both reviewers were merged to calculate the average score for each dimension. Finally, these scores were analyzed using the measures ANOVA (Analysis of Variance), considering the design Conditions as a factor within the subject for each CPSS dimension. In addition to CPSS ratings, the fluency of ideation was also collected to provide a quantitative account of each participant's creative output (Shah et al., 2003).

3.4.2 Measurement of Design Fixation

Design fixation was measured by applying 2 methods. One is using a Fixation Score, a widely adopted method in design cognition research when participants are exposed to a reference or example solution (Youmans and Arciszewski, 2012). The Fixation Score was operationalised as:

$$\text{Fixation Score} = \frac{Nf}{Nt} \times 100 \quad (1)$$

where **Nf** is the number of design ideas containing fixed feature(s), and **Nt** is the total number of design ideas generated.

Fixed features referred to non-essential or superficial elements of the reference design that participants unintentionally replicated, such as shapes, components, or stylistic attributes. A panel of 2 reviewers reviewed all concepts and coded them for the presence of such features. A higher Fixation Score indicated a greater degree of cognitive anchoring to the initial stimulus. The second method deals with the best idea chosen by the participants, where the reviewers rate them in comparison to six predefined fixed features in the provided stimuli. In the AI-assisted conditions, fixation was also examined through comparative analysis between participant-generated concepts and the GenAI-provided stimuli. If participants mirrored AI suggestions without reinterpretation or synthesis, this was recorded as instance-based fixation, aligning with recent findings that AI can act both as a source of stimulus and a potential fixation trigger (Popescu and Schut, 2023).

In addition to the use of the quality metrics, the survey questions were also open ended in order to allow qualitative analysis of the reasoning of the participants. In this case, the participants were required to look back at their design process and the use of artificial intelligence, cognitive barriers, and the effect of stimuli on their idea generation (Lawson, 2005).

3.5 Data Analysis

Data generated from this experiment were analyzed in a manner that integrated both qualitative and quantitative analysis methodologies in order to capture both the quantifiable outcomes of the ideation methods and the subjective experiences of the process of designing. Data analysis methods in this case were aligned with contemporary methodologies for analyzing data in areas of creativity and design cognition, in which measures of creative performance are informed by both outcome based and interpretive analysis approaches (Lawson, 2005).

3.5.1 Quantitative Data Analysis

The quantitative data set included idea fluency, fixation scores, and CPSS scores for novelty, resolution, and style. The analyses performed were done over two stages:

1. Descriptive Statistics: Calculations of central tendency (means) and dispersion (standard deviations) helped to form a general impression of the performance on each condition. It summarizes the initial comparisons of ideation techniques and the presence or absence of GenAI support (Borgianni et al., 2020).

2. Fixation Analysis: Fixation scores were analyzed across the experimental conditions to assess the presence of anchoring or conceptual reuse from viewing the stimuli generated by the AI (Youmans and Arciszewski, 2012).

3.5.2 Quantitative Data Analysis

The qualitative data consisted of open-ended responses from the post-surveys as well as reflective statements generated by participants after the ideation exercise was analyzed using thematic analysis, following a structured process of coding, category development, and theme refinement. First-cycle open coding was used to label emergent insights related to participants' strategies, emotional responses, barriers to ideation, and perceived influence of reference stimuli. These codes were then grouped into higher-order categories representing recurring cognitive and interaction patterns. This interpretive approach enabled the study to reveal how creativity aligns with contemporary recommendations in human-AI collaboration research (Popescu and Schut, 2023).

Special attention was given to language concerning the fixation triggers, including "sticking with the first idea," "following what the AI suggested," or "not wanting to depart from an early design." Attention to such qualitative markers added depth to fixation-score analysis in that it helped explain process-related decisions at the output level. By using triangulation between the creativity scores and qualitative thoughts, better insight into the outputs and decision-making processes that drove them was achieved.

4 Result

The study measured both objective and subjective aspects of the ideation process across two conditions. Objective metrics used in this study were the total number of ideas proposed and the Fixation Score, calculated as the percentage of ideas having similar looks or functionalities, thus reflecting fixation or constraining in ideation. Subjective measures were obtained by means of self-reports, specifically via a Likert scale, addressing four factors, namely the influence of external stimuli on ideation, teamwork, role of GenAI, and designer's sense of control in design processes. The above-mentioned measurement approach made possible comparing how GenAI impacted the studied factors within the framework of ideation.

4.1 Pre-Exercise Survey Findings

14 participants completed the pre-exercise questionnaire. Most were aged 25–32 and were primarily Master's students, with some PhD researchers and a few postdocs, mainly in Computer Science, AI, and related fields (e.g., design/creativity). They reported frequent internet use and intermediate-to-advanced programming skills. Most had completed at least one AI-related course and often integrated AI topics into their studies, learning mainly from academic sources alongside news and hands-on experimentation. Overall attitudes toward AI were positive, but participants also raised concerns about ethics, privacy, and overreliance.

