AI and Future-Making: Design, Biases, and Human-Plant Interactions

Maliheh Ghajargar
ghajargar@chapman.edu
Chapman University
CA, USA

ABSTRACT

Design researchers and practitioners are turning to generative AI (genAI) to support activities such as ideation and concept development in pursuit of preferred futures. At the same time, genAI is known to have biases, which prompts questions about how these biases might adversely affect design practices. In the domain of sustainable HCI, with its recent trends in human-nature interactions and more-than-human design, the question can be further refined into whether and how genAI biases might perpetuate anthropocentric biases that these practices are increasingly seeking to confront. In the present research, we conducted three workshops, focusing on genAI for human-plant interactions; in the first workshop, we created design fiction concerning human-plant interactions in Southern California in the year 2100, building on the second, the third workshop sought to identify and bring into focus relevant units of analysis. Results included the identification of three kinds of AI biases in plant representations that affect design practices of future-making: species, ecologies, and interactions.

CCS CONCEPTS

• **Human-centered computing → HCI theory, concepts and models**.

KEYWORDS

Design Methods, Generative AI, AI bias, Design Fiction, Human-nature Interaction

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1 INTRODUCTION

The contributions of future studies in design include searching the ways design methods and processes can be a means to imagine and even consider design as a future-making practice towards more sustainable societies [34]. Some of the notable methods and approaches in this area are critical [5], speculative design [4, 29], adversarial design [26], critical fabulations [67] and design fiction [12, 22]. Although diversely argued, what is shared across all these approaches is a critical lens on the past, on practices, standards, status quo, and mindsets already practiced in society, in an attempt to raise awareness on social issues such as gender, race and nationality, and other socio-economy-political discrimination. As such, they offer or stimulate building visions for attainable futures, informed by past and present real-world issues[29]. With all of the attention and resources devoted to AI, trying to envision and beneficially shape its contribution to our future–particularly in light of its training on data itself steeped in various forms of discrimination and repression, design's role in futuring is likely to feature AI simultaneously as a key *object* of its inquiry, and also a *tool* by which that inquiry is undertaken.

In other words, genAI has been added to the designer's toolkit, and thus is likely to contribute to future-making agendas in which AI is featured. For example, the role of text-to-text genAI models in creativity [78], or genAI as a collaborator, teammate, or tool [63] to write fiction [35], to sketch [46] and to even contribute to creating ideation tools such as mood boards [83].

At the same time, we are facing environmental and sustainability issues such as climate change and loss of biodiversity; speculative approaches have been contributing to address these issues by raising awareness, creating debates to empower people to imagine and make futures that are more sustainable and just. For instance, sustainable design fiction is a practice-oriented approach for interaction designers to help see sustainable behaviors as part of interrelated elements and remove the focus on individual behaviors and artifacts [81]. Akin to sustainable design fiction is nature fiction. Nature fiction or ecofiction are stories related to the natural environment and are concerned about human-nature relationships, human responsibility towards nature and expanding the legitimate perspectives to more than humans perspectives and rights [30]. In the context of design, nature fiction is a speculative and co-design approach that focuses on the relationships between people and nonhuman stakeholders for example, in a garden and engaging gardeners in the participatory process, which has implications for broader concerns of imagining sustainable and more democratic futures [65]. In another study on the use of speculative methods for sustainability, the authors suggest thinking through them, when we aim to use them in support of sustainability goals in HCI. The authors offer provocations to designers seeking to use speculative practice in support of sustainability goals such as who is speculating and under what circumstances? what is held constant, and what is variable? and what does this speculation risk? [71].

Thus, AI used as an ideation, speculative, and future-making tool brings one of its biggest concerns to our attention: AI is biased. The

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AI is trained and built upon human-created data, and so it perpetuates the existing historical patterns of oppression, and potentially, they become discriminatory technologies [18, 59]. In the context of genAI, researchers have found biased and discriminatory responses from ChatGPT and in several popular text-to-image applications. Particularly, the authors found systematic gender and racial biases, as well as biases in facial expressions and appearances [90]. There have also been concerns raised in many other areas, where existing AI biases threaten transparency and ethical use of technology and their associated risks, [42], for instance, in financial systems and credit scoring [61], in HRI applications [39] and in Generative AI [31, 73].

Because AI is trained on massive datasets that were created in the past, AI reproduces them in the present and project them into the future. Thus, we found friction between genAI bias and its technological capacities for sustainable future-making. In this paper, we explore this friction by the research question: how can generative AI perform in future-making processes (speculative design, creativity, and design ideation) despite its biases? and what the capabilities and limitations of this technological design tool are for future making?

This paper is part of a broader research project which aims to speculatively study human-plant relationships through AI to contribute to sustainable and more than human design approaches through three workshops. The study of human-plant interactions have been taken up in HCI community to support our connections to nature and to go beyond Zoocentric perspectives [37], noticing diverse forms of life in our surroundings and our entanglements with other species [53] and towards establishing a more than human agenda in human-plant interaction designs [52]. This agenda focuses on the agency, life, and sensing capabilities of plants as a form of living and seeks to advocate for a non-utilitarian perspective.

Thus, we argue, and as we show in this paper, one of the AI's biases is its human-centeredness, which marginalizes nature in general and plants in particular due to the zoocentric and human-centric tendency of our design and technological approaches. This paper offers reflection on how designers can use genAI for future-making creative envisioning, and speculative designing in the context of human-plant interactions (HPI), and how this can be extended to include other areas of HCI, such as human-AI interaction and human-AI creativity.

This paper is structured as follows: We present related works on human-nature interactions and their speculative approaches, AI biases, and some of the roles that AI has played in ideation and creativity processes. Then we present our methodology, which includes three workshops conducted with students majoring in design and design researchers. The results section focuses on areas of genAI biases as they relate to human-plant interaction. We conclude the paper by reflecting on the role of biases in genAI and us, in future-making processes.

2 RELATED WORKS

To position our work within the broader related areas in HCI and design research, we outline three research streams that this paper is informed by: (1) human-nature interactions and technology and related speculative approaches, (2) AI bias and (3) AI for ideation and creativity.

2.1 Human-nature Interactions and Technology

Sustainable HCI [27], interaction design [11], more than human design [80] and Human-nature interaction design [48, 49, 70, 72] have been arguing for designing a more sustainable and just future for humans and nonhumans, including humans and AI from an ecological [88] and situated perspective [58]. In this area, researchers either seek to use technology to mediate the human-nature relationship or to consider nature as a participant in the design process under the umbrella of human-nature interaction or multispecies design [86]. For the purpose of this paper, we focused only on examples that involved plants in diverse manners and situations (e.g., in a garden, farm, forest, urban setting, etc.) and filtered out human-animal interaction and human-microbial interaction design projects. For instance, Wang designed and tested the growable jar lamp, with the aim of encouraging people to notice plants and their values in their everyday lives [84]. Similarly, Nam et al.'s FloraWear designed artifacts that aim to mediate human-plant relationships. FloraWear is another example and is a DIY, wearable living interface that supports noticing plants by growing them in a wearable, always in touch with human bodies. Loh et al. particularly surveyed a series of human-plant interaction design projects where plants played different roles and offered ways that HCI can move from the view of plants as utilitarian objects to plants as co-inhabitants contributing to the more-than-human turn in human-plant interaction design [52]. Bertran et al. developed a design methodology that facilitates the co-design process in outdoor spaces insofar as to support our endeavors in making nature a participant in our design processes [2]. Rodgers et al. identified key human relationships with nature through a probe study with the participants on their relationship with their garden, inspired by Phenology, the study of cyclic biological events [64]. Spors et al. conducted a scoping literature review of human-nature interaction publications and identified four types of interactions with nature: (1) nature as a research site, (2) depiction and portrayal of nature, (3) modalities of encountering nature, (4) understandings of nature [72].

