

# Designing Transformative Lenses to Aid Thinking

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## Abstract

How we look at the world shapes how we think, feel, act, and grow. In my research, I explore how technologies such as generative artificial intelligence (gen-AI) and augmented reality (AR) can serve as transformative lenses, empowering individuals to adopt new and constructive perspectives. In this short paper, I present a selection of projects from my portfolio that illustrate this vision, including work on reducing public speaking anxiety using AR filters and enhancing creativity and learning motivation using gen-AI.

## CCS Concepts

- Human-centered computing → Human computer interaction (HCI); Interactive systems and tools; Empirical studies in HCI.

## Keywords

generative AI, augmented reality, AI-assisted creativity, learning, communication, character design, virtual instructors

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## 1 Introduction

When I studied visual arts, one lesson that really struck me came from learning to draw. Usually, it can be pretty difficult to draw things realistically. To counter this, we can deliberately try drawing the “negative spaces”—the empty spaces around the object, rather than the object itself (see Figure 1). This simple change in focus can help people draw remarkably more accurately! I use this principle when designing technologies to support thinking. In my research, I explore how technologies can serve as transformative lenses, empowering individuals to adopt new and constructive perspectives. My works investigate this idea across various domains, including creativity, learning, and communication, as showcased in the projects below. Taking a human-centered and research-through-prototyping approach, I uncover key factors and principles that can inform the design of future technologies that empower individuals to purposefully pursue their learning and performance goals.

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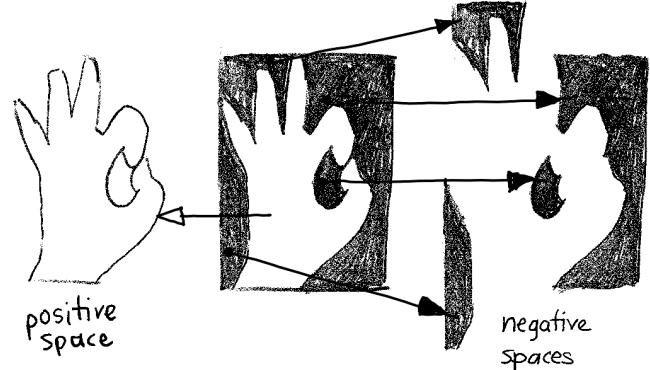


Figure 1: Drawing something accurately, like a hand, can be made easier by focusing on the “negative spaces”—the gaps in, around, and between the fingers, rather than the hand itself. This purposeful shift in focus helps us yield better results and master this complex task.

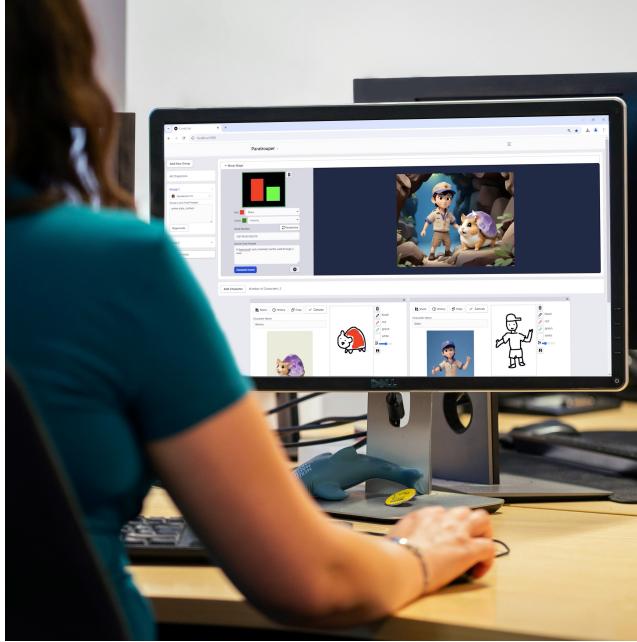
## 2 Enhance Creative Workflows Through Rapid Externalized Thinking

*Using Generative AI to Facilitate Rapid, Parallel, and Holistic Design Thinking in the Context of Visual Design.* Designing the visuals for casts of characters is a complex craft, for which there is a lack of tool support. Dedicated avatar and character creation interfaces (e.g., for games and video conferencing), are typically geared towards creating an individual character for a specific universe. General purpose artistic tools, while flexible, do not cater to the entire complex creative workflow. In the process of creating a cast of characters, beyond developing a concept for a single character (e.g., in turnarounds, expression sheets, etc.), designers must fit them within the context of other characters and the larger story (e.g., in lineups and storyboards).