4.1 Quantitative Result

The design Exercise examined the level of design fixation in teams of two working on the redesign of a water bottle under two conditions: task 1 used traditional methods and task 2 involved GenAI in the design process. The Figure 3 shows the

provided stimuli on the left with six annotations, used to identify the fixation level caused by the stimuli, where 1=Low to 6=High (here 6 represents the 6 annotated areas). Some design outcomes from the exercise session can be found on the right side of Figure 3.



Figure 3. Evaluation of design fixation

Participants were encouraged to produce as many ideas as possible within a certain time frame, during which 69 ideas were generated. After examining all similarities and differences in participants' ideas, reviewers identified 42 ideas that fixate on looks or features, which gives an average with a Fixation Score of 60.87%. The quality of the water bottle designed by each participant was rated based on a reference water bottle in Figure 3.

The results show that teams are able to produce more ideas without the support of GenAI than those with GenAI support ($M = 4.14$ vs. 3.29). However, participants rated the influence of stimuli slightly higher for the GenAI than for the non-GenAI condition ($M = 3.50$ vs. 2.93). In terms of collaborative influence, participants rated teammates' ideas moderately high without GenAI support ($M = 3.43$), while it was slightly lower for those in the GenAI condition ($M = 3.00$), showing moderate variability for those without GenAI support and higher variability for those in the GenAI support group.

Perceived control was high in both conditions, slightly higher without GenAI than with it ($M = 3.79$ vs. $M = 3.57$). Although in the GenAI condition, there was a higher concentration of answers at level 4 and lower variability ($SD = 0.90$ vs. 1.15), overall results suggest that GenAI slightly reduced perceived control, which was still high.

In both conditions, participants reported moderate influence of teammates on design thinking, but it was slightly higher without GenAI than with it ($M = 3.43$ vs. $M = 3.00$). In the no GenAI condition, there was a strong concentration of answers around level 4 (57.14%), whereas in the GenAI condition, answers were distributed across all levels with higher variability ($SD = 1.25$ vs. 1.05), suggesting that GenAI slightly reduced participants' reliance on teammates.

Most participants perceived GenAI as an active contributor to the ideation process: 43% rated it as significant and 21% as extreme. In the Negative Ideation with GenAI condition, answers were less extreme: 36% rated it as moderate, 14% as significant, 7% as extreme, and 14% rated it as none. A strong majority of participants (79%) believed that working in a team with GenAI would be the best way to produce creative ideas, whereas only small percentages chose working individually or traditionally in teams.

4.2 Qualitative Result

Open-ended comments and observation notes indicate that teams generally treated GenAI as an active partner rather than a tool. Participants described the AI as contributing new options, variations, and perspectives that the group could build upon, and many reported that AI suggestions were easy to interpret and adapt. However, a small minority experienced difficulty related to prompting or steering the AI towards relevant solutions. Teamwork itself was rated positively in both conditions: participants felt able to share unconventional ideas and that their contributions were acknowledged alongside AI-generated proposals.

Idea fixation did occur when their teams sometimes locked onto an early direction and continued refining it, but negative ideation was often described as a practical way to disrupt this pattern. They also mentioned that starting from intentionally “wrong” suggestions actually encouraged them to question their assumptions, reframe the problem, and consider alternatives they might not otherwise have explored. At the same time, some reflected that AI-generated concepts could themselves become new focal points that were hard to abandon. Figure 4 shows the difference between AI generated good and bad ideas of three teams.



Figure 4. GenAI's responses to negative ideation

In their reflections, the teams described the human-only round as rewarding for the opportunities it afforded for human ideation in terms of sketching, discussing, and refining individual and joint conceptual developments of ideas, despite the cognitive loads associated with coming up with novel insights for a familiar object. In contrast, the participants described the AI-supported round as playfully exploratory in nature, as they appreciated the combination of human and AI-generated ideas and joint refinements of those ideas achieved via negative ideation. There was appreciation for the difference between individual and joint ideation activities: individual ideation helped in freely capturing personal thoughts, whereas joint ideation involving additional factors such as AI assistance had better outcomes for merging diverse perspectives and understanding generated output from the AI-supported process.

5 Discussion

5.1 Human and AI Creativity

Recent work by Gero and colleagues suggests that using Generative AI in the early stages of design can lighten the mental workload for human designers by taking over some of the effortful analysis and recall that would otherwise be handled internally by the designer's working memory and executive functions (Borgianni et al., 2020). When AI is used to surface constraints or generate initial design material, designers no longer have to remember everything at once; instead, they can focus more on recognising patterns, evaluating options, and making higher-level choices. Brain-activity measurements in that study indicate that designers working with AI show lower activation in regions associated with demanding cognitive control compared to those working entirely unaided, and this more efficient mode of working appears to carry over even after the AI is removed. This experiment points to a similar “cognitive amplifier” role for GenAI, but they also show that this effect is neither uniform nor unproblematic. In the design task, teams came up with more concepts during the human-only condition and labelled the AI-supported condition as more engaging and felt that the AI helped them reframe the problem in light of novel perspectives. This pattern suggests that AI does not automatically increase idea fluency; instead, its main contribution lies in changing how designers think, which can help to reduce the perceived mental effort of managing complexity and expanding the perceived space of possibilities.