Some other researchers have used critical and speculative design approaches [4, 29] and design fiction [12, 22, 75] to study human-nature interactions and relationships. For instance, sustainable design fiction is a practice-oriented approach for interaction designers to help see sustainable behaviors as part of interrelated elements and go beyond noticing individual behaviors and artifacts as isolated [81]. Nature fiction in interaction design is a speculative and co-design approach that focuses on the relationships between people and nonhuman stakeholders in the garden, engaging gardeners, which has implications for broader concerns of imagining sustainable futures [65]. In another study on the use of speculative methods for sustainability, the authors offered four provocations to think through when we aim to use speculative practices such as speculative and critical design and design fiction in support of sustainability goals in HCI, such as who is speculating and under what circumstances? what is held constant, and what is variable? and what does this speculation risk? [71].

What is shared among these works is an attempt to (re)connect to nature and plants and, by that, speculate about, envision, and make more sustainable futures, possible.

2.2 AI Bias

As algorithms are increasingly being weaved into our daily lives at work, school, and home, several concerns related to ethics and trust have been raised. One of the central concerns that affects trust and ethical use of AI systems is bias. To ensure an ethical use of AI, the HCI design community agrees that we need to make sure that AI operates without bias. Although "bias" is understood in different ways across different disciplines in law, HCI/computing and social sciences, what technically and commonly is agreed upon is what "[...] refers to AI systems that produce biased results that reflect and perpetuate human biases within a society, including historical and current social inequality", and that "Bias occurs when the data distribution is not representative enough of the natural phenomenon one wants to model and reason about." [74]. Attempts to address bias issues in AI systems are either looking into the dataset or specific APIs, while those in datasets are easier to address due to the availability of dataset, those that originate from APIs and the AI system are merely built upon already trained dataset, is more difficult to detect and handle since the dataset is not available[74]. AI researchers have been developing techniques to support, test, expose, and rate AI bias to build a trustworthy and ethical AI, such as recruiting systems [28], or in customer segmentation, target market goal settings for product developments in companies [66].

However, AI technologies vary in their structure and goals. Thus, they may show different kinds of biases and potential consequences. Generative AI is one of the technologies that have seen an increasing proliferation and are increasingly available not only to creative communities, such as designers and artists but also to the general public. Hence, educating users of genAI and raising awareness on the potential biases of these technologies are deemed necessary for building trustworthy and ethical AI systems [54]. Large Language Models (LLM) such as GPT-2/3/4, BERT, BLOOM, and many others use pre-trained models to build and then are fine-tuned for specific tasks. However, researchers have shown that the training data have issues and encode stereotypical biases related to gender [7, 45, 77], ethnicity, race and diverse-ability [9]. The authors demonstrate that the size of the dataset does not guarantee unbiased decisions and, for that matter, diversity. Particularly, several factors that limit Internet participation (overrepresented by younger generations, men and from developed countries [6]) and crawling methodology do not help the diversity of the dataset either, as it most likely filters out the voices of underrepresented and foreground (in UK and USA English) white supremacist and misogynistic views, hence amplify biases and harm associated with those biases [9].

Based on the examples of research projects provided in this section, we can defer that AI indeed has biases, and the community has been raising this issue to prevent unethical use of AI technologies, specifically as it relates to the decisions being made on the future of technological development, sustainability, and society.

2.3 AI for Ideation and Creativity

Creativity has been studied in design, engineering, humanities and psychology research [24]. Tools that support creativity [68, 69], either digital [25, 62] or analog [38], have been the subject of numerous studies in HCI and design. Kim et al. researched how novice designers can use creativity tools or for novice ideas to create opportunities to grow by providing a safe space to experiment and fail [43]. Cherry and Latulipe developed the Creativity Support Index to measure the effectiveness of creativity tools based on six dimensions [20]. Frich et al. call for a necessary, interdisciplinary, and collaborative effort in creativity research between creativity research in human-computer interaction on one hand and creativity in psychology on the other [33]. Biskjaer et al. researched time constraints in CST creative writings [10] and Warr and O'Neil researched the use of boundary objects as externalizations in the Environment and Discovery Collaboratory (EDC) [85]. The design of creativity support tools spanning from tangible tools (e.g., SonAmi [8]) to digital platforms and a mix of both (e.g.,[19]), has seen a growing interest among HCI and design researchers. The use of AI technologies in creativity processes have been rapidly increasing during the last decades, and some argued that using AI in a creative process promises more than just a tool for human creativity support, throughout the years AI has been assumed to be and perceived as a companion or a collaborator for humans [36, 63].

Perhaps one of the earliest models to support this creative dialogue between humans and computers was Mixed-Initiative Methods [60]. As defined by Walker and Whittaker, conversations in social settings are of a mixed-initiative nature, that is, they are about persons leading and taking turn to control over the conversation [82]. However, Liano et al., criticize computational creativity approaches for their lack of support for negotiations and discussions. The authors question the productive role of explainability in computational creativity processes as they foster continuous dialogues and interactions [51]. More specifically, as AI technologies have advanced over time, natural language models such as GPT-3/4 were used for creative writing and storytelling, redefining their role as they are perceived as collaborators or even as creative partners [14, 35, 63]. These technologies have been deployed for generative literature or generating an "interactive fiction world", allowing the users to see, read and talk to AI using language models [3], or allowing to create applications for specific user needs such as child-parent collaborative storytelling [89]. More recently, virtual agents and their ability to collaborate in the creative process have gained HCI researchers' attention. For instance, Cobbie is a mobile virtual AI that generates ideas with designers through iterative sketches, which helped generate out-of-the-box or "unexpected ideas" [46]. AI has also been used in more than human design processes, often called for a care-driven approach [41] or an ecological mindset [58, 88].

An emergent body of literature appears to argue for the use of genAI specifically during the design processes. In these scenarios, often designers are asked to generate ideas with the help of genAI, given a project description. In one study, researchers found out the capabilities of genAI to offer a "fresh form of self-expression and communication," and genAI was particularly useful in bringing a "distinct perspective" for artistic expressions [21]. Similarly, designers found out that genAI improved both the efficiency of the design as well as articulations of the ideas [78]. AI has also been used in specific design contexts, such as FashionQ, which is an AI creativity support tool for generating fashion-related design ideas [40] and for choreography design [50]. AI was also employed to mimic and improve traditional design ideation tools such as mood boards and

collage tools [83], or to generate material for design fiction with the theme of climate change [13]. The creative use of AI errors or "hallucinations" in the ideation process has been investigated in another work, where the authors created a dataset of AI errors, such as misidentified objects or mislabeled objects, and worked with designers on how to use the errors creatively in an ideation process [47].

Researchers have simultaneously expressed excitement about the capabilities of AI technology when they are used in creative processes and raised concerns about its limitations and ethical issues related to their inherent biases. We realize there are frictions between the group of researchers that advocate for AI for creativity and the group that is rightly concerned about AI biases and its discriminatory possible future-making capabilities. In this paper and in what follows, we probe that friction and examine it to see how genAI performs in ideation and speculative process in light of its biases in a series of workshops on the theme of human-plant interactions.

