Co-Creating with AI: Using AI as a Creative Partner in Design Teams

Duration	36 months
Level	Ph.D.
Team	Loki
Advisor(s)	Janin Koch (Janin.Koch@inria.fr) (Co-advisor), Géry Casiez (gery.casiez@univ-lille.fr) (Main Advisor)

Abstract: This Ph.D. focuses on designing and taking advantage of AI in professional design teams. In particular, we aim to evaluate the role such AI agents can play in collaborative design ideation and how to understand, support and design the underlying cognitive ability to enable a successful human-computer partnership. It will extend our previous work on building AI agents for group ideation in design [10], as well as our theoretical work on group cognition for designing collaborative AI systems [9]. We see a large potential of applying a more human-centered design approach to AI agents to identify benefits and address challenges when several stakeholders, intentions and goals are involved.

The Team: Loki is an Inria project team created in January 2018 in partnership with Université de Lille within the Joint Research Unit UMR 9189 CNRS-Centrale Lille-Université de Lille, CRIStAL. Our research aims at producing original ideas, fundamental knowledge, and practical tools to inspire, inform and support the design of human-computer interactions.

Description of the PhD proposal

Context

As GenAI image generation offers creative professionals a wealth of new creative possibilities, designers and artists have begun to adopt new workflows that incorporate AI. Despite its ease of access with text and creative potential, it still poses challenges for non-AI professionals [13, 27].

Professional designers are a particularly demanding audience, who seek to generate new artifacts or forms of personal visual expression, that have to reflect their intention as well as fulfill project and client goals. Recent research has highlighted the potential of using GenAI systems for creating design expressions [12, 26] as well as visual inspirations [17, 18]. However, today's professional interactive tools exhibit a limited degree of human agency in controlling or fine-tuning the creative process. They generally focus on applying existing concepts, such as rendering or completing prompts based on past work, rather than assisting designers in visually generating and exploring new ideas. Enabling a more joint human-computer process requires systems to adapt their agency and interaction style throughout the creative process in a more situated way.

In recent work, we have explored how to integrate AI in a more meaningful way into individual design practice. We showed how to use multimodal prompts to better steer GenAI algorithms in their work [18]. We show that multimodal prompt input enhances designers' self-expression, with preferences varying based on overall control over GenAI and ideation phase. In similar work we proposed "smart" pens for GenAI interaction, enabling "composition-as-prompts" for more contextually relevant and editable output, allowing designers to focus on visual composition rather than input refinement [17]. However, these insights are limited to individual designers interacting with a GenAI in their work. **We are interested in how these could be expanded to enhance the ideation workflow by increasing collaboration with other designers and providing intelligent advice in this context**.

Collaboration becomes crucial in group processes of collaborative emergence [20]. These processes are described as having: an unpredictable outcome; a moment-to-moment contingency in which each person's behavior depends upon the one just before; and an equal contribution of each participant to the collaborative process. This leads to 'interactional effects' where any given action can be altered by those of others [21]. A prominent example of such emergence are collaborative creative processes such as ideation or improvisation. In such distributed creative situations "collaborating groups of individuals collectively generate a shared creative product" [21] like new ideas or concepts. These creative thinking and approaches constitute the fundaments of innovations and change.

Application Domain
This PhD focuses on collaborative AI agents for design ideation, particularly in design teams. Ideation is a dynamic process involving divergent thinking (generating many ideas) and convergent thinking (narrowing down to the best ones) [7]. Designers draw inspiration from multiple sources, including collaboration, self-reflection, and serendipitous encounters [25]. Such ideation techniques for generating, evaluating, and refining ideas are the foundation for people's creative endeavors ranging from art to design to problem-solving. Research has shown that the quality of ideas often increases when people collaborate with each other [23, 24]. This is due to the fact that group members can express diverse viewpoints that individuals may not consider otherwise and collaborate on ideation efforts by building on each other's contributions [2, 3, 11]. This *human-human collaborative ideation* can be observed in diverse contexts such as when individuals with shared interests seek better ideas or when groups with conflicting needs seek to formulate satisfying solutions for everyone' [22].