5.2 Future of GenAI in Design Creativity

The results suggest that using Generative AI in the early results suggest that GenAI is most promising not as a replacement for human ideation, but as an embedded collaborator within existing creative practices. Participants consistently framed

the “best” configuration as human creativity supported by GenAI. GenAI was valued for its ability to offer unexpected combinations, reinterpret known constraints, and provide quick, vivid material that designers could build upon or deliberately oppose (Georgieva & Georgiev, 2025). This finding supports the broader understanding of “co-creativity,” in which AI systems are thought of as human partners that can enhance human imagination instead of becoming independent designers of outputs (Georgiev et al., 2025). Looking ahead, the implications of this work point towards a future for designers in hybrid environments. In such settings, GenAI may be used for catalyst scenarios in the case of Negative Ideation, may be active in variation generation during the refining phase, or may help in transforming conceptual thinking into sketched-out and narrative forms for review by teams and stakeholders. Importantly, the experiment shows that participants enjoyed AI’s presence when they felt they remained “in the driver’s seat”. Maintaining this sense of agency through transparent control over prompts, adjustable levels of AI influence, and clear attribution of human decisions will likely be critical for the sustainable adoption of GenAI in creative practice.

5.3 Implications for Human–AI Collaborative Design Practice

Based on the research findings, the efficiency of the use of GenAI in design ideation seems to be strongly dependent on how the designer works with and critically evaluates the generated results. Even though the use of GenAI expanded the scope of ideas and introduced alternative perspectives, it did not enhance idea fluency, suggesting that human-AI interaction may require more thoughtfulness than fast-paced ideation (Borgianni et al., 2020; Fu et al., 2024). Hence, it can be concluded that future design practice will be significantly influenced by the development of better prompts and critical thinking in decision making. The research also showed that human-AI cooperation remains predominantly human-oriented, with GenAI receiving the highest value from participants when it facilitates rather than replaces human creativity. Nevertheless, human-AI interaction may lead to new fixation points, so further implementation of GenAI in design ideation should be based on methods like Negative Ideation to prevent idea fixation and encourage divergent thinking (Wadinambiarachchi et al., 2024).

6 Conclusion

This study examined how Generative AI reshapes early-stage design ideation, with a particular focus on AI-generated stimuli and design fixation in collaborative settings. The analysis considered not only what kinds of ideas were produced, but also how participants experienced and managed human–AI collaboration during ideation. During the exercise, GenAI proved most effective when it was treated as an augmenting partner embedded in a structured process, rather than as a stand-alone idea generator.

Findings indicate use of GenAI increased the search space, aided in exploring unusual directions, and in the team scenario, served as an extra “voice” that may present alternatives. Simultaneously, it shows that human-based ideation remained at least as prolific in terms of idea generation, and AI-generated novel examples may embody the potential to create new fixation points rather than reduce the issue of fixation. Methods such as “Negative Ideation” encouraged participants to reframe, decompose and transform both their own sketches and AI-generated content. Further, the role of prompt engineering and critical thinking is highlighted in this study. Whether GenAI responses were seen as useful or distracting largely depended on participants’ capacity to craft focused and appropriate prompts. If the prompts were generic or shaped around initial thoughts, this led GenAI responses to further solidify those patterns.

This investigation emphasizes some of the existing limitations and points towards possible routes for further study. Firstly, this investigation focused on small numbers of students in controlled environments within workshops given the time limitations, and it only focused on selected tools and methods of interaction and partially relied on limited reviewers’ assessment rather than large-scale expert evaluation of design quality. Further investigations into GenAI and its effects on creative outcomes and abilities may include professional designers for comprehensive periods of observation, and comprehensive comparisons of the different roles of GenAI in design tasks such as environmental stimulus searches and collaboration in the generation of creative solutions or critique and judgment of solutions.

In the area of Human-AI Collaboration in Design, this study brings forward a better understanding of how GenAI affects the process of early ideation, creativity, and design fixation. It was found out that the implementation of GenAI could open up the design solution space and allow one to adopt an alternative perspective, while also being able to cause fixations that must be prevented through critical thinking. The effectiveness of approaches such as “Negative Ideation” in terms of promoting idea reinterpretation was also confirmed. It is clear, therefore, that GenAI should be treated as a design tool only if framed correctly and used within the context of human-centered collaboration.

To conclude, the findings of this study support a view of GenAI not as a replacement for human creativity, but as a powerful and sometimes unruly partner that must be carefully framed, prompted and questioned. When integrated into existing frameworks and supported by methods that help to overcome fixation, GenAI can potentially allow designers to view problems from different perspectives and widen their pool of solutions.

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