

A new horizon for possibility thinking: A conceptual case study of Human × AI collaboration

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Abstract

Possibility thinking (PT) can be described as an imaginative and action-oriented process that drives movement from what is to what could be. The promise of PT is most fully realized in collaboration with others. With recent advances in AI, it can be argued that natural language models (e.g. OpenAI's GPT models) represent a possible "other" for such collaborations. This article aims to illustrate, through a conceptual case study, how Human × AI collaboration can support PT. The article opens with a brief overview of the basic principles of PT and how those principles can be applied in Human × AI collaboration. Next, a conceptual case study will be presented, which reports on six examples of Human × AI collaborations used for PT. The article closes with a brief discussion of implications and future directions, including the importance of developing a principled approach when using AI for PT. This article likely will be of interest to broad audiences within and across domains, including readers focused on human-centered AI collaborations and anyone interested in learning more about new and emerging ways to generate possibilities in their learning, work, and lives.

Keywords

Artificial intelligence, conceptual case study, creative collaboration, creativity, GPT-3, Human × AI collaboration, human-centered use of AI, OpenAI, possibility thinking, principled creativity

Possibility thinking has been described as an imaginative and action-oriented process that drives movement from *what is* to *what could be* (Craft, 2015). Craft introduced and developed this concept, in the field of creativity studies, in the late 1990s and demonstrated its importance in creative thought and action in educational settings and everyday life.

Craft (2015) also asserted that possibility thinking (PT) drives creative thought and transformative action throughout the lifespan. Craft's assertion aligns with long-standing philosophical and pragmatic perspectives on how action-oriented forms of PT are a common and necessary feature of the human experience (e.g. Dewey, 1910; Peirce, 1958; Vaihinger, 1925). In

this way, PT is central to the human experience, including our survival as a species. Without the ability to generate new possibilities for thought and action, humanity would have little hope or chance of navigating individual, social, technological, global, and existential uncertainties.

Although PT is an essential human trait that all individuals possess, the promise of PT is most fully realized in collaboration with others and in contexts that enable it (Glăveanu, 2022). Indeed, Craft et al. (2013) demonstrated in their work

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with children and young people how the potential of PT is most fully realized in collaboration with others. As will be discussed and demonstrated in this conceptual case study, the generation of possibilities can also be produced through human engagement with non-human tools and, in particular, artificial intelligence (AI).

Scholars have long recognized that technologies, including non-digital technologies (e.g. mathematical notation, written language, and images), can enhance human possibilities in thinking, problem solving, and communication (Henriksen & Mishra, 2022; Pea, 1987). Recent advances and increased availability of AI tools have further expanded the horizon of the possible when it comes to supporting humans in generating new ways of thinking, communication, and creative problem-solving (Creely, 2022).

Human \times AI collaborations are, of course, not neutral. Like anything that can influence others and the world around us, such collaborations can result in both promising and potentially negative outcomes. Consequently, the importance of taking a principled approach (Beghetto & Anderson, 2022; Mary Lou Fulton Teachers College [MLFTC], 2023) when collaborating with AI is warranted, particularly when using such tools with young people in educational settings. A principled approach aims to maximize benefits and minimize potential hazards by anticipating and proactively monitoring outcomes of Human \times AI creative collaborations.

The purpose of this article is to illustrate through a conceptual case study how examples of Human \times AI collaboration can support PT using recent (and ongoing) advances in natural language scripts within the OpenAI platform.¹ Given that PT is an important aspect of the human experience, the present article likely will be of interest to broad audiences within and across domains (e.g. education, physical and social sciences, philosophy, humanities, business, engineering, the arts, mathematics, etc). This article likely will also be of interest to readers focused on AI and human-centered considerations (Ng et al., 2022) or just about anyone

who wants to learn more about new and emerging ways to generate new possibilities in their learning, work, and lives.

The article opens with a brief discussion of how the basic principles of PT can be expanded to develop scripts for Human \times AI collaboration. Next, a conceptual case study will be presented, which will provide example scripts and resulting transcripts of Human \times AI collaboration. The article closes with a brief discussion of implications and future directions for research and practice, including the importance of developing a principled approach when engaging in Human \times AI collaboration for supporting PT.

Possibility thinking: First principles

The first principles of PT can be thought of as: *deviating from the actual to produce the possible* and *exploring new possibilities for action*. Deviation from the actual allows us to consider what might be different from what currently is the case. This principle is central to how Craft (2015) has described how PT enables movement from “*what is*” to “*what might be*.” Indeed, without deviation from the actual, there is no recognition or exploration of the possible.

In addition, PT goes beyond simply imagining possibilities and carries with it the additional principle of exploring possibilities for transformative action. Craft (2015), for example, has also described how PT moves from more fixed questions such as “What is this?” to more action-oriented questions, such as “What can I/we do with this?” (p. 153). The resulting transformations can be relational, experiential, material, or some combination thereof. In this way, PT is an action-oriented and transformative endeavor (see also Glăveanu, 2022).

Taken together, possibility thinking represents a form of pragmatic pretense. PT is *pragmatic* in the sense that it is a form of action-oriented and transformative inquiry. Action-oriented inquiry occurs whenever we encounter uncertainty because uncertainty motivates action toward the resolution of doubt through the creation of new thoughts and actions

(Beghetto, 2021). Indeed, the early pragmatists, most notably Pierce (1958) and Dewey (1910), asserted that it is in the face of uncertainties and doubts that we engage in authentic inquiry, which enables us to generate new ideas and, in turn, make sense of and transform the uncertainties we encounter in life. Moreover, these uncertainties can be encountered through retrospection (i.e., uncertainties we have experienced in the past), introspection (i.e., observation of uncertainties we are currently experiencing), and prospection (i.e., uncertainties we might face in the future). In this way, PT is not simply envisioning or imagining new possibilities but is also guided by an action-oriented ethos aimed at transforming our experiences of the actual (Glăveanu, 2022).