Based on background research and formative interviews with five character designers, we determined that a tool for this task should (1) support rapid instantiations of ideas, (2) allow multi-modal input to maximize expressivity, and (3) enable varied visualizations for contextual thinking.

This led us to create Paratrouper [2], a generative-AI-powered multi-modal authoring tool for visual character cast design (see Figure 2). With it, one can use text, sketches, and image references to create images of original characters within cards. Characters cards can be viewed side-by-side, as well as sorted and styled in groups. Characters can also be visualized from multiple angles in character sheets, and staged together in different settings.

In a user study, we invited eight character designers to use the tool to design an original cast of characters. Based on observations



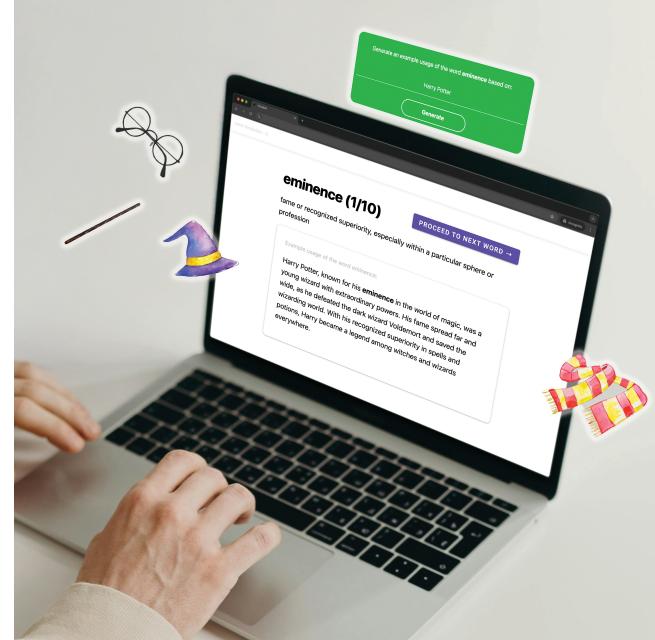
**Figure 2:** Paratrouper is a generative-AI-powered system to support the creation of character cast visuals [2]. Generative AI can help empower character designers to rapidly explore multiple concepts in parallel with one another.

and interviews, we learned that Paratrouper can help creators articulate and refine their design intent through rapid externalization. Character cards encouraged non-linear and parallel design exploration, multi-modal input afforded creative agency and expressivity, and stages fueled holistic thinking as well as sparked new ideas.

## 2.1 Learn New Concepts Through the Lens of Your Personal Interests

**Using Generative AI to Reframe Learning Materials in the Context of Your Personal interests.** Students often struggle to feel motivated while learning. What if we could empower students to learn new material through the lens of their own interests? We investigated this possibility in the context of vocabulary learning [3]. To do this, we prototyped a generative-AI-powered vocabulary learning app (see Figure 3) comprising three conditions:

- **Control:** Shows the target word, its definition, and an example of how the word can be used in a sentence taken from an existing source (e.g., book, news article, etc.)
- **AI-Generated Sentence:** Shows the target word, its definition, and allows someone to type a word or phrase which drives the generation of a personalized sentence, showing how the word can be used.
- **AI-Generated Story:** Shows the target word, its definition, and allows someone to type a word or phrase which drives the generation of a personalized short story, showing how the word can be used.



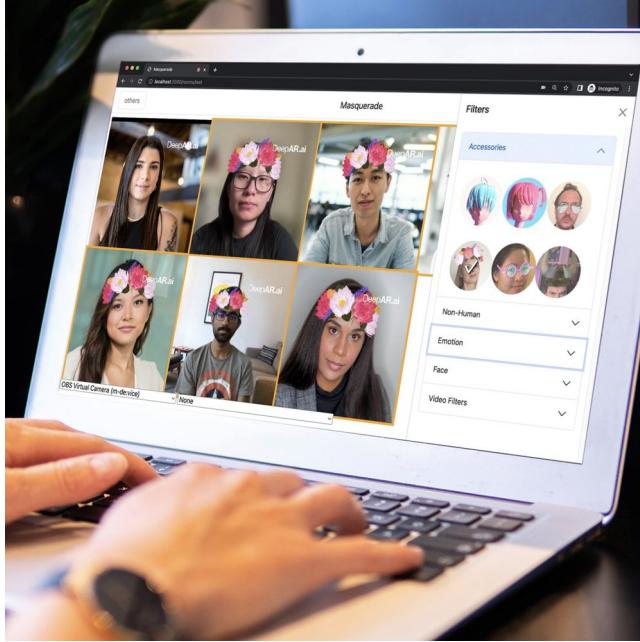
**Figure 3:** A generative-AI-powered vocabulary app can output personalized sentences or stories based on users' inputs, enabling them to learn new vocabulary through the lens of their interests [3].

