MIT Open Access Articles

Using Generative AI to Cultivate Positive Emotions and Mindsets for Self-Development and Learning

Massachusetts Institute of Technology

Using Generative AI to Cultivate Positive Emotions and Mindsets for Self-Development and Learning

The arrival of new generative AI tools is creating waves. Here are some ideas for how we could channel them for supporting self-development and learning.

By Joanne Leong

`OPEN ACCESS`

For many of us, a new year is a fresh slate and an invitation to better ourselves. This may be to develop healthier habits, be a better friend, learn or improve a skill, or advance our studies or career. It can be a time of excitement, but also tension. Our journeys may be riddled with unpleasant or boring steps, periods of self-doubt, and concerns about what others might think. As someone interested in self-growth, and who is also a researcher in the human-computer interaction (HCI) community, I like to think about how technology can be designed to make it easier for us to fulfill our dreams of self-betterment. When the going gets tough, could tech help us get going?

All the while, 2023 is characterized by a dizzying array of landmark AI developments, such as Dall·E, MidJourney, Stable Diffusion, ChatGPT, GPT-4. Their capabilities to generate images and text have astonished many and have also triggered a palpable sense of uneasiness and uncertainty about the future of work, art, and education. Amidst the challenges that these developments pose, this article seeks to present a few ideas for how developments in generative AI could be channeled toward facilitating the process of self-development and learning. In the spirit of renowned computer scientist, Dr. Alan Kay: "The best way to predict the future is to invent it" [1].

EMOTIONS AND MINDSETS MATTER

Growing up, I heard several classmates say countless times: "I'm just not a math person." The words are typically weighed down with negative feelings and memories of bad learning experiences. However, the late Dr. Seymour Papert, widely considered the "father of educational computing," offered a refreshing change of perspective: "...while it's true that most people in math class don't learn much math, most kids in French class don't learn much French. But we don't

say that they're not 'Frenchly minded.' We don't say that they don't have a head for French, because we know that if they grew up in France, they would learn French perfectly well" [2].

Dr. Carol Dweck distinguishes between these two ways of thinking as having a "fixed" versus a "growth mindset." Those with a fixed mindset believe their abilities and intelligence are capped and unchangeable, whereas those with a growth mindset believe the opposite [3]. In the face of failure, people with the latter mindset put in the effort needed to improve, rather than give up. In a similar vein, Dr. Angela Duckworth has dedicated the bulk of her research toward understanding what helps people succeed. The answer, she says, is grit—a mixture of passion and perseverance. Underlying grit are three key compo-

nents: sustained interest, sustained effort, and long-term goals [4]. The research in psychology rings loud and clear—mindset and emotions have a critical influence on our trajectories for self-growth.

Naturally, such concepts are tightly interwoven with the design of technologies for learning. Papert argued people "construct" knowledge through an iterative and cumulative learning process [5]. He stressed that people must be able to develop their own personal understanding of things by linking new concepts to their prior knowledge. Forcing people to learn ideas that are "fully-formed" and devoid of their own experiences could trigger disdain for learning. Dr. Mitchel Resnick, who leads the Lifelong Kindergarten group at the MIT Media Lab and is a co-creator of the Scratch program-

ming language for kids, continues to carry the torch forward by creating educational platforms that carefully integrate what he calls the four P's: projects, passion, peers, and play [6]. With Scratch, children can create any number of projects that align with their personal goals and are fueled by their own curiosities and interests.

Amidst the new surge in AI capabilities, how might these concepts translate to the designs of the next generation of interfaces for learning and self-development? While vast possibilities await, I would like to bring a focus to how generative AI could be leveraged to cultivate the kinds of emotions and mindsets that are conducive to learning and self-growth. Borrowing the term "epic" from Agile development, which typically refers to a larger body of work, I structure my ideas on

Figure 1. With AI-generative techniques, various characters can be created to facilitate educational experiences.