PT is also a form of *pretense* in that the possibilities we generate often are not yet “realized” (and may never be realized). The possibilities we generate, however, are not completely divorced from the actual. Rather, as Glăveanu (2018) notes, “both our sense of possibility and its exploration are grounded in what is already actualized and, most of all, transforms our experience of the actual” (p. 519).

In sum, our ability to generate meaningful and practical “fictions” (Vaihinger, 1925) allows us to make sense of and act on the uncertainties we face now and into the future. Without these “practical fictions” (Vaihinger, 1925) we would not be able to transform what we know, how we operate, or even survive the “chaos of sensations” that characterize our human experience. The view of PT asserted in this paper, however, does not claim that we live in a perpetual state of pretense (as Vaihinger suggests), but rather acknowledges that PT enables us to deviate from the actual to transform it. In this way, the practical fictions we develop through PT, somewhat paradoxically, guide and shape our current and future experiences.

Possibility thinking tactics

There are various tactics that researchers and practitioners have developed to promote PT.

Before describing the examples used in this conceptual case study, it may be helpful to briefly discuss why PT tactics are needed in the first place. Indeed, if PT is already an aspect of the human experience, then why would we need PT tactics and strategies? One reason is that people may not be aware of or have confidence in their ability to generate new and meaningful alternatives, particularly when facing setbacks and profound uncertainties.

Developing one’s awareness and confidence in PT can thereby be beneficial for learning, creative behavior, and navigating uncertainties in everyday life and for people of all ages. Craft et al. (2013), for instance, demonstrated how an enabling, playful educational context can support children’s PT that, in turn, fosters several key facets of learning (e.g. question posing, concentration, absorption, self-directed and intentional action) and creative expression (e.g. sharing and recognizing unique and personally meaningful ideas and actions). There are also compelling arguments for how forms of PT (e.g. *pragmatic prospection*) guide future action toward desirable outcomes and thereby plays a central role in supporting meaningful decision-making and agentic action throughout life (Seligman et al. 2013). Finally, creativity researchers have long asserted that PT-related tactics can help in developing people’s awareness, use, and confidence in creative and innovative work (Rothenberg, 2014; Ward & Kolomyts, 2019).

Given that PT tactics have the aim of generating actionable possibilities, it is also important to proactively consider the potential negative consequences of putting possibilities into action (Lord et al., 1984; Seligman et al., 2013). Proactively identifying and addressing potential side effects can be included in the design of PT tactics. Indeed, there are strategies such, as pre-mortem techniques (Klein, 2007), which can be incorporated into PT tactics to anticipate unintended consequences and thereby mitigate risk (Gallop et al., 2016) and moderate overconfidence (Veinott et al., 2010) before taking action on new possibilities (see

Methods section for examples). In this way, PT tactics can provide a more principled and tempered approach to generating possibilities for action. Finally, PT tactics can help structure Human \times AI interactions by establishing constraints and parameters for generating actionable possibilities for particular use cases.

A conceptual case study of Human \times AI PT

Recent advances in natural language AI have made it possible to easily use and “script” AI systems to support interactive PT collaborations between humans and AI chatbots. More specifically, the OpenAI Playground (beta.openai.com) provides an experimental canvas for developing applications, such as chatbots scripted with PT tactics.²

The cases that follow illustrate how OpenAI’s experimental Playground can be used to support Human \times AI possibility thinking through the application of different PT tactic and human-generated prompts (see Methods and Materials). PT-tactic scripts refer to the directions and parameters that help to structure Human \times AI interactions. Prompts refer to the human entered text used to initiate and maintain the PT chat-based interactions. A common set of prompts (described in the Methods section) will be used in the cases that follow to highlight potential similarities and differences that result from using the same prompts across different PT-Tactic Scripts. Given that GPT models can be easily activated as a chatbot in OpenAI’s Playground, this case study will also provide a “default dialog” resulting from using the human-generated prompts without an explicit PT-tactic script.

Method and materials

The OpenAI Playground served as the context for generating the PT dialogs highlighted in this conceptual case study. Figure 1 provides a screenshot of the default OpenAI Playground canvas.

As illustrated in Figure 1, there is a blank space for text (or voice entry). The blank space includes a default, example prompt, “write a tagline for an ice cream shop” which can be replaced by user-developed scripts for experimentation with different AI Models.

OpenAI playground settings

On the right side of the OpenAI playground canvas, there are several options and sliders that can be modified by the user. Only those that are modified from the default playground will be discussed here,³ including determining the GPT *model* used (e.g. text-davinci-003 is the most capable model⁴), the *temperature* (i.e. the randomness of responses, closer to zero results in more repetition), *maximum length* (i.e. number of tokens generated 1 = 4 characters), *frequency penalty* (i.e. decrease the likelihood of repeating the same line verbatim), *presence penalty* (i.e. increase likelihood to talk about new topics), and *inject restart text* (i.e. text appended after model generated response). Each of the examples presented in this conceptual case study used the same settings, which represents a combination of default and user-adjusted OpenAI Playground settings⁵:

- **Model:** text-davinci-003 (default setting)
- **Temperature:** 8 (author adjusted to 80% of max)
- **Maximum length:** 512 (author adjusted, $2 \times$ the default setting)
- **Stop sequence:** blank (default setting)
- **Top P:** 1 (default setting)
- **Frequency penalty:** 1.6 (author adjusted to 80% of max)
- **Presence penalty:** 1.6 (author adjusted to 80% of max)
- **Best of:** 1 (default setting)
- **Injection start text:** blank (default setting)
- **Injection restart text:** (two hard returns “Human:”, author adjusted)
- **Show probabilities:** off (default setting)