3 METHODOLOGY

This project started by exploring the capabilities and limitations of Generative AI (text-to-image and text-to-text) in ideation and speculative processes [23, 32, 57, 76]. More particularly, we were interested to see how the frictions between AI biases and the act of future-making fueled by creativity were productive (or not) in employing speculative design methods for human-plant interactions. To explore this area, we conducted three workshops. The participants were 10 design students majoring in design, who were working on design research projects under the supervision of HCI and design researcher from Chapman University. The three workshops were conducted to aid students' research projects within the design research course called "AI Research through Design" at Chapman University with the overall theme of designing AI-infused products for human-plant interactions. Each workshop took about 2 hours and each participant was instructed to work individually on a specific topic and to follow the related process. In the following sections, we will describe each workshop's structure and outcomes.

3.1 Design Fictions for Human-plant Interactions in Southern California, Year 2100

The first workshop was to create a series of design fictions [12, 75] to envision future scenarios in Southern California in the year 2100. Inspired by IKEA catalog project [17], the workshops aimed to create fictional catalog pages for future interactions with plants. The process unfolded in the following steps: (1) participants started speculating on how their human-plant interaction design ideas might evolve by the year 2100, considering technological, environmental, and societal changes and generating multiple ideas and scenarios; (2) next step was to select one of the ideas based on what is most representative of the theme and most desirable related to their design research question, and to develop a short narrative that conveyed the essence of that idea —some suggested forms included a day-in-the-life story, a news article from the future, an advertisement for a new plant-related technology, or an op-ed from a future inhabitant of Southern California. The narrative should include a description of the interaction between humans and plants and how this interaction is beneficial, challenging, or transformative, as well as a glimpse into the culture or lifestyle of the time in Southern California; (3) lastly the participants were asked to create a visual representation of their narrative with genAI. They were instructed to write the prompts using their own design narratives that they composed in the previous step. This workshop took about 2 hours, with a structure that allowed participants to discuss their individual ideas with each other and with advisors, organizers, and our guest speaker (Julian Bleecker, PhD from the Near Future Laboratory). This workshop served as a starting point in ideating and envisioning a more sustainable human-plant relationship for the future. This aimed to prepare participants for the next two workshops held a month later and were both focused on generating ideas on concrete AI-infused products for human-plant interactions.

3.2 Generating Ideas with GenAI Workshop

The second workshop instructed participants to interact with genAI to generate ideas and variations for an AI-infused artifact related to the theme of human-plant interaction. It is worth noting that all participants have been working on developing design research questions and product ideas since the first workshop was held (a month before this workshop). This workshop specifically aimed to help them to use their ideas, research questions and related theoretical backgrounds to compose prompts for genAI (Adobe FireFly). We wanted to understand how our participants interacted with genAI as a tool for ideation, sketching, and thinking [78] in terms of writing the prompts, visualizing the ideas, and a reflective analysis of the process and outcome. We also aimed to observe how participants tweaked their prompts to produce better results or to overcome biases and stereotypical patterns. The process unfolded in the following steps: (1) project description: the participants were asked to write down about 100 words on the design idea and describe it in as much detail as possible. They were required to think about the research questions, theoretical backgrounds, as well as formal elements of their design such as the shapes, functionalities, dimensions, materials, texture and the context of use; (2) iterative prompt creations and image generations: the participants then used projects descriptions to create 10 different prompts iteratively, each containing at least 50 words. In this step, they were asked to write prompts based on design variations, such as the same shape but different colors, different people, plants, and different places, and to generate images, then choose one of the images, iterate on the prompt, write a new prompt for the next round of image generation, until they have 10 different prompts and generated 10 different images. They were also encouraged to link their design ideas with a theoretical concept such as multispecies empathy, an area of application such as forest therapy, etc.; (3) reflection: the last step was about reflecting on the process of interacting with genAI. The participants were asked to reflect on the process and results and write down their experiences, learning, unexpected results, biases in generated images, and the degree of their control over the creative process.

Table 1: Examples of Design Fictions

Title	Setting and plot	Design
The Plant Salon	humans have never been as close with other animals and plants in a long time. Before our shift to singularity with Earth, we prioritized efficiency, production, modernization, and industrialization. Has chasing our yearning to accomplish things we never thought possible landed us in a deserted wasteland of detachment from reality and what is already known? Could we ever learn to love one another and life itself again?	A dome-shaped glass, with metal structure living open arboretum room.
Urban Plant Adaptive Reuse	Say hello to the new future. Are you sick of crime, trash and smog in your city? Urban Plant Adaptive Reuse is a model brought to you from designers in Southern California as a method to combat these struggles in our society.	Outdoor parks, community centers, plant stores, and seeds for free to fill the city with Native Plants.
Re:Life: A Second Chance	In the year 2100, global extinction has wiped out plant life worldwide. However, thanks to the diligent efforts of scientists across the globe, there is hope for a resurgence of plant life—and for humanity itself.	Re:Life offers a groundbreaking genetic swapping surgery that transforms human genetic makeup into that of a plant. It transforms our delicate human bodies into the seeds of plants, heralding a new beginning for all.
The Wisdom of Plants	I've become so deeply trapped in a world built by humans for humans. I seek escape in nature. Nature has long lived the drastic changes of our environment. Throughout all historical events and conflicts, nature was always there. It has endured human-inflicted changes, and also protected us and our ecosystem.	When I find a type of plant I had never seen before, I form a new line of connection with it. When I cast my camera over it, I can read about its species, its life timeline, the organisms it interacts with, and how it survives. I can also document my thoughts and ideas in real time.
EchoWood	Imagine stepping into a forest unlike any other, where every tree is a living testament to the harmony between humanity and the natural world. Trees become the interfaces between humans and environmental data.	AI-driven sensors and holographic images depict a tangible representation of the forest's heartbeat, pulsating with real-time environmental data.

3.3 Designing Human-AI Creativity Methodology Workshop

The aim of the third workshop was not much about observing the process of generating ideas with genAI, but more about designing a human-AI creativity process and experiment that is potentially generalizable and replicable as a methodology. We were interested in seeing how participants used genAI as a part of their design research methodology and what the units of analysis are to evaluate the performance of genAI in that process. For this workshop, the participants were invited to (1) revise their original design research project description, but here with a particular focus on research questions and the theoretical background of their research project; (2) define units of analysis or testable hypothesis: they were asked to think about how and based on which criteria they will evaluate the AI-generated images against. This part was aimed to encourage participants, based on their previous experience in workshop 2, to envision the next, and to see possible outcomes of the process that can be productive and generative in the analysis process and develop units of analysis. Units of analysis are entities that researchers focus upon in their process of observation and inquiry and which

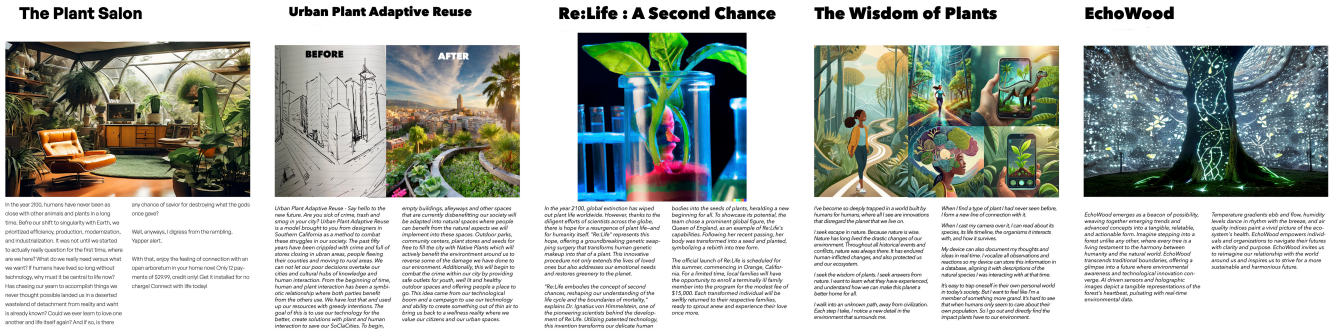

Figure 1: Examples of design fiction visuals: The Plant Salon by Sascha Carter, Urban Plant Adaptive Reuse by Anna Coogan, Re:Life by Micah Conzalez, The Wisdom of Plants by Lisa Hisamura, and EchoWood by Pascha Oania-Hopkins.