In a study, we found students are more motivated to learn when their virtual instructor resembles someone they like or admire [8].
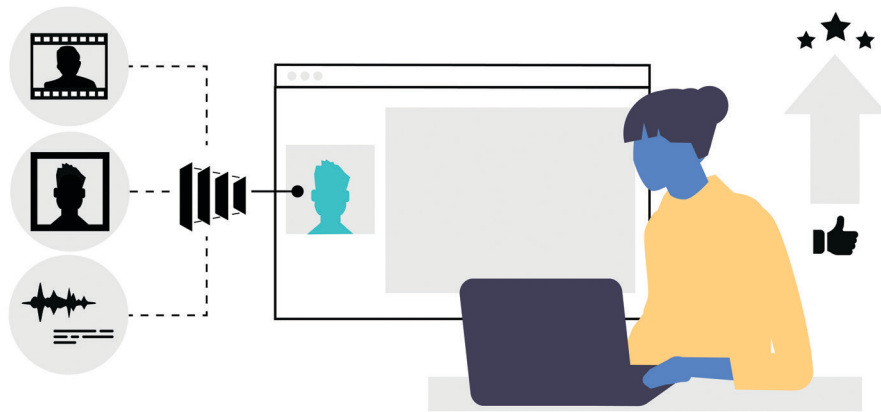
AI into three epics. These center on AI's potential to trigger interest, synthesize new perspectives, and provide non-judgmental feedback.

EPIC 1: GENERATING INTEREST AND MOTIVATION

Have you ever asked someone to tell you about an influential person in their career? Teachers are often at the top of the list. I have fond memories of my own high school science teacher. He ran really fun experiments, such as projecting Pringles cans into the ceiling and incinerating gummy bears (thanks Mr. Law!). Sadly, many people would conversely trace their lack of interest in a subject to a teacher they found boring or with whom they had trouble connecting.

One way to address this with AI is to generate characters to serve as engaging teachers and peers. For example, what if you could learn about winter weather formations from Disney's ice princess, Elsa? What if students could puppeteer characters in educational role-playing activities? Or, what if you could have a supportive AI peer in your learning group? While conducting research in the Fluid Interfaces group at the MIT Media Lab led by Dr. Pattie Maes, I have had the fortune to collaborate with several brilliant minds in thinking about what AI-generative techniques have to offer in this realm.

In an article published in *Nature Machine Intelligence*, we proposed how AI can be leveraged to generate characters for beneficial applications in well-being and education [7]. We outlined several usage strategies based on the idea of interacting with or embodying characters. Furthermore, we provided an open-source pipeline that combines various state-of-the-art machine learning models for generating characters. With this, we hope to invite people of all backgrounds to explore the positive potential of AI-generated characters and to contribute their unique perspectives in important discussions around its ethical and legal use.

In a follow-up paper, we conducted an online study to investigate the effects of learning from an AI-generated virtual instructor, whose appearance is based on a person one likes and admires (see Figure 1) [8]. Would people learn better? Would they feel more motivated? Would they perceive the instructor to be a better teacher? In a controlled experiment, we leveraged the face of a highly controversial figure, Elon Musk, to yield participants who would vary on a spectrum of liking or admiring him. Participants either learned from a virtual instructor with Musk's appearance, or a non-recognizable person with similar demographic traits, and then answered a quiz and survey. The results? Although listening to a single lecture from a person you like cannot immediately make you remember the learn-ing material better, students are likely to appraise their instructor more positively and feel more motivated to learn when the instructor resembles a person they like or admire.

This points to the idea that AI can be leveraged to blend our interests with learning materials in new ways to motivate us to learn what we might otherwise find boring.

EPIC 2: SEEING YOURSELF IN A NEW LIGHT

There is a very interesting video of Dr. Alan Kay, from back in the 1980s, reacting to a video that once aired on the ABC network. He popped a videotape into a VCR machine to play a reel that showed Timothy Gallwey, author of *The Inner Game of Tennis*, coaching a woman to play the sport. Despite having been judged as having little athletic potential, the woman learned to hit a tennis ball consistently for the first time ever—in a single afternoon. Kay's reaction was, "Holy cow!" According to him, a key thing Gallwey did to help her learn quickly was to give her particular things, such as a rhythm, to focus on. This was to help prevent parts of her brain from becoming preoccupied with making self-critical commentary. Kay stressed that this is a principle that should be applied to how we approach learning, teaching, and interface design overall. You can help people learn better by relieving them of this "mental interference" [9].