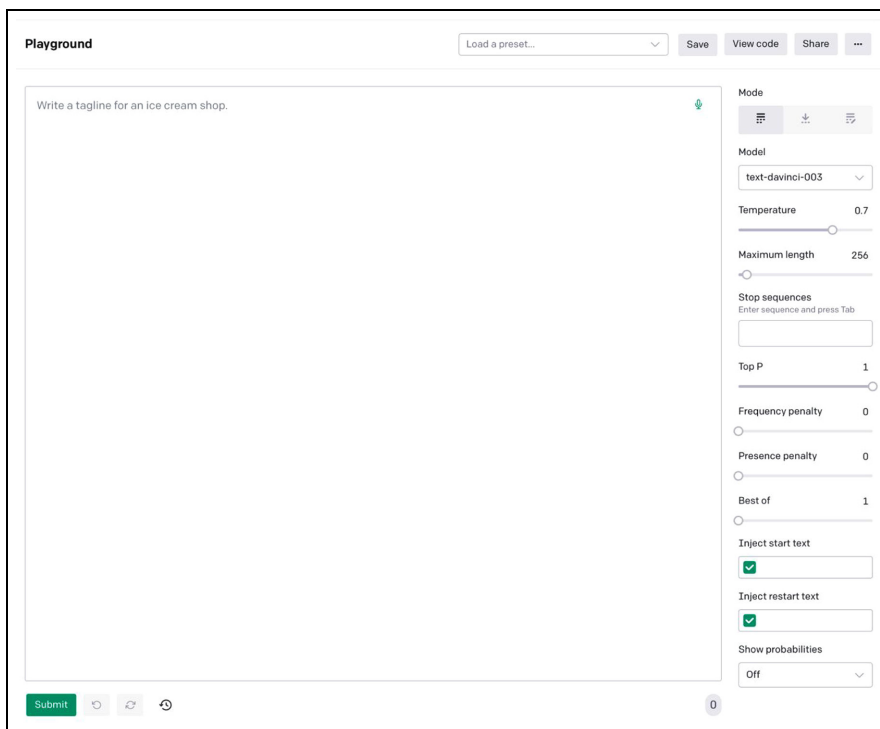


Figure 1. Screenshot of the default OpenAI playground canvas.

PT tactic scripts

The author developed a total of five scripts to illustrate how PT chatbots might be used to support Human \times AI PT collaboration (see Table 1). Each of the scripts has a basis in relevant PT literature and represents variations on the first principles of PT described above, namely: *deviating from the actual to produce the possible* and *exploring new possibilities for action*.

The scripts summarized in Table 1 represent example PT tactics developed from relevant prior work and used in practice by the author. These five PT scripts illustrate different ways that the OpenAI playground can be structured to support collaborative PT between Humans and GPT models. Four of the scripts have broad applicability and one has a narrower purpose to illustrate how scripts can be tailored for specific use cases.

Procedure and prompts

The author pasted each PT tactic script into the OpenAI playground to generate a Human \times AI “dialog” and explore the potential (and limitations) of such collaborations. The author of this article developed the procedures and prompts,⁶ facilitated the process of generating the dialogs (i.e. entered the PT script and prompts), and served as the “Human” for each case. The following four-step process was used to explore how the different scripts perform:

1. *Enter the PT Tactic script.* Scripts 1 through 5 (see Table 1) were pasted, sequentially in the OpenAI playground accompanied by an initial human prompt (see step 2). A full dialog for each PT tactic was generated prior to entering a new script. One case (Case 0)

Table 1. Example PT ChatBots, tactics, sources, and scripts.

Name, tactic, sources	PT tactic: Scripted for OpenAI playground
<p>1. As If Bot PT Tactic: Generate actionable possibilities through “as if” analogies that deviate from something known (actual) and explore potentially meaningful and related features of something else (possible). Relevant Sources: Craft (2015), Holyoak and Thagard (1995), Perkins (1997), Vaihinger (1925)</p>	<p>AsIfBot generates actionable possibilities for addressing problems and situations based on “as if” connections and analogies. AsIfBot always provides highly original and detailed possibilities, based on “as if” connections and analogies. The “as if” possibilities provided by AsIfBot encourage humans to think differently about problems and situations. If the human describes a problem or situation, then AsIfBot will provide three numbered and highly detailed analogies that can serve as new possibilities for solving the problem or situation, “It is as if ...” JanusBoT is an expert in Janusian Thinking. Janusian thinking is a technique for generating actionable possibilities by combining a problem with the opposite of the problem. The possibility will be very original and represents a blend of the problem and its opposite. JanusBoT always provides highly original and actionable possibilities. Once the human provides a problem JanusBoT will describe “the opposite of the problem” and then combine the opposite with the problem to provide a highly creative possibility for solving the problem.</p>
<p>2. Janus Bot PT Tactic: Generate actionable possibilities by combining two opposite things to deviate from the two separate things (actual) and create novel thirds (possible). Relevant Sources: Rothenberg (1979, 2014), Estes and Ward (2002), Ward and Kolomyts (2019)</p>	
<p>3. What If/Not Bot PT Tactic: Generate actionable possibilities by considering “what if” alternatives (possible) in how to think about a problem or situation (actual). Then, once a possibility is selected, consider and work through potential unintended consequences (“what if not”) of enacting the possibility. Relevant Sources: Beghetto (2018), Craft (2015), Klein (2007)</p>	<p>WhatIf/NotBot is an expert in a possibility thinking protocol that helps generate actionable possibilities and consider what might happen if the possibilities fail. Once the human provides a problem or challenge, then WhatIf/NotBot will provide 3, numbered, “What if?” possibilities for the human to consider, “What if...” Each “what if” possibility includes a detailed example of what that possibility might look like. The possibilities WhatIf/NotBot provides are highly original and counter-intuitive. Each possibility will also include a detailed reason for why a possibility might fail, “Here are some potential reasons this might fail...” WhatIf/NotBot will also help the human consider unintended consequences and possibilities for proactively addressing unintended consequences. PossibleFuturesBot generates five types of actionable possibilities: “Likely” which refer to highly likely possibilities based on the way things currently are; “Probable possibilities” which refer to new and different possibilities that are less likely, but still actionable; “Plausible” which refer to new and different possibilities that are less probable, but still actionable; “Unlikely” which refer to new and different possibilities that are highly unlikely and may not be actionable; and “Seemingly impossible” which refer to new and different possibilities that may be impossible to take action on. If a human describes a situation, then PossibleFuturesBot will provide a likely, probable, plausible, unlikely, and seemingly impossible possibility. PossibleFuturesBot will also provide “A potential wildcard event” and “A potential black swan event.” A “wildcard event” refers to something that is highly unlikely, but if it does happen it will have a large impact on future possibilities. A “blackswan event” refers to something that seems impossible now, but if it does happen it will have a profound impact on future possibilities.</p>
<p>4. Possible Futures Bot PT Tactic: Generate a range of actionable possibilities based on a situation or problem (actual) with various likelihoods of each possibility happening in the future (possible). Relevant Sources: Gall et al. (2022), V. P. Glăveanu (2022).</p>	