Using this prototype, we conducted an online, between-subjects user study ( $n=272$ ) to investigate the impact personalized, AI-generated learning examples would have on people's learning performance (based on quizzes) and perception of their learning experiences (based on a survey). From this, we learned that while generated learning examples do not lead to better learning outcomes (i.e., immediate and delayed), people experience higher levels of intrinsic motivation when learning from them. We also discovered that people take different approaches to personalizing their learning materials. For instance, while some typed inputs based on their interests or aspects of their daily lives, others played with word associations to shape the generation of their own learning examples.

## 3 Overcome Emotional Hurdles that Inhibit Learning & Skill Development

**Use Augmented Reality to Reframe How You See Others (or Yourself) to Engage in Activities that Promote Self-Development.** Public speaking anxiety can get in the way of people sharing their ideas. To deal with this, a common piece of advice is to imagine your audience in a new light. However, what if augmented reality (AR) filters could be used for this instead?

We explored this idea in a two part investigation [4]. Firstly, we conducted a survey ( $n=100$ ) to capture a snapshot of a general public's perception of this idea (i.e., acceptance, filter effects, possible motivations, concerns). Furthermore, we prototyped a custom web conferencing application called Masquerade (see Figure 4), that enabled users to apply AR filter effects privately (meaning no one else on the call would see the effects) either on others or on



**Figure 4: Privately applying AR filters on others can transform how a person perceives an audience during video calls. This can help mitigate public speaking anxiety [4].**

themselves. Secondly, in a user study, we invited 16 people with a fear of public speaking (FOPS) to deliver an online speech using the app. We found that AR filters, particularly applied on others, can be helpful to mitigate public speaking anxiety, via a variety of strategies: moderating the distance they feel to their audience, changing how they feel towards themselves (i.e., more confident, or less self-focused), or altering their perception of the overall situation (i.e., less serious or distracting). Their AR filter preferences varied depending on the intensity of their anxiety, their existing public speaking habits, and additional personal and social factors. We also uncovered several important ethical considerations. In particular, enabling all stakeholders to be aware of what features are available, and providing mechanisms for negotiation and consent are helpful for maintaining a safe and respectful social atmosphere.

More broadly, the emotions and mindsets we carry govern whether and how we approach experiences that can lead to self growth. In an XRDS magazine article [1], I outlined some of the ways in which I believe generative AI can be used to cultivate positive emotions and mindsets that are conducive to learning and self-development.

#### 4 Enhance Learning Motivation via AI-Generated Characters That Inspire You

**Using Generative AI to Make Engaging AI-Generated Teachers and Peers.** With generative AI, we can create portrayals of characters ranging from fictional characters to historical figures. Despite many possible negative use cases for this technology, there are also potential positive use cases of AI-generated characters, specifically in supporting learning and well-being.



**Figure 5: AI can be used to generate virtual instructors who resemble people we like or admire. This in turn can help boost feelings of learning motivation [6].**

In a perspective article [5], we outlined opportunities to leverage AI-generated characters for learning. Such characters can be used to boost motivation and engagement using inspiring virtual instructors (see Figure 5). They can also be embodied by learners to enable learning via role-play. Additionally, characters can serve as interactive peers, collaborators, or intellectual sparring partners.

Delving into the topic of virtual instructors more deeply, we conducted an online between-subjects study ( $n=134$ ) to investigate the effects of learning from an AI-generated virtual instructor who resembles a person one likes or admires [6]. In the study, some participants watched a lecture featuring an AI-generated character modeled after a celebrity, while others learned from a non-recognizable character with similar demographic traits. After the lecture, they each answered a quiz and survey. We found that while it does not help learners recall the content better, they are more likely to appraise the virtual instructor positively, and to feel more motivated to learn when the instructor resembles a person they like or admire.

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