Virtual reality (VR) experiences appear to be one way for people to escape the internal mental chatter and self-beliefs that can interfere with performance. The Proteus effect is a phenomenon in which people's behaviors shift in accordance with their digital representations [10]. In line with this, researchers at the Event Lab at the University of Barcelona, co-directed by Dr. Mel Slater, have been working on VR body-swap illusions. In one of their experiments, young men who virtually embodied an avatar of Albert Einstein displayed better problem-solving skills compared to those who embodied a standard male avatar [11]. In another experiment, Dr. Tabitha Peck from Davidson College found body-swap experiences can mitigate stereotype threat. Stereotype threat is

a phenomenon in which a person's apprehension of confirming a negative stereotype interferes with their learning and performance in a given task. Female participants who were made to consider adverse math stereotypes performed better on working memory tasks, when they virtually embodied a male avatar [12]. While such interventions are only skin-deep, they have been shown as one avenue to bypass deleterious mental interference.

Sometimes, simply seeing a different version of yourself on screen can be enough to shift your thinking. A series of experiments conducted by Dr. Jeremy Bailenson and his research team at Stanford University's Virtual Human Interaction Lab found that people who are shown digitally age-progressed renderings of themselves have a greater tendency to save for their retirement [13]. In another study conducted by my colleagues and I, we investigated the potential impact augmented reality (AR) camera filters can have on people's creative thinking. Participants were asked to try on filters that made them look more child- or inventor-like (see Figure 2). The child filter made their faces fuller and more youthful, while the inventor filter gave them a spiky head of hair and black-rimmed goggles that enlarged their eyes. Given divergent thinking tasks, the participants showed a slight, but not statistically significant, improvement in their creativity with these filters applied and visible in their self-view [14].

Beyond appearance-driven experiences, AI could be used to imbue our digital representations with new behaviors and abilities. Machine learning algorithms for motion transfer make it simple to animate the face and body of a person from a photo to match the motions of another person in a source video. While there is rightfully much alarm around ill-uses of this technology (e.g., fueling misinformation in the form of deepfakes), this technology could be used to envision new possibilities and fuel a growth mindset. In my master's thesis, I experimented with showing people deepfakes of themselves speaking confidently [15]. While the participants had polarized views of the experience, some people came away with the belief that if a digi-

Forcing people to learn ideas that are "fully-formed" and devoid of their own experiences could trigger disdain for learning.

tal representation of themselves could succeed at confident speaking, then so could their real selves.

EPIC 3: RECEIVING JUDGMENT-FREE FEEDBACK

Humans are social creatures. Learning doesn't happen in a vacuum, and often we get trapped in trying to please our teachers or comparing ourselves to peers. Dr. Martin Levy, an orthopedic surgeon at New York's Montefiore Medical Center, has a radical proposition to get around this—clicker training. You might have heard about this technique for training dogs and dolphins: A trainer presses a button to make a clicking noise, signaling to the creature that they performed the desired behavior (i.e., positive-reinforcement).

In an episode of the podcast "Hidden Brain" hosted by NPR, Levy recommends clickers to be used not only on our flippered or furry friends, but even

on humans—such as aspiring orthopedic-surgeons. In a training program devised by Levy, when a medical student performs a particular action correctly, such as tying a knot or drilling a hole, the teacher clicks rather than comments. Why? He explains, to remove the sort of interference from the teacher that can make learning miserable—"It is baggage-free" [16]. Indeed, the fear of negative judgment can have a powerful grip on us, even as children. In a psychology experiment by Elliott and Dweck, children were either primed with thoughts of looking competent or increasing their competence [17]. Later, when asked to choose a task to complete, the children concerned with looking competent would sacrifice the opportunity to learn via a challenging task. Instead, they would opt for an easy task, in order to avoid the risk of making mistakes in front of the experimenter.