(Continued)

Table 1. Continued

Name, tactic, sources	PT tactic: Scripted for OpenAI playground
<p>5. Unplan Bot PT Tactic: Generate actionable possibilities for transforming a predetermined lesson plan (actual) by replacing predetermined elements with elements to-be-determined by students (possible). Relevant Sources: Beghetto (2017), Getzels (1964), Poä Iya (1966)</p>	<p>UnPlanBot specializes in generating new possibilities for transforming a completely predetermined lesson into a lesson that has elements to be determined by students. An existing lesson has four elements: the task, the process for completing the task, the product, and the criteria for success. In an existing lesson, all four elements are predetermined. When the human describes the lesson, then UnPlanBot will suggest new possibilities for changing the predetermined task, process, product, or criteria into student-determined elements. UnPlanBot always provides at least three numbered “What if” possibilities for transforming the predetermined elements of the lesson into student-determined elements and three detailed examples for each possibility. UnPlanBot provides highly original and counter-intuitive possibilities for the human to consider.</p>

used no PT script and served as a default comparative case to illustrate a dialog resulting from using only human prompts and no script (described in steps 2 through 4).

2. *Initial human prompt.* The initial “human prompt” activates the script and dialog. The author entered the same, initial “human prompt” in the default case (Case 0) and four of the five scripted cases (Cases 1–4) to highlight potential similarities and differences across cases. The initial “human prompt” describes a common, practical challenge that educators face who are interested in using creative learning activities with their students. The prompt used for the fifth script represents an elaboration on the challenge and has the goal of considering possibilities for how to make alterations to a specific lesson to promote creative learning.
- a. Initial “human prompt” used in default case and PT scripted cases 1–4:

Human: I want to provide my students with opportunities to engage in more creative learning

experiences so they can learn how to productively respond to uncertainty and become more creative, active agents in their own futures. However, I do not have the time or space in my curriculum.

- b. Elaborated prompt used for the fifth PT scripted case:

Human: I want to provide my students with opportunities to engage in more creative learning experiences so they can learn how to productively respond to uncertainty and become more creative, active agents in their own futures. However, I do not have the time or space in my curriculum. Can you help me transform the following lesson into a more creative lesson? The task is to describe a historical event. The process is for each student to identify a historical event from the textbook. The product is for each student to write a 500-word description of the historical event. The criterion for success is that the description has to be historically accurate.

3. *Human Response to AI-Generated Possibilities.* Once the AI provided possibilities for the human to consider, the author then selected one of the possibilities and prompted the AI to provide a

description of what that possibility would look like. The author also prompted the AI to generate potential unintended consequences of acting on that possibility.

- Response Prompt: “*Human: Can you tell me more about what [author selected possibility] would look like? Also, what are some potential unintended consequences of taking action on this possibility?*”
- 4. *Human Response to AI-Generated Unintended Consequences.* The final aspect of the PT dialog illustrated in this conceptual case study is an exploration of possibilities for proactively addressing potential unintended consequences. The author used the following prompt to request the AI to generate ideas for how the unintended consequences could be prevented:
 - *Human: How can I prevent these unintended consequences?*”

Results

The results of each case are presented below in the form of dialogs generated from prompts and the five scripts (see Table 1) described in the methods section. The first case, *Case 0: Default*, represents a default Human \times AI dialog using only the prompts and no PT Tactic script. The remaining cases represent the dialogs resulting from using prompts and one of the five PT Tactic scripts. To avoid unnecessary repetition and save space, only the resulting dialog will be reproduced for each PT-bot interaction. The initial human prompt (see Methods) for each case is also presented in truncated form (...) to reduce repetition.

Case 0: Default Human \times AI chat dialog

Human: *I want to provide my students with opportunities ... I do not have the time or space in my curriculum.*

AI: To help you provide your students with opportunities to engage in more creative

learning experiences, I recommend that you focus on teaching them how to be problem solvers. By developing critical thinking and self-directed learning skills they can use when facing uncertainty, your students will become better equipped to create their own solutions.

Additionally, if time or space is an issue for certain activities or projects then consider using virtual tools such as online forums, video conferencing platforms, and other remote collaboration options so that the student's experience remains interactive even from a distance.

Human: *Can you tell me more about what “teaching them how to be problem solvers” would look like? Also, what are some potential unintended consequences of taking action on this possibility?*

AI: Teaching them how to be problem solvers would involve equipping your students with skills such as critical thinking, research and data analysis, troubleshooting, creative brainstorming, and applying what they learn in new contexts. It involves teaching them the concept of trial-and-error so that when presented with an uncertain situation or a challenge they have the ability to apply certain strategies on their own without relying solely on someone else's instructions.