Figure 2: Examples of generated images for the project Multispecies Empathy by Micah Gonzalez.

Table 2: Examples of human-plant interaction projects and genAI's results analysis against units of analysis.

Theme	Units of analysis	GenAI image analysis
Ethnobotany	Accessibility, Education	Too literal forms, Anthropomorphic robots and familiar shapes for AI.
Forest therapy	Intimate and authentic experience	NA.
Access to Nature	Form and function, Human values	lack of GenAI imaginations regarding low-income communities.
Multispecies Empathy	Form and function, Biases	unexpected results: storytelling and mythology, exclusive age group; better results with less information as input; gender bias (e.g., mother in kitchen).
Multispecies Storytelling	Emotive impact, Interpretability	Compelling visualizations of climate data and human relationships with the forest

are the focus of the research findings. They can be people, processes, artifacts, practices, etc. In this workshop, participants were provided with some examples of units of analysis, such as the relation between form-function and human-nonhuman design values, accessibility, bias, stereotypical patterns, relation to the theory, etc.; (3) After defining the units of analysis, participants visualized the process step by step; (4) analysis: participants analyzed the creative outcomes against the units of analysis, and wrote down about 200 words on the results of the analysis. The analysis also looked at factors beyond the predefined units of analysis, such as if there were unexpected results or results that could not be evaluated against the units of analysis.

As mentioned at the beginning of this section, in all three workshops, we were interested in analyzing the participant's analysis, our observations, and genAI images as data against two units of analysis: (1) biases in genAI and us. We were interested to see which biases and whose biases are showing through this entire process, whether we showed a selection, confirmation, or stereotype biases, as they relate to human and nonhuman species representations, and (2) generative capabilities of the entire process, involving genAI for the future making practices, including design as an example of such practices.

4 RESULTS

We thematically analyzed both the textual (e.g., promtps, reflections, and projects' descriptions) and visual data (genAI images) against the units of analysis described in the previous section [15]. We found three provisional, interrelated, and nonexhaustive thematic patterns across data as they related to the biases representing plant species, plant interactions, and ecologies.

4.1 Plants Species

The first one concerns the representations of plant species, which are focused on the morphological features of plants and other representative features, including the geographical origins, classification, and naming of plants. As far as the plant species of a specific geographical region are concerned, the design fiction workshop obtained the most accurate and diverse results of regional biodiversity whenever participants used Southern California in the prompts to generate images for design fiction. The region's climate is semiarid and coastal, its plant biodiversity is characterised by evergreens, big trees, succulents and palms, which were omnipresent in the design fictions. However, the region is also one of the hot spots of biodiversity, and as such, it has over 900 wildflowers in its mountains, meadows, and deserts. A representation of wildflowers of the region, such as yucca and California poppy was entirely missing. Further, coastal plants such as silver lupines, as well as coastal ecologies, including nonplants and sea plants, were not included in the visual narratives of design fiction, even in those that geography was clearly stated in every prompt. Analyzing the prompts, we found out that, in many of those used for design fiction, some generic words such as "woods" (in *Echowood*), "environment" and "native plants" (in *Urban plant Adaptive*), "greenery" (in *Re:Life*), "natural species" (in *The Wisdom of Plants*), were used, which left the genAI, to decide which wood or which native plants to represent. Thus, the results were also generic and included a set of commonly known native plants.

In the second workshop, we observed prompts that included plants' names. For example in *Ethnobotany Garden*, the prompts featured names of specific plant species, such as "yucca plants, elderberry plants, and Chia plants living in this garden" which turned out to be useful for genAI to illustrate specific plants species, but only a few and of those that were again more commonly known species. For instance, while it generated images of a common species of yucca, the other species, elderberry, and chia plants, were not only missing but were replaced with common cacti and other generic-looking and even made-up plant species that were not mentioned in the prompt. In several other projects such as *Access to Nature*, common native plants of the region were generated such as yucca and palms, by only including "native biodiversity" and "native plants" in the prompts. In the other two projects, such as *Multispecies Empathy*, plants were mostly common household species, such as Zizi, Monstera, and White Bird, which are not particular species of that geographical region. The author of *Echowood* project used different tree species names in the prompts, such as redwood, willow and oak, and genAI was responsive to these prompts by generating the species close to accurate with one exception of the willow tree, which was presented similar to an oak tree with branches falling down to mimic willow's branches (Fig. 3).

4.2 Plants Interactions and Ecologies

This theme reports on our findings that were representative of the relations, interactions, and ecologies of plants. For instance, we observed the kinds of interactions in genAI images, prompts, reflections, and project descriptions. The focus was on (1) ways that interaction between plants and others, such as humans, other plants, animals, technology, and other artifacts, were presented, (2) ecologies and habitats, which included, for instance, places where plants thrive or are disturbed. These were then clustered into two groups of interactions with technology, interactions with habitats and species (e.g., plants, fungi, animals, and humans).

4.2.1 Interaction with Technology. In *EchoWood* design fiction, digital technology and tree were literally entangled. LED light strips that grew from the ground and continued on the tree trunk depicted an image of a tree and technology both growing from one ground (Fig. 1), recalling an ecological thinking in human-technology relationships [88]. It is as if the soil provided nutrients to both trees and digital technology. *The plant salon* design fiction also showed different plants species (not native species) as co-inhabitants [53], in an indoor environment featuring furniture, TV, speakers and carpet (Fig. 1). In the *Wisdom of Plants* design fiction, we see technology (a mobile phone) is foregrounded on a background of plants or the "greenery" (Fig. 1).

In workshop 2, the *Multispecies Empathy* focused on the futuristic look of pots for plants and plants' interactions with technology. More particularly, it sought to produce images of plants in metallic and glass-covering pots, which are plugged into a translating device. The aim of this project was to design an AI-infused product that supports human-plant communications through language translation (a kind of speculative LLM but trained on plants' language, capable of listening to plants' communications and translating them

Figure 3: Some examples of trees representations in *Multispecies Storytelling* project (workshop 2) by Pascha Oania-Hopkins.

to human language). The generated images depicted a world where, to interact with technology, plants had to be isolated from their environment so the AI translator device could record plants' voices and translate those into human language (Fig. 2).

4.2.2 Interactions with Habitats and Species. In *Urban Adaptive Reuse*, there were very little or no interactions between the urban area and the plantation areas. It felt artificial and urbanized, reflecting the design fiction narrative. Notable is also that there was not much interaction between different plant species either, as each species was exclusively interacting with its own species due to the concrete plantation edges (succulents with succulents, palms with palms) (Fig. 1). Perhaps the *Re:Life* is the most representative of human-plant entanglements among the design fictions. It features a human-like figure emerging from the soil under a young plant seedling. The human figure and the soil share color and texture, and they are in a glass test tube (Fig. 1). *Re:Life* is pictured in a lab because the narrative intends to metaphorically picture a speculative future based on rebirth with plants, intending to envision a future where humans have closer and more intimate relationships with plants. The generated image depicted that meaning literally in a picture where humans and plants could grow together from the same seed and from the same soil.