The concepts of behaviorism and operant conditioning that inspired clicker training date back to the early and mid-20th century. At the time, psychologists and learning theorists Dr. Sidney Pressey and Dr. B.F. Skinner were experimenting with offloading learning feedback to machines [18]. While their machines were not well-received, Levy might be onto something in weighing the merits of human feedback against feedback from a machine. In the Personal Robots group led by Dr. Cynthia Breazeal at the MIT Media Lab, researchers are investigating numerous ways for social robots to be used for education

Figure 2. AR filters can be used to change how you see yourself during online video calls.

In an online experiment [14], we observed a slight tendency for participants to come up with more creative ideas in divergent thinking tasks, with a child- or inventor-filter applied.
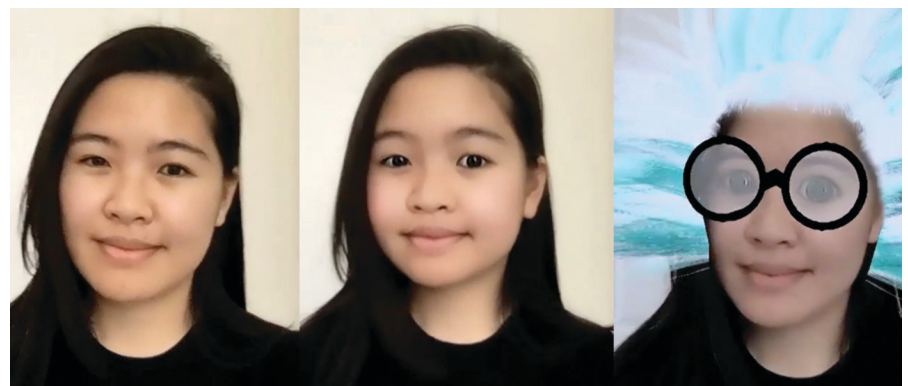
and well-being. In one paper, they explored the use of a social robot to guide students through positive psychology lessons and exercises (e.g., explaining what character strengths are, and identifying one's own signature strengths) [19]. After multiple sessions with the robot, one participant felt compelled to say, "…it's nice to have a robot that doesn't judge you."

While many people are worried about the negative effects of generative language models, a clever paper by Dang et al. [20] at the ACM UIST 2022 conference caught my eye. The authors built a text editor that incorporated automatic, NLP-powered text summarization. As participants in their study would write essays, they would see how the AI would summarize their text. This offered a rapid AI-driven feedback loop. With this "external perspective," participants could reflect on whether the message they wanted to convey was coming across in their writing. All the while, there was no mention of the participants fearing being "negatively judged" by the AI-powered tool.

So where does this bring us? With AI, computerized feedback evolves to be much more comprehensive than the click of a clicker, yet remains just as non-emotional. For people who cringe at the idea of having someone else critique their early-stage essays, advanced AI-powered tools can be a welcome addition to ward off some embarrassment. Of course, such tools cannot fully replace the value of eliciting a fellow human's perspective. However, these tools can at least fill a gap and assist you in iterating on your work and honing your craft in private, until you are ready to show things off to the world.

CLOSING REMARKS
This article aimed to provide a hopeful perspective on how forms of generative AI could be used to expand the landscape of technologies and experiences for learning and self-development. As new developments in AI challenge us to reassess our relationship with technology, there is the opportunity to apply knowledge from psychology, education, and technology to create tools and experiences that help us flourish. As technologists, it is important to keep in mind that while

> **AI can be leveraged to blend our interests with learning materials in new ways and motivate us to learn what we might otherwise find boring.**

technology can help tackle the many challenges humanity faces, it cannot do it alone. Nevertheless, as one piece of a larger puzzle, AI-driven technologies can be designed to help invigorate, revitalize, and empower us as people to fulfill one of our most fundamental needs—to self-actualize.

ACKNOWLEDGMENTS

References

[1] Kay, A.C. *Predicting the Future*. Stanford Engineering 1, 1 (1989), 1–6.