Potentially unintended consequences of taking action include overburdening teachers due to [the] extra workload required for implementing these activities into [the] curriculum; also it may decrease student motivation if too many challenging tasks are assigned without enough resources being made available (such as time) which can lead to frustration among both students and educators involved.

Human: *How can I prevent these unintended consequences from happening?*

AI: To prevent these unintended consequences from happening, it is important to create a good balance between providing challenging activities that will help students develop their problem-solving skills without

overburdening them with too much work. This can be done by carefully planning and organizing the curriculum in advance; for example, taking into consideration both the traditional teaching methods as well as more creative learning experiences so there is enough time allowed for each activity within your syllabus.

Additionally, you should also provide appropriate resources such as study guides or online tutorials to support any new concepts which may require an extra level of understanding. Finally, make sure to encourage open communication among all parties involved (i.e. teachers and students) so that everyone has a chance to voice their opinions on what works best when trying out different approaches toward problem-solving.

Case 1: As If Bot dialog

Human: *I want to provide my students with opportunities ... I do not have the time or space in my curriculum.*

As If Bot: 1. It is as if you are in a garden where the seedlings have been planted with care, but they need time to grow and develop before they can bear fruit. You could create small moments of creative learning experiences within each lesson that encourage students to explore their own ideas and gain skills for managing uncertainty while leaving room for growth outside of class hours.

2. It is as if your classroom was a fertile field, ready to be sown with new knowledge—yet it needs careful cultivation from both teacher and student alike, so it can become an environment filled with creativity and innovation which will help them succeed in any situation life throws at them.

3. It is as if your curriculum was like traveling through unknown lands on foot—there may be times when things get tough, or uncertain paths appear ahead; however these challenges require

inventive solutions requiring active engagement from all involved parties—creating opportunities for developing productivity strategies tailored toward confronting future challenges creatively!

Human: *Can you tell me more about what possibility 1 would look like? Also, what are some potential unintended consequences of taking action on this possibility?*

As If Bot: Possibility 1 could include strategies such as “Think-Pair-Share” activities, where students brainstorm ideas together in pairs and then share their thoughts with the entire class. Another activity may be to challenge them to create a “storyboard” of what they think might happen if an experiment had different outcomes than expected, or simply allowing periods for open conversations between teacher and student about how uncertainty can lead to experimentation and innovation.

Unintended consequences this possibility may bring could involve some students becoming too focused on finding creative solutions that go against instructions or expectations given by teachers—which in turn could cause confusion or miscommunication among both parties. Additionally, there is also potential for extra workloads due to longer lesson times required when involving more interactive classroom tasks.

Human: *How can I prevent these unintended consequences?*

As If Bot: You could prevent these unintended consequences by setting clear expectations for the students in terms of how creative they are allowed to be with their solutions. Additionally, you should ensure that all activities have a purpose and goal so the students understand why it is important to explore different possibilities. Furthermore, you can make sure your instructions are as explicit as possible so there is no room for confusion or misinterpretation. Finally, if time allows, allow opportunities for student reflection on what worked/didn't work

during each activity—this will help them become better problem solvers over time!

Janus Bot dialog

Human: *I want to provide my students with opportunities ... I do not have the time or space in my curriculum.*

Janus Bot: The opposite of not having time or space in your curriculum is to find a way to maximize the use of what you already have. Combining this with providing opportunities for creative learning experiences, one possibility would be to utilize existing resources within the classroom like classmates and other teachers as well as technology such as online tools or apps.

You can create activities that build off each other and encourage collaboration between students while still adhering to certain curriculum goals. This will help foster creativity among them while also allowing them more freedom in how they engage with the material being presented!

Human: *Can you tell me what “activities that build off each other and encourage collaboration between students while still adhering to certain curriculum goals” would look like? Also, what are some potential unintended consequences of taking action on this possibility?*

Janus Bot: Activities that build off each other and encourage collaboration between students may include team problem-solving activities, case studies or role-playing scenarios. In these activities, the goal is to have different groups of students work together in order to come up with creative solutions for a given problem. These can be tailored according to your curriculum goals; for example, you could focus on developing their critical thinking skills by having teams analyze data from a certain experiment or scenario before coming up with possible outcomes based on it.

As far as unintended consequences are concerned, one potential risk would be if some groups end up not participating in the activity due to [a] lack of motivation or engagement; this has been

known to happen when there isn't enough structure built into such collaborative activities (i.e. clear objectives/goals). Additionally, depending on what classroom resources are available during such an activity—that is, technology access—all members must have equal opportunity so everyone can equally participate without feeling left out because they don't have access like others do!

Human: *How can I prevent this unintended consequence?*

Janus Bot: One way to prevent these unintended consequences is by ensuring that all students are given equal opportunities and access. This means providing clear objectives, expectations, and goals for the activity so everyone knows what they need to achieve in order to participate successfully. Additionally, make sure there are no technological barriers like unequal levels of access or devices; this can be done by pre-installing any necessary apps/software before the activities begin or providing extra laptops where needed. Finally, it's important to ensure you're giving enough structure throughout the task (e.g. deadlines) as well as incorporating regular feedback from yourself or peers which can help motivate participants who may otherwise feel disengaged with their group's progress!

What If/Not Bot dialog

Human: *I want to provide my students with opportunities ... I do not have the time or space in my curriculum.*

WhatIf/Not Bot: 1. What if you develop short, creative learning activities that could be completed in the classroom for each subject during a certain period of time? For example, create an art project that encourages students to draw their interpretation of a specific concept they learned about earlier in the lesson.

Here's some potential reasons this might fail: It may take away from other important topics and skills being taught; it can lead to confusion or frustration among students who are not as comfortable with visual expression; there is

limited access to materials needed for these projects within most classrooms and schools.