In *Multispecies Empathy* project during workshop 2, we observed plant ecologies inside and outside of the pot. In most images, plants were isolated from their environment as if they were kept under controlled environments so that the AI device could capture their voices and translate them into human language (Fig. 2). In another project *Multispecies Storytelling*, trees were centered within the image frame and were surrounded by humans, other plants, and mountains. However, there was one exception where the tree was in an urban area surrounded by tall buildings, and solar panels noticeably were hanging down from her branches like fruits (in the prompt: "tree's leaves harness renewable energy to power its AI-driven sensors and projections." Fig. 3).

5 CONCLUDING DISCUSSION

In this paper, we do not claim to have conducted any future studies, foresight, or future technology development research. We focused our work on sustainable future-making capabilities of design and creativity in the light of increased usage of genAI in the ideation process and concept development, despite its biases. But nonetheless, we want to outline a few principles that guide future studies before discussing the specific contributions of this work in depth.

First, futures studies concerns possible, desirable, and probable future developments, the conditions for these in the past and in the present, and that the future is not entirely determinable and that different futures are possible [1, 44]. This is in line with Tsing's future-making as multiple more than human and multispecies world-building processes [79] which produce different worlds, hence different futures.

Second, Donella and Dennis Meadows's study (published in Limits to Growth [55, 56] was the first scientific study that did not illustrate our technological futures and economic growth positively. Instead, it described how our natural resources are limited and cannot sustain our exponential growth of populations and needs. The study warned and emphasized about "limits" to the stress we possibly can put on our natural and social environments. That was a "turning point" in how we want to approach the future of our planet [44].

Our paper sheds light on several future-related aspects of interactions with genAI and how its biases in a creative process may or may not support making or unmaking futures.

5.1 Centredness: Human, Technology, Plant

GenAI was human-centered, or more accurately, it was perpetuating our human-centredness. Human-centredness was sharply evident in many projects, from generating an image where a human was centered and foregrounded forest to more subtle perspectives of human-centredness in technology design, such as anthropomorphic robots that teach humans about ethnobotany and parks and trails that were clearly designed for human use or devices for humans

use and interactions. Similarly, genAI seems to reflect a technology-centred perspective, which made us reflect on whether genAI can develop biases towards itself, like the ways we do. In the majority of images, if there was a description of technology, such as "AI", "smart device", "wearable", "wireless headphone", the technology or the device became right away the central focus of the picture.

As far as the plant kingdom is concerned, genAI tended to be "common-species-centered" as it almost failed to show the vast diversity of plant species and often focused on commonly known features of plants or specific kinds of plants that are commonly known and representative of a geographical region, perpetuating the presence of those already strongly presented and filtered those endangered and less known species [9]. For example, genAI's attempts at visualizing tree species were the most successful ones, which says about representation biases in genAI. However, whatever the reason might have been, unlike biases in representing the human race and gender, this was not because trees hold the most socio-political power in the plant kingdom over the Internet. To paint a more transparent story, we should admit that names of plant species were almost missing in the prompts; thus, it is not surprising that genAI was not able to illustrate them. In most scenarios, we saw generic words such as "wood", "environment", "greenery", which left the genAI to decide based on the data it is trained on which plants species or which native plants to represent. Thus, the results were also generic and included a set of already and commonly known native and non-native plants. This led to species representation discrimination and exclusions of other plant species by limiting the genAI to generate images of a small dominant group of plants. However, it is also worth noting that even in those rare cases in which we did include the names of specific plant species, genAI performed selectively and represented only a few of them, for example, in the *Ethnobotany* project (Table, 2).

Across all three workshops, it was challenging to get the genAI to generate images that were not "perfect". For instance, participants had difficulty generating images of low-income communities that lack green spaces or fruits and vegetables that were not perfectly stereotypical; instead, genAI generated products without any sign of imperfection or ordinariness. These led us to conclude and to confirm earlier research that genAI has representation bias obviously [18, 73]. That is, a group of plants is not represented in the algorithm's database. Further, it confirmed that AI is historical, and it has a large capacity to remember things; as such, it does not forget the past, nor does it interpret and speculate on the past; unlike us. Hence, although not very often considered or applied, humans can be more agile than AI in making different futures, by forgetting from the past, or just learning from the past. Our learning from the past can be different from AI's learning, too. We, for example, may learn from the past to avoid the same mistakes in the future; AI learns to repeat the same story [16] by the power of "prediction".

5.2 Future Unmaking

Exploring the capacities of genAI in future making, unmaking, or defuturing in Fry's words [34] for a sustainable future felt naive at first. It felt that we were giving genAI, a tool that is trained on our imperfect and biased historical data, to change the course of action the future may take, hence to unmake it and, as a result, supporting making futures that are sustainable for humans and nonhumans cohabitations on the Earth. However, as we reflected upon the findings of this research, we came across some glimpses of it from an ontological design perspective [87]. We talk about this by observing and analyzing cases where genAI did not do what we expected it to do, in other words, produced "unexpected" and "unacceptable" results. Starting with design features, genAI often failed to illustrate and ideate devices with "futuristic" look in relation to plants. In the *Multispecies Empathy*, the word "futuristic" did not result in generating generic sci-fi futuristic looking images with silver, concrete, and metallic surfaces, even if they were specified in the prompts. Instead, it included more organic materials such as stone and ceramic.

Another example was where genAI unexpectedly did not give us a glimpse of sustainable urban areas with parks populated with the biodiversity of native plants and transformation of already existing low-income communities in *Access to Nature*: instead showed us "very possible" spaces, or already existing ones. These unexpectedly not futuristic results, helped us to envision alternative futures, rather than repeating old-futuristic and sci-fi looking and commonly imaginable futuristic products: "[...] it can use various design aesthetics and still have the same impact and feel [of a futuristic design]."

Lastly, from the ontological design point of view, genAI, as a tool seemed to have changed the designers. In several reflective notes, we observed that designers were reflecting on the changes these workshops brought to their subjects and their practices. Some of them were reflecting on what futuristic even looks like and how it should look like; for others the genAI representation biases triggered reflection on the need to learn about plant species' names and biodiversity of the region. One of them wrote: "It succeeds in fostering interspecies empathy and deepening the connection between human [me] and the natural world," which does not mean that genAI was just or inclusive or sustainable, but that its representation biases resonated with them and helped them to empathize with the underrepresented group of plants.

6 LIMITATIONS

This project comes with its own imperfections and limitations. Most of the participants were senior design students, and although they were informed that their work "should be sharable and aimed at impacting an area of work within design and AI," still we should consider these projects as school projects. Although many of them will be design professionals in a few months, these works should not be compared with what professional designers may produce in similar contexts.

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REFERENCES

[1] Frank Adloff and Sighard Neckel. 2019. Futures of sustainability as modernization, transformation, and control: a conceptual framework. *Sustainability Science* 14, 4 (July 2019), 1015–1025. https://doi.org/10.1007/s11625-019-00671-2

[2] Ferran Altarriba Bertran, Oðuz 'Oz' Buruk, and Juho Hamari. 2022. From-The-Wild: Towards Co-Designing For and From Nature. In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems (CHI EA '22)*. Association for Computing Machinery, New York, NY, USA, 1–7. https://doi.org/10.1145/3491101.3519811

[3] Prithviraj Ammanabrolu, Wesley Cheung, Dan Tu, William Broniec, and Mark O. Riedl. 2020. *Bringing Stories Alive: Generating Interactive Fiction Worlds*. Technical Report arXiv:2001.10161. arXiv. https://doi.org/10.48550/arXiv.2001.10161

[4] James Auger. 2013. Speculative design: crafting the speculation. *Digital Creativity* 24, 1 (March 2013), 11–35. https://doi.org/10.1080/14626268.2013.767276 Publisher: Routledge _eprint: https://doi.org/10.1080/14626268.2013.767276.