As a use case we will focus on mood boards, which are visual collages composed of images, text, and objects, that express concepts, ideas and emotions. Commonly used in creative fields such as design or fashion, they stimulate the perception and interpretation of more ephemeral phenomena such as color, texture, form, image and status [6]. Designers often collaborate in the design of physical mood boards, where the act of finding, choosing and curating visual material not only helps designers express ideas they already have, but also inspires new ideas based on their reactions to the images that emerge [8]. Exploring the potential of GenAI in design teams hence provides a high level of external validity and opens up the possibility to deploy our work in design teams for long-term observation.

Problem and Objective
Most work in human-AI interaction for creative practice focuses on either active participation of artificial agents in dyadic interactions, or help/support tools for collaborative interactions. The objective of this project is to evaluate the role of GenAI 'agents' in the context of a human-human ideation in design. While our previous work showed how creativity can benefit from human-human-**agent** interactions, complementing rather than replacing the designers' roles, it opened up a number of questions.

RQ1: How can we integrate contributions from intelligent agents seamlessly within a group ideation process? While in dyadic interaction, AI agents can focus and align on human intention, group processes pose an additional challenge, which relates to selecting a target of alignment (i.e. to whom does the agent answer/suggest) as well as when is a good time to explore or exploit ideas within a collaborative ideation process. This requires the interaction paradigm to go beyond reactive approaches (answering to one user) and instead create a larger context of the task and actions (i.e. ideas) contributed by all participants.

RQ2: Which kinds of intelligent assistance are appropriate for which types of ideation phase? Our previous work has shown that designers prefer different levels of engagement of AI agents depending on the ideation phase. How these levels differ for each designer and how to select, integrate and provide these levels of support for ideation is one of the questions we want to address. This would include the ability to adapt the role of the AI agent between a tool and an engaged partner throughout the process.

RQ3: How to design the agency of intelligent assistants in design teams, and how can they adapt to each other? Agency is the ability "to perform activities in a particular environment in line with a set of goals/objectives that influence and shape the extent and nature of [the agent's] participation" [4]. Within group ideation, we often observe different levels of agency, where one participant takes the lead and suggests an idea, and the others exploit this idea further until someone else takes the lead to explore new ideas. How to design AI agents that are able to adapt their level of agency and when this is necessary is an open question.

In order to answer these questions the student will develop systems that help users to interactively explore diverse capabilities of creative systems, such as suggesting, explaining and negotiating contributions on visual creations adapted to several participants.

Theoretical foundations
The student will build on theory-based interaction approaches informed by previous work of the supervisors and the lab. This includes principles such as instrumental interaction [1] and co-adaptation [16] to create interactive systems that are discoverable [5], appropriable [14], and expressive [18], that grow with the user to enhance rather than replace the users skills.

Of particular relevance will be our work on facilitating human-GenAI interaction for creative exploration in design practice [17, 18] (RQ1); expanding our insights from our previous work on human-human-agent interaction in

design ideation [10,22] (RQ2); and our work on group cognition for collaborative AI [9] and how to design different levels of initiative in human-AI games [15] (RQ3).

Nature of digital collaboration

For the purpose of this project, collaboration is defined as "a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem" [19]. Although collaboration has received extensive attention in research on robotics, artificial intelligence (AI), and human–computer interaction (HCI), it is often applied in the context of dyadic human-AI interactions.

Instead we want to extend the notion of collaboration in this project to human-human-agent collaboration for exploring design ideas. Similar to our previous work (see Fig. 1), this project will mainly focus on two professional designers that work together to collect ideas in a remote setting. This small group would allow us to focus on individual interactions between the designers and the agent and explore different levels of agency within this interaction. As ideation and brainstorming are iterative tasks, where one contribution builds on the others, it is necessary to maintain a synchronous interaction to study the role and usability of AI agents in this context. We expect, however, that our result will be applicable to larger design team, as the challenges we address persist on larger scales.