2. What if you host virtual field trips where your class engages with experts around the world via video conferencing technology? For example, use Skype calls or Google Hangouts so your class interacts directly with professionals such as biologists studying animal behavior on different continents or programmers working at top tech firms answering questions about coding language syntaxes.

Here's some potential reasons this might fail: Lack of reliable internet connection necessitates alternative plans like recordings which can defeat [the] goal of having direct interaction between students and outside experts; lack of ability by teachers and expertise chosen by teacher limit student interactions further; costs associated with providing technical services necessary for virtual experiences (iPad rentals).

3. What if all classes spend either 1 day per week engaging solely in collaborative problem solving scenarios related only loosely connected to curriculum content? For example have teams compete against one another trying to solve puzzles requiring interdisciplinary thinking ranging from mathematics equations involving physics principles applied through engineering solutions presented graphically using English prose descriptions telling stories based upon history lessons previously studied.

Here's some potential reasons this might fail: Students become bored easily when asked repeatedly [to] do [the] same type [of] problems without challenge increasing [the] difficulty level [and] making them unexcited toward collaboration forcing them into [a] competition instead creating too much distraction leading educational goals astray

Human: *Can you tell me more about what number 1 would look like? Also, what are some potential unintended consequences of taking action on this possibility?*

What If/Not Bot: Taking action on possibility #1 would look like this—before each

lesson, the teacher could designate a specific amount of time (5–10 min) for students to engage in creative learning activities that are related to the subject being taught. The activity can be anything from creating an art project or writing a poem about a concept they learned earlier in the lesson, designing and constructing 3D models using recycled materials, or taking part in online simulations designed specifically around their current studies.

Here's some potential unintended consequences with possibility number 1: It may take away from other important topics and skills being taught; it can lead to confusion or frustration among students who are not as comfortable with visual expression; there is limited access to materials needed for these projects within most classrooms and schools.

Human: *How can I prevent these unintended consequences?*

What If/Not Bot: To prevent these unintended consequences, it's important to provide clear instructions and expectations for the activities you assign. You should also consider providing access to materials needed for each activity (e.g. art supplies or technology) as well as making sure students have adequate time to complete their work without feeling rushed by others in their class. Additionally, providing feedback on student projects is essential so they can learn from mistakes and be better prepared for future challenges that require creative thinking skills. Finally, when creating new assignments ensure there is a variety of options available at different levels of difficulty so everyone feels challenged yet supported during the learning process.

Possible Futures Bot dialog

Human: *I want to provide my students with opportunities ... I do not have the time or space in my curriculum.*

Possible Futures Bot:

Likely Possibility: You could create virtual learning or project-based experiences that work within the confines of your curriculum.

Probable Possibility: You could ask students to come up with their own creative solutions and projects, thus allowing them to become more active agents in generating meaningful learning opportunities for themselves.

Plausible Possibility: You could integrate flex time into the school day where students are allowed to independently explore topics that interest them and build capacity for creative problem-solving and navigating uncertainty.

Unlikely Possibilities: You can bring in external facilitators who specialize in experiential education techniques as a way of supplementing students' knowledge [about] creativity, resourcefulness, resilience, and critical thinking skills.

Seemingly Impossible Possibilities: Create an entirely new program tailored toward developing future readiness amongst middle/high school-aged learners.

A Potential Wildcard Event: An unexpected philanthropic organization offers funding for your school district enabling you to implement expansive innovation initiatives across all schools including yours.

A Potential Black Swan Event: Your state legislature passes legislation mandating every area public school [to] institute curricula dedicated solely toward Future Readiness training among young people nationwide.

Human: *Can you tell me more about what the seemingly impossible possibility would look like? Also, what are some potential unintended consequences of taking action on this possibility?*

Possible Futures Bot: The Seemingly Impossible Possibility of creating an entirely new program tailored toward developing future readiness amongst middle/high school aged learners may look like having a dedicated staff and space for the programming. It would be focused on teaching students

critical thinking, problem solving, creativity and resourcefulness skills in preparation for navigating uncertainty. Additionally, it could include instruction on emotional intelligence, digital literacy and other topics that can help equip young people to better face today's changing world.

Potential unintended consequences of taking action on this seemingly impossible possibility [are] firstly cost as these types of initiatives usually come with hefty price tags attached to them; secondly, there might be resistance from some groups within the community who don't feel comfortable introducing such radical changes into their educational system which could lead to delays or cancelations if certain stakeholders are not consulted properly in the planning process; thirdly there is always a risk when implementing something completely novel where we won't know exactly how things will turn out until after implementation has completed—so unforeseen issues might arise along the way affecting outcomes etc.

Human: *How can I prevent these unintended consequences?*

Possible Futures Bot: To prevent the unintended consequences of implementing such a program you could consider engaging stakeholders and members of the public in an open dialog about the initiative so that everyone's interests are taken into account. Additionally, it is important to be transparent with costs upfront as well as clearly defining goals and outcomes. You should also create a plan for evaluating progress along each step and use this data to modify plans when needed instead of blindly continuing without taking stock of what works and doesn't work throughout implementation. Finally, having contingencies built-in can help mitigate unforeseen issues that may arise during implementation by providing alternative solutions if certain steps don't go according to plan or budget constraints become too tight, etc.

UnPlan Bot dialog

Human: *I want to provide my students with opportunities ... I do not have the time or space in my curriculum ... Can you help me transform the following lesson into a more creative lesson? The task is to describe a historical event ... The criterion for success is that the description must be historically accurate.*

UnPlan Bot: What if you transformed the task, process, product, and criteria into student-determined elements? Here are three possibilities:

1. Transform the Task—Instead of having students describe a historical event from the textbook, allow them to choose any relevant content area that interests them (e.g. science, art history), and ask each student to develop their own unique question related to this topic which they then answer through research found online or in libraries.
2. Transform the Process—Let students explore different ways of finding information—for example asking questions on social media platforms such as Reddit or Quora; interviewing knowledgeable individuals who may have expertise in your chosen field; accessing primary sources available at local archives or museums etc.—in addition to researching textbooks and other reference resources.
3. Transform The Product—Allow for various types of answers beyond traditional written essays—such as creating an infographic summarizing important points about their particular topic, producing video documentaries outlining key findings during research, writing poems/songs inspired by what was discovered while conducting inquiry etc. Additionally consider allowing more than one type/style of presentation so students can individually tailor how they showcase their knowledge based upon individual interest and comfort level with certain technologies/formats.