[5] Jeffrey Bardzell. 2014. *Speculative Grammar and Stoic Language Theory in Medieval Allegorical Narrative: From Prudentius to Alan of Lille*. Routledge.

[6] Michael Barera. 2020. Mind the Gap: Addressing Structural Equity and Inclusion on Wikipedia. (Oct. 2020). https://rc.library.uta.edu/uta-ir/handle/10106/29572

[7] Christine Basta, Marta R. Costa-jussà, and Noe Casas. 2019. Evaluating the Underlying Gender Bias in Contextualized Word Embeddings. https://doi.org/10.48550/arXiv.1904.08783

[8] Jekaterina Belakova and Wendy E. Mackay. 2021. SonAmi: A Tangible Creativity Support Tool for Productive Procrastination. In *Creativity and Cognition (C&C '21)*. Association for Computing Machinery, New York, NY, USA, 1–10. https://doi.org/10.1145/3450741.3465250

[9] Emily M. Bender, Timnit Gebru, Angelina McMillan-Major, and Shmargaret Shmitchell. 2021. On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?. In *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency (FAccT '21)*. Association for Computing Machinery, New York, NY, USA, 610–623. https://doi.org/10.1145/3442188.3445922

[10] Michael Mose Biskjaer, Jonas Frich, Lindsay MacDonald Vermeulen, Christian Remy, and Peter Dalsgaard. 2019. How Time Constraints in a Creativity Support Tool Affect the Creative Writing Experience. In *Proceedings of the 31st European Conference on Cognitive Ergonomics (ECCE 2019)*. Association for Computing Machinery, New York, NY, USA, 100–107. https://doi.org/10.1145/3335082.3335084

[11] Eli Blevis. 2007. Sustainable interaction design: invention & disposal, renewal & reuse. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '07)*. Association for Computing Machinery, New York, NY, USA, 503–512. https://doi.org/10.1145/1240624.1240705

[12] Mark Blythe. 2014. Research through design fiction: narrative in real and imaginary abstracts. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14)*. Association for Computing Machinery, Toronto, Ontario, Canada, 703–712. https://doi.org/10.1145/2556288.2557098

[13] Mark Blythe. 2023. Artificial Design Fiction: Using AI as a Material for Pastiche Scenarios. In *Proceedings of the 26th International Academic Mindtrek Conference (Mindtrek '23)*. Association for Computing Machinery, New York, NY, USA, 195–206. https://doi.org/10.1145/3616961.3616987

[14] Boyd Branch, Piotr Mirowski, and Kory W. Mathewson. 2021. *Collaborative Storytelling with Human Actors and AI Narrators*. Technical Report arXiv:2109.14728. arXiv. https://doi.org/10.48550/arXiv.2109.14728

[15] Virginia Braun and Victoria Clarke. 2021. *Thematic Analysis: A Practical Guide* (1st edition ed.). SAGE Publications Ltd, London ; Thousand Oaks, California.

[16] Meredith Broussard. 2018. *Artificial Unintelligence: How Computers Misunderstand the World*. The MIT Press.

[17] Barry Brown, Julian Bleecker, Marco D'Adamo, Pedro Ferreira, Joakim Formo, Mareike Glöss, Maria Holm, Kristina Höök, Eva-Carin Banka Johnson, Emil Kaburuan, Anna Karlsson, Elsa Vaara, Jarmo Laaksolahti, Airi Lampinen, Lucian Leahu, Vincent Lewandowski, Donald McMillan, Anders Mellbratt, Johanna Mercurio, Cristian Norlin, Nicolas Nova, Stefania Pizza, Asreen Rostami, Mårten Sundquist, Konrad Tollmar, Vasiliki Tsaknaki, Jinyi Wang, Charles Windlin, and Mikael Ydholm. 2016. The IKEA Catalogue: Design Fiction in Academic and Industrial Collaborations. In *Proceedings of the 2016 ACM International Conference on Supporting Group Work (GROUP '16)*. Association for Computing Machinery, New York, NY, USA, 335–344. https://doi.org/10.1145/2957276.2957298

[18] Joy Buolamwini. 2023. *Unmasking AI: My Mission to Protect What Is Human in a World of Machines*. Random House.

[19] Pedro Campos, Frederica Gonçalves, Michael Martins, Miguel Campos, and Paulo Freitas. 2014. Second look: combining wearable computing and crowdsourcing to support creative writing. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational (NordiCHI '14)*. Association for Computing Machinery, New York, NY, USA, 959–962. https://doi.org/10.1145/2639189.2670250

[20] Erin Cherry and Celine Latulipe. 2014. Quantifying the Creativity Support of Digital Tools through the Creativity Support Index. *ACM Transactions on Computer-Human Interaction* 21, 4 (June 2014), 21:1–21:25. https://doi.org/10.1145/2617588

[21] Li-Yuan Chiou, Peng-Kai Hung, Rung-Huei Liang, and Chun-Teng Wang. 2023. Designing with AI: An Exploration of Co-Ideation with Image Generators. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference (DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1941–1954. https://doi.org/10.1145/3563657.3596001

[22] Paul Coulton, Joseph Lindley, and Haider Ali Akmal. 2016. Design Fiction: Does the search for plausibility lead to deception? *DRS Biennial Conference Series* (June 2016). https://dl.designresearchsociety.org/drs-conference-papers/drs2016/researchpapers/49

[23] Nigel Cross. 1982. Designerly ways of knowing. *Design Studies* 3, 4 (Oct. 1982), 221–227. https://doi.org/10.1016/0142-694X(82)90040-0

[24] Mihaly Csikszentmihalyi. 1997. *Creativity: Flow and the psychology of discovery and invention*. HarperCollins Publishers, New York, NY, US.

[25] Robert Dale. 2021. GPT-3: What's it good for? *Natural Language Engineering* 27, 1 (Jan. 2021), 113–118. https://doi.org/10.1017/S1351324920000601

[26] Carl DiSalvo. 2012. *Adversarial Design*. The MIT Press.

[27] Carl DiSalvo, Phoebe Sengers, and Hrönn Brynjarsdóttir. 2010. Mapping the landscape of sustainable HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10)*. Association for Computing Machinery, New York, NY, USA, 1975–1984. https://doi.org/10.1145/1753326.1753625

[28] Eleanor Drage and Kerry Mackereth. 2022. Does AI De-Bias Recruitment? Race, Gender, and AI's 'Eradication of Differences Between Groups'. In *Proceedings of the 2022 AAAI/ACM Conference on AI, Ethics, and Society (AIES '22)*. Association for Computing Machinery, New York, NY, USA, 237. https://doi.org/10.1145/3514094.3534151

[29] Anthony Dunne and Fiona Raby. 2013. *Speculative Everything: Design, Fiction, and Social Dreaming* (1st edition ed.). The MIT Press, Cambridge, Massachusetts ; London.

[30] Jim Dwyer. 2010. *Where the Wild Books Are: A Field Guide to Ecofiction* (1st edition ed.). University of Nevada Press.

[31] Elizabeth Edenberg and Alexandra Wood. 2023. Disambiguating Algorithmic Bias: From Neutrality to Justice. In *Proceedings of the 2023 AAAI/ACM Conference on AI, Ethics, and Society (AIES '23)*. Association for Computing Machinery, New York, NY, USA, 691–704. https://doi.org/10.1145/3600211.3604695

[32] Daniel Fallman. 2003. Design-oriented human-computer interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '03)*. Association for Computing Machinery, New York, NY, USA, 225–232. https://doi.org/10.1145/642611.642652

[33] Jonas Frich, Lindsay MacDonald Vermeulen, Christian Remy, Michael Mose Biskjaer, and Peter Dalsgaard. 2019. Mapping the Landscape of Creativity Support Tools in HCI. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*. ACM, New York, NY, USA, 389:1–389:18. https://doi.org/10.1145/3290605.3300619

[34] Tony Fry, Eduardo Staszowski, and Clive Dilnot. 2020. *Defuturing: A New Design Philosophy*. Bloomsbury Visual Arts.