[2] Seymour Papert 2002 interview. The Daily Papert. 2002; http://dailypapert.com/seymour-papert-2002-interview

[3] Dweck, C.S. *Mindset: The New Psychology of Success*. Random House, 2006.

[4] Duckworth, A. *Grit: The Power of Passion and Perseverance*. Scribner, New York, 2016.

[5] Papert, S. A. *Mindstorms: Children, Computers, and Powerful Ideas*. Basic Books, 2020.

[6] Resnick, M. *Lifelong Kindergarten: Cultivating Creativity Through Projects, Passion, Peers, and Play*. The MIT Press, 2017.

[7] Pataranutaporn, P., Danry, V., Leong, J., Punpongsanon, P., Novy, D., Maes, P., and Sra, M. AI-generated characters for supporting personalized learning and well-being. *Nature Machine Intelligence* 3, 12 (2021), 1013–1022.

[8] Pataranutaporn, P., Leong, J., Danry, V., Lawson, A. P., Maes, P., and Sra, M. AI-generated virtual instructors based on liked or admired people can improve motivation and foster positive emotions for learning. In *IEEE Frontiers in Education Conference*. IEEE, 2022, 1–9.

[9] Alan Kay on Learning. YouTube. Jan. 25, 2008; https://www.youtube.com/watch?v=50L44hEtVos

[10] Yee, N. and Bailenson, J. The Proteus effect: The effect of transformed self-representation on behavior. *Human Communication Research* 33, 3 (2007), 271–290.

[11] Banakou, D., Kishore, S., and Slater, M. Virtually being Einstein results in an improvement in cognitive task performance and a decrease in age bias. *Frontiers in Psychology* 9, 917 (2018).

[12] Peck, T. C., Doan, M., Bourne, K. A., and Good, J. J. The effect of gender body-swap illusions on working memory and stereotype threat. *IEEE Transactions on Visualization and Computer Graphics* 24, 4 (2018),1604–1612.

[13] Hershfield, H. E., Goldstein, D. G., Sharpe, W. F., Fox, J., Yeykelis, L., Carstensen, L. L., and Bailenson, J. N. Increasing saving behavior through age-progressed renderings of the future self. *Journal of Marketing Research* 48, SPL (2011), S23–S37.

[14] Leong, J., Pataranutaporn, P., Mao, Y., Perteneder, F., Hoque, E., Baker, J. M., and Maes, P. Exploring the use of real-time camera filters on embodiment and creativity. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems* (CHI '21). ACM, New York, 2021, 1–7.

[15] Leong, J. S. Investigating the use of synthetic media and real-time virtual camera filters for supporting communication and creativity. Doctoral dissertation. Massachusetts Institute of Technology. 2021.

[16] Vedantam, S., Schmidt, J., Lu, T., and Boyle, T. When things click: The power of judgment-free learning. KUOW. February 3, 2020; https://www.kuow.org/stories/when-things-click-the-power-of-judgment-free-learning

[17] Elliott, E. S. and Dweck, C. S. Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology* 54, 1 (1988).

[18] Watters, A. *Teaching Machines: The History of Personalized Learning*. The MIT Press, 2023.

[19] Jeong, S., Alghowinem, S., Aymerich-Franch, L., Arias, K., Lapedriza, A., Picard, R., Park, H. W., and Breazeal, C. A robotic positive psychology coach to improve college students' wellbeing. In *29th IEEE International Conference on Robot and Human Interactive Communication*. IEEE, 2020, 187–194.

[20] Dang, H., Benharrak, K., Lehmann, F., and Buschek, D. Beyond text generation: Supporting writers with continuous automatic text summaries. In *Proceedings of the 35th Annual ACM Symposium on User Interface Software and Technology*. ACM, New York, 2022, 1–13.

Biography
Joanne Leong is a Ph.D. student in the Fluid Interfaces group at the MIT Media Lab, dedicated to research in HCI. Her work focuses on designing novel techniques to facilitate learning and self-development in areas such as communication and creativity. Her explorations span a breadth of technologies from generative AI and AR to wearables and tangibles.