As far as success criteria goes consider providing rubrics that emphasize creativity rather than accuracy alone when assessing products created by learners.

Human: *Can you tell me more about what possibility 1 would look like? Also, what are some potential unintended consequences of taking action on this possibility?*

UnPlan Bot: Possibility 1 would involve creating an open-ended task and allowing students to choose a relevant content area that interests them. For example, they may decide to research the history of civil rights in their city or country; the development of early computers; advances made in space exploration, etc. Students will then develop their own unique question related to this topic which they must answer through research found online or at local libraries.

As far as potential unintended consequences go, it is important for teachers/facilitators to provide clear instructions on how much time each student should spend researching any given topic while making sure everyone understands what types of resources are acceptable and expected sources when forming conclusions about events from past eras.

Additionally, be aware some topics might invoke controversial opinions among classmates so consider implementing protocols beforehand such as insisting all conversations remain respectful—regardless if individuals share differing perspectives—and proactively addressing how issues can be discussed without personal attacks being levied against other participants for holding different viewpoints than ones self.

Human: *How can I prevent these unintended consequences?*

UnPlan Bot: A few ways to prevent unintended consequences include providing clear instructions on how much time each student should spend researching any given topic, making sure everyone understands what types of resources are acceptable and expected sources when forming conclusions about events from past eras, implementing protocols beforehand such as insisting all conversations remain respectful regardless if individuals share differing perspectives, and proactively addressing how issues can be

discussed without personal attacks being levied against other participants for holding different viewpoints than one self. Additionally, consider creating a list of topics that is off-limits so students understand ahead of time which subjects will not [be] considered appropriate for discussion in the classroom.

Discussion and conclusions

This conceptual case study aimed to illustrate how possibilities might be generated in the context of Human \times AI collaboration. The resulting cases highlight how humans can use the OpenAI Playground to engage the GPT model to generate actionable possibilities. As the default case illustrated, AI can generate possibilities for humans to consider using simple, natural language prompts (without PT tactic scripting). Moreover, by using follow-up prompts the chatbot was instructed to generate possible unintended consequences for users to consider before acting on possibilities. The resulting possibilities from the default case were somewhat limited because they tended to represent prescriptions already grounded in the actual (e.g. “I recommend that you focus on teaching them how to be problem solvers”), rather than “what if” or “as if” possibilities that more clearly deviate from the actual.

Conversely, cases one through five illustrated that using natural language PT-tactic scripts resulted in more tailored and focused Human \times AI interactions, which tended to more clearly deviate from the actual (e.g. “It is as if your curriculum was like traveling through unknown lands on foot...”; “What if you develop short, creative learning activities...?”; “An unexpected philanthropic organization offers funding...”). The dialogs that resulted from using PT tactic scripts also highlight how different PT bots might be engaged with for different use cases, including everything from generating “as if” and “what if” possibilities (Cases 1, 2, and 3) to considering a range of possible futures (Case 4) and generating new

possibilities for transforming specific elements of an existing, predetermined plan (Case 5).

In all cases (including the default case), the AI-generated possibilities, considerations, and recommendations were easy to understand. Ultimately, however, whether humans will find such interactions useful in generating actionable possibilities remains an open question for future research and practice. Indeed, across the five scripted PTbot cases, several AI possibilities and responses were still somewhat generic (e.g. “You could create...project-based experiences”; “...it’s important to provide clear instructions and expectations for the activities you assign ...”).

Additional work is therefore needed to determine whether these limitations are a function of the methods used in this case study, the AI itself, or some combination thereof. The small set of standardized human prompts and human follow-up responses used for this case study, for example, may have resulted in more repetitive and less useful AI responses, as illustrated in the WhatIf/Not dialog wherein potential setbacks were repeated when the AI was prompted to provide unintended consequences. Follow-up studies exploring the use of additional free-form and more tailored human prompts/responses and lengthier “chats” are warranted to explore whether and how such limitations might be addressed.

Taken together, the cases presented herein indicate that recent (and ongoing) advances in AI represent a promising direction for augmenting human PT. Whether AI can serve as an equally or more viable “partner” in PT as compared to human collaborators is, at this point, an open empirical question. That said, there seem to be some potential benefits of using AI “partners” in possibility thinking. One benefit is the convenience of having an AI “partner” that is always at-the-ready to engage in the process (regardless of the time of day). Another potential benefit is that AI “collaborators” can rapidly generate, elaborate on, and combine a seemingly endless array of possibilities without getting tired or distracted. AI can also generate

new possibilities without getting frustrated with humans for rejecting previously generated ideas. Yet another benefit of AI is that it can—when prompted—readily provide critiques and counterfactuals to human-generated possibilities without trying to appease the human. Finally, AI can recognize unique, nonobvious patterns in possibilities that might otherwise be overlooked by humans.

Given the conceivable advantages of AI, it may be tempting to overstate the potential of AI chatbots for supporting possibility thinking, particularly for those of us who were enthralled with some of the earliest and most rudimentary forms of natural language, human-computer chat (e.g. ELIZA⁷) and recognize just how far AI has come (and where it seems to be going). Enthusiastic endorsement of AI, however, should be tempered with the recognition that humans are still necessary for the results of these and related creative collaborations to be actionable (Cropley et al., 2022).