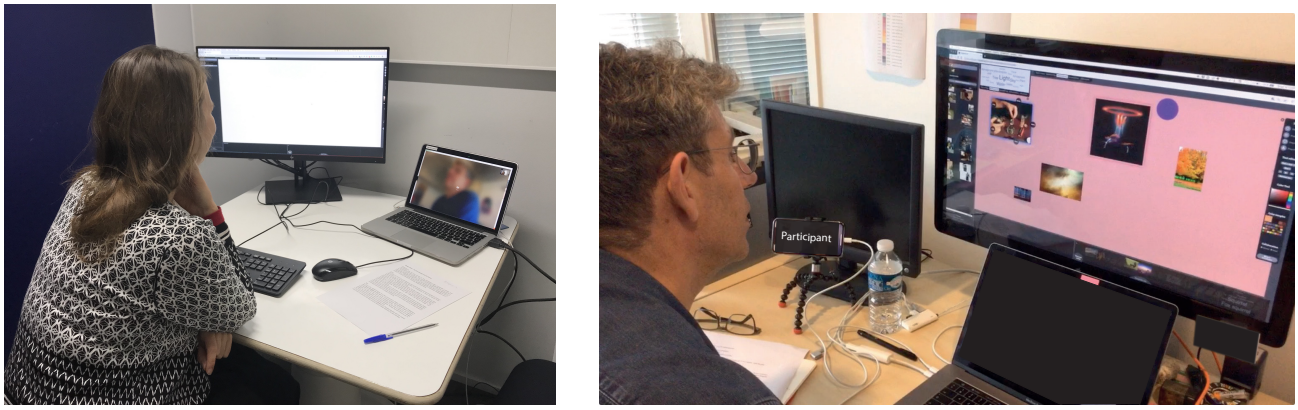

Figure 1: Study setup of [10]: Local designer (left) and remote designer (right) using a shared AI agent

Contribution to digital collaboration: Expected results and Impact

The goal of this Ph.D. is to design and develop a novel form of human-computer partnership in the context of professional design teams.

The student will develop novel interactive systems that enable effective human-human-agent interaction, to:

- Investigate how humans in a design team could actively take control and collaborate with a GenAI agent.
- Provide a better understanding how users directly and indirectly communicate while creating visual designs and how these diverse signals can be interpreted by an AI agent
- Develop working prototype(s) that demonstrate these methods in realistic design practice.
- Develop and apply evaluation methods to determine the efficacy of the interaction from a human point of view.

The doctoral candidate will be expected to conduct empirical studies and workshops (e.g., participatory design workshops), prototype, design, and develop novel interactive systems, and design, run, and analyze qualitative and quantitative studies to evaluate interaction techniques with professional design teams. In addition, they will be responsible for writing and publishing research articles for top-level research venues.

The expected results include advancing our understanding of how AI can be meaningfully adapted and applied in design practice, developing novel interaction methods for exploring visual ideas, and creating working interactive system(s) that demonstrate new interactive approaches in design practice.

Positioning in the eNSEMBLE program

This project directly relates to PC 3 *"MATCHING"* and in particular to theme 2 (*"Modelling and understanding collaborative or competitive interactions between two (or more) humans and intelligent systems"*) and partly theme 3 (*"Impact of intelligent systems on expertise and the loss of skills"*).

This project aims to explore how AI agents can be integrated in human-human ideation practice, that would allow the agent to take part of the ideation practice, express agency through meaningful contributions. This requires

the agent to better understand the designers current needs and joint focus, as well as adapt to an evolving and iterative process of ideation itself. Insides will be applicable beyond ideation practice, but contribute to outline the potential for AI in creative human-human exploration overall (theme 2).

Designers often collaborate on creating physical mood boards, allowing them to express ideas and inspire new ones based on their reactions to emerging visual material. The use of AI in design teams offers a high external validity and therefore the potential for placing our prototypes in design teams for long-term observation. This will allow us to identify the impact of such AI agents on existing workflows, as well as design and team reflections when using such tools for professional means (theme 3).

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