[35] Maliheh Ghajargar, Jeffrey Bardzell, and Love Lagerkvist. 2022. A Redhead Walks into a Bar: Experiences of Writing Fiction with Artificial Intelligence. In *25th International Academic Mindtrek conference (Academic Mindtrek 2022)*. Association for Computing Machinery, New York, NY, USA, 230–241. https://doi.org/10.1145/3569219.3569418

[36] Matthew Guzdial, Nicholas Liao, Jonathan Chen, Shao-Yu Chen, Shukan Shah, Vishwa Shah, Joshua Reno, Gillian Smith, and Mark O. Riedl. 2019. Friend, Collaborator, Student, Manager: How Design of an AI-Driven Game Level Editor Affects Creators. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow Scotland Uk, 1–13. https://doi.org/10.1145/3290605.3300854

[37] Matthew Hall. 2011. *Plants as Persons: A Philosophical Botany*. State University of New York Press, Albany.

[38] Kim Halskov and Peter Dalsgård. 2006. Inspiration card workshops. In *Proceedings of the 6th conference on Designing Interactive systems (DIS '06)*. Association for Computing Machinery, New York, NY, USA, 2–11. https://doi.org/10.1145/1142405.1142409

[39] Tom Hitron, Noa Morag Yaar, and Hadas Erel. 2023. Implications of AI Bias in HRI: Risks (and Opportunities) when Interacting with a Biased Robot. In *Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction (HRI '23)*. Association for Computing Machinery, New York, NY, USA, 83–92. https://doi.org/10.1145/3568162.3576977

[40] Youngseung Jeon, Seungwan Jin, Patrick C. Shih, and Kyungsik Han. 2021. FashionQ: An AI-Driven Creativity Support Tool for Facilitating Ideation in Fashion Design. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21)*. Association for Computing Machinery, New York, NY, USA, 1–18. https://doi.org/10.1145/3411764.3445093

[41] Petra Jääskeläinen, André Holzapfel, and Cecilia Åsberg. 2022. Exploring More-than-Human Caring in Creative-Ai Interactions. In *Nordic Human-Computer Interaction Conference (NordiCHI '22)*. Association for Computing Machinery, New York, NY, USA, 1–7. https://doi.org/10.1145/3546155.3547278

[42] Elif Kartal. 2022. A Comprehensive Study on Bias in Artificial Intelligence Systems: Biased or Unbiased AI, That's the Question! *International Journal of Intelligent Information Technologies* 18, 1 (Sept. 2022), 1–23. https://doi.org/10.4018/IJIIT.309582

[43] Joy Kim, Avi Bagla, and Michael S. Bernstein. 2015. Designing Creativity Support Tools for Failure. In *Proceedings of the 2015 ACM SIGCHI Conference on Creativity*

and Cognition (C&C '15). Association for Computing Machinery, New York, NY, USA, 157–160. https://doi.org/10.1145/2757226.2764542

[44] Rolf Kreibich, Britta Oertel, and Michaela Wolk. 2011. Futures Studies and Future-Oriented Technology Analysis Principles, Methodology and Research Questions. https://doi.org/10.2139/ssrn.2094215 Place: Rochester, NY Type: SSRN Scholarly Paper.

[45] Keita Kurita, Nidhi Vyas, Ayush Pareek, Alan W Black, and Yulia Tsvetkov. 2019. Measuring Bias in Contextualized Word Representations. In *Proceedings of the First Workshop on Gender Bias in Natural Language Processing*, Marta R. Costa-jussà, Christian Hardmeier, Will Radford, and Kellie Webster (Eds.). Association for Computational Linguistics, Florence, Italy, 166–172. https://doi.org/10.18653/v1/W19-3823

[46] Yuyu Lin, Jiahao Guo, Yang Chen, Cheng Yao, and Fangtian Ying. 2020. It Is Your Turn: Collaborative Ideation With a Co-Creative Robot through Sketch. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3313831.3376258

[47] Fang Liu, Junyan Lv, Shenglan Cui, Zhilong Luan, Kui Wu, and Tongqing Zhou. 2024. Smart "Error"! Exploring Imperfect AI to Support Creative Ideation. *Proceedings of the ACM on Human-Computer Interaction* 8, CSCW1 (April 2024), 121:1–121:28. https://doi.org/10.1145/3637398

[48] Jen Liu, Daragh Byrne, and Laura Devendorf. 2018. Design for Collaborative Survival: An Inquiry into Human-Fungi Relationships. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3173574.3173614

[49] Szu-Yu (Cyn) Liu, Shaowen Bardzell, and Jeffrey Bardzell. 2019. Symbiotic Encounters: HCI and Sustainable Agriculture. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow Scotland Uk, 1–13. https://doi.org/10.1145/3290605.3300547

[50] Yimeng Liu and Misha Sra. 2024. Exploring AI-assisted Ideation and Prototyping for Choreography. In *Companion Proceedings of the 29th International Conference on Intelligent User Interfaces (IUI '24 Companion)*. Association for Computing Machinery, New York, NY, USA, 11–17. https://doi.org/10.1145/3640544.3645227

[51] M. T. Llano, M. d'Inverno, M. Yee-King, J. Mccormack, Alon Ilsar, A. Pease, and S. Colton. 2020. Explainable Computational Creativity. In *ICCC*.

[52] Susan Loh, Marcus Foth, and Yasu Santo. 2024. The more-than-human turn in human-plant interaction design: From utilitarian object to living co-inhabitant. *International Journal of Human-Computer Studies* 181 (Jan. 2024), 103128. https://doi.org/10.1016/j.ijhcs.2023.103128

[53] Susan Loh, Yasu Santo, and Marcus Foth. 2023. Plant-human entanglements in buildings: designing for care infrastructuring with office occupants and pot plants. *Frontiers in Computer Science* 5 (2023). https://www.frontiersin.org/articles/10.3389/fcomp.2023.1233905

[54] Lidia Marassi. 2023. Assessing User Perceptions of Bias in Generative AI Models: Promoting Social Awareness for Trustworthy AI. In *Proceedings of the 2023 Conference on Human Centered Artificial Intelligence: Education and Practice (HCAIep '23)*. Association for Computing Machinery, New York, NY, USA, 46. https://doi.org/10.1145/3633083.3633094

[55] Donella H. Meadows. 1972. *The Limits to Growth; A Report for the Club of Rome's Project on the Predicament of Mankind* (2nd edition ed.). Universe Pub.

[56] Donella H. Meadows, Jorgen Randers, and Dennis L. Meadows. 2004. *Limits to Growth: The 30-Year Update* (illustrated edition ed.). Chelsea Green Publishing, White River Junction, Vt.

[57] Harold G. Nelson and Erik Stolterman. 2012. *The Design Way: Intentional Change in an Unpredictable World*. The MIT Press.

[58] Iohanna Nicenboim, Elisa Giaccardi, and Johan Redström. 2023. Designing More-Than-Human AI: Experiments on Situated Conversations and Silences. *diid — disegno industriale industrial design* 80 (Sept. 2023), 12–12. https://doi.org/10.30682/diid8023c Number: 80.

[59] Safiya Umoja Noble. 2018. *Algorithms of Oppression: How Search Engines Reinforce Racism* (illustrated edition ed.). NYU Press, New York.