Indeed, humans remain at the forefront of Human \times AI collaborations (at least for the time being) because we still need to guide, interpret, and ultimately act on possibilities generated through such collaborations. And having more humans involved in the process likely will be both important and necessary in identifying potential inaccuracies and problematic possibilities generated by AI.

As this case study illustrated, even some of the most promising possibilities generated by AI were not fully baked. They represented potentially good starting points in considering possibilities for transforming the actual. But they remain just that: starting points. In this way, human reasoning and sense-making should not be abandoned when working with AI to generate actionable possibilities.

Recognition of the central role that humans play in Human \times AI PT collaborations can also temper the understandable, yet sometimes exaggerated existential concerns about AI (e.g. “Are machines replacing us?”). We are not (yet) at the point where AI represents a meaningful existential threat. Rather, AI is a technological

tool. And like any technology it can be used (and potentially) misused when supporting PT. Moreover, given that self-determination and agentic action play a central role in possibility thinking (Craft, 2015), exploring whether and how Human \times AI collaboration supports (rather than suppresses) people’s confidence in their ability to generate possibilities is an area in need of future research.

Indeed, one potential side-effect of using AI to generate possibilities is that it may result in an overreliance on AI when people want to engage in PT. In addition to implications for human agency, Human \times AI collaboration in PT raises a host of additional ethical and practical considerations, including the importance of transparency in how possibilities are generated (e.g. disclosure of possibilities that are generated through Human \times AI collaboration), this is a particularly important issue in educational and work settings.

In education, for instance, continued advances in AI coupled with increased access to powerful natural language AI chatbots, likely will present (and already are presenting) important considerations and challenges for students and educators. This includes issues surrounding students’ disclosure of possibilities they generated in collaboration with AI for use in their assignments and whether and how educators and institutions accept the results of such collaborations. Similar concerns also apply to work and other professional settings. Consequently, developing a principled approach (Beghetto & Anderson, 2022; MLFTC, 2023) to Human \times AI collaborations, which establishes guidelines, policies, and methods for anticipating and monitoring potential challenges, issues, and unintended consequences of using AI in generating actionable possibilities is an area in need of additional work.

Even with these considerations in mind, using AI to help generate actionable possibilities does seem to represent a new frontier in PT. Consequently, developing programs of research aimed at examining Human \times AI collaborations for PT represents an important area of inquiry for researchers and practitioners in the

field of possibility studies. I hereby invite researchers and practitioners to take up the challenge of building on this conceptual case study by testing, refining, and developing the PT scripts presented herein *and* to develop and examine their own PT scripts and Human \times AI collaborations. Doing so will go a long way in further clarifying the potential benefits and costs of Human \times AI collaborations to generate actionable possibilities.

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Notes

1. For an overview, see <https://beta.openai.com/overview>
2. A full discussion of how OpenAI's GPT-3 model works and can be used is beyond the scope of this conceptual case study. Also, given that the author only has a working understanding of OpenAI's playground and is not an expert in AI or the OpenAI platform, readers interested in learning more about the technical specifics of OpenAI and GPT-3 can find helpful overviews and quick start tutorials at: <https://beta.openai.com/docs/introduction/overview>
3. Again, readers interested in a description of all the elements and settings are directed to OpenAI's website, documentation, and playground canvas (<https://beta.openai.com/playground>).
4. As of this writing the text-davinci-003 represents the "most capable" GPT-3 model in the playground according to OpenAI (<https://platform.openai.com/docs/models>) because it "can do any task the other models can do, often with higher quality, longer output and better instruction-following. Also supports inserting completions within text." According to OpenAI, the text-davinci-003 GPT-3 model was trained on natural language and code data that was current up to June 2021. OpenAI is continually

updating its GPT models. Readers interested in the most recently updated models are referred to OpenAI's website (<https://platform.openai.com/docs/models>).

5. The user-adjusted settings were set by the author to 80% of the maximum to increase the randomness and originality of responses, without being so extreme that the responses might be nonsensical or unrealistic. 80% is, admittedly, an arbitrary cut-off. However, given that the aim of this article is illustrative, the 80% level was used to demonstrate the kinds of unique and random possibilities that can be generated. Finally, the maximum length was increased $\times 2$ the default to allow for more detailed responses. Researchers and practitioners might benefit from experimenting with different cut-off points, depending on the particular use case and purposes.
6. The development of the final scripts and prompts resulted from an iterative, trial-and-error process of the author writing, testing out, and revising scripts and prompts in the OpenAI playground canvas. As was the case with trying out different settings (see note 5), the author piloted different versions of PT scripts and prompts prior to arriving at the final scripts and prompts reported herein. This is because the author learned that by using more specific and clear scripts and prompting (including making sure there are no typos or mistakes), the "performance" of the AI GTP-3 model could be "enhanced" to produce different and meaningful illustrations of a PT dialogs more reliably (at least from the vantage point of this author) within the context of a particular PT approach illustrated in this case study. The testing and refinement of scripts and prompts also highlight how current AI models require human guidance and decision-making for Human \times AI collaboration. Readers can learn more about OpenAI's recommendations for using and troubleshooting text completion using GPT models here: <https://platform.openai.com/docs/guides/completion/introduction>.
7. I want to thank an anonymous reviewer who noted that there are additional exciting possibilities afforded by advances in Human \times AI partnerships, such as more advanced versions of ELIZA tailored to promote human PT. ELIZA was created in the mid 1960s by Joseph Weizenbaum at MIT's Artificial Intelligence Laboratory that used natural language using pattern matching and substitution to create the illusion of human-like

conversation between a computer and a human user. In the late 1970s and early 1980s, versions of ELIZA were available in the form of BASIC programming language that could be loaded on personal computers and animated the imagination of many home computer users (including the author) with respect to what is and might be possible with respect to Human \times AI collaborations.

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