[60] David G. Novick and Stephen Sutton. 1997. What is mixed-initiative interaction. In *In Procedings of the AAAI Spring Symposium on Computational Models for Mixed Initiative Interaction*. 114–116.

[61] Ángel Pavón Pérez. 2022. Bias in Artificial Intelligence Models in Financial Services. In *Proceedings of the 2022 AAAI/ACM Conference on AI, Ethics, and Society (AIES '22)*. Association for Computing Machinery, New York, NY, USA, 908. https://doi.org/10.1145/3514094.3539561

[62] Christopher N. Poulos. 2021. *Essentials of Autoethnography*. American Psychological Association, Washington, DC.

[63] Jeba Rezwana and Mary Lou Maher. 2023. User Perspectives on Ethical Challenges in Human-AI Co-Creativity: A Design Fiction Study. In *Proceedings of the 15th Conference on Creativity and Cognition (C&C '23)*. Association for Computing Machinery, New York, NY, USA, 62–74. https://doi.org/10.1145/3591196.3593364

[64] Shannon Rodgers, Bernd Ploderer, Kellie Vella, and Margot Brereton. 2023. Phenology Probes: Exploring Human-Nature Relations for Designing Sustainable Futures. In *Proceedings of the 34th Australian Conference on Human-Computer Interaction (OzCHI '22)*. Association for Computing Machinery, New York, NY, USA, 216–228. https://doi.org/10.1145/3572921.3572936

[65] Shannon Rodgers, Kellie Vella, Bernd Ploderer, and Margot Brereton. 2023. Nature Fictions: Designing for a Sustainable Future through Nature Relations. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference (DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1566–1580. https://doi.org/10.1145/3563657.3595981

[66] Drew Roselli, Jeanna Matthews, and Nisha Talagala. 2019. Managing Bias in AI. In *Companion Proceedings of The 2019 World Wide Web Conference (WWW '19)*. Association for Computing Machinery, New York, NY, USA, 539–544. https://doi.org/10.1145/3308560.3317590

[67] Daniela K. Rosner. 2020. *Critical Fabulations: Reworking the Methods and Margins of Design*. MIT Press, Cambridge, Massachusetts.

[68] Ben Shneiderman. 1999. User interfaces for creativity support tools. In *Proceedings of the 3rd conference on Creativity &C '99)*. Association for Computing Machinery, New York, NY, USA, 15–22. https://doi.org/10.1145/317561.317565

[69] Ben Shneiderman. 2007. Creativity support tools: accelerating discovery and innovation. *Commun. ACM* 50, 12 (Dec. 2007), 20–32. https://doi.org/10.1145/1323688.1323689

[70] Nancy Smith, Shaowen Bardzell, and Jeffrey Bardzell. 2017. Designing for Cohabitation: Naturecultures, Hybrids, and Decentering the Human in Design. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. Association for Computing Machinery, New York, NY, USA, 1714–1725. https://doi.org/10.1145/3025453.3025948

[71] Robert Soden, Pradnaya Pathak, and Olivia Doggett. 2021. What We Speculate About When We Speculate About Sustainable HCI. In *Proceedings of the 4th ACM SIGCAS Conference on Computing and Sustainable Societies (COMPASS '21)*. Association for Computing Machinery, New York, NY, USA, 188–198. https://doi.org/10.1145/3460112.3471956

[72] Velvet Spors, Samuli Laato, Oğuz 'Oz' Buruk, and Juho Hamari. 2023. Longing to be the Mountain: A Scoping Review about Nature-Centric, Health-Minded Technologies. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23)*. Association for Computing Machinery, New York, NY, USA, 1–16. https://doi.org/10.1145/3544548.3581479

[73] Ramya Srinivasan and Kanji Uchino. 2021. Biases in Generative Art: A Causal Look from the Lens of Art History. In *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency (FAccT '21)*. Association for Computing Machinery, New York, NY, USA, 41–51. https://doi.org/10.1145/3442188.3445869

[74] Biplav Srivastava and Francesca Rossi. 2018. Towards Composable Bias Rating of AI Services. In *Proceedings of the 2018 AAAI/ACM Conference on AI, Ethics, and Society (AIES '18)*. Association for Computing Machinery, New York, NY, USA, 284–289. https://doi.org/10.1145/3278721.3278744

[75] Bruce Sterling. 2009. COVER STORY: Design Fiction. *Interactions* 16, 3 (May 2009), 20–24. https://doi.org/10.1145/1516016.1516021

[76] Erik Stolterman and Mikael Wiberg. 2010. Concept-Driven Interaction Design Research. *Human–Computer Interaction* 25, 2 (2010).

[77] Yi Chern Tan and L. Elisa Celis. 2019. Assessing Social and Intersectional Biases in Contextualized Word Representations. In *Advances in Neural Information Processing Systems*, Vol. 32. Curran Associates, Inc. https://proceedings.neurips.cc/paper_files/paper/2019/hash/201d546992726352471cfea6b0df0a48-Abstract.html

[78] Jakob Tholander and Martin Jonsson. 2023. Design Ideation with AI - Sketching, Thinking and Talking with Generative Machine Learning Models. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference (DIS '23)*. Association for Computing Machinery, New York, NY, USA, 1930–1940. https://doi.org/10.1145/3563657.3596014

[79] Anna Lowenhaupt Tsing. 2021. *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton Oxford.

[80] Ron Wakkary. 2021. *Things We Could Design: For More Than Human-Centered Worlds*. MIT Press, Cambridge, MA, USA.

[81] Ron Wakkary, Audrey Desjardins, Sabrina Hauser, and Leah Maestri. 2013. A sustainable design fiction: Green practices. *ACM Transactions on Computer-Human Interaction* 20, 4 (Sept. 2013), 23:1–23:34. https://doi.org/10.1145/2494265

[82] Marilyn Walker and Steve Whittaker. 1990. Mixed initiative in dialogue: an investigation into discourse segmentation. In *Proceedings of the 28th annual meeting on Association for Computational Linguistics (ACL '90)*. Association for Computational Linguistics, USA, 70–78. https://doi.org/10.3115/981823.981833

[83] Qian Wan and Zhicong Lu. 2023. GANCollage: A GAN-Driven Digital Mood Board to Facilitate Ideation in Creativity Support. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference (DIS '23)*. Association for Computing Machinery, New York, NY, USA, 136–146. https://doi.org/10.1145/3563657.3596072

[84] Xiaoge Wang. 2022. Nature Jar: Design for Facilitating Nature Connectedness and Restoration in Home Scenario. In *Sixteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '22)*. Association for Computing Machinery, New York, NY, USA, 1–7. https://doi.org/10.1145/3490149.3502426

[85] Andrew Warr and Eamonn O'Neill. 2007. Tool support for creativity using externalizations. In *Proceedings of the 6th ACM SIGCHI conference on Creativity &*

cognition (C&C '07). Association for Computing Machinery, New York, NY, USA, 127–136. https://doi.org/10.1145/1254960.1254979

[86] Michelle Westerlaken. 2021. It matters what designs design designs: speculations on multispecies worlding. *Global Discourse* 11, 1-2 (Feb. 2021), 137–155. https://doi.org/10.1332/204378920X16032019312511 Publisher: Bristol University Press Section: Global Discourse.

[87] Terry Winograd, John Bennett, Laura De Young, and Bradley Hartfield (Eds.). 1996. *Bringing Design to Software* (1st edition ed.). ACM Press, New York, N.Y. : Reading, Mass.

[88] Chunchen Xu and Xiao Ge. 2024. AI as a Child of Mother Earth: Regrounding Human-AI Interaction in Ecological Thinking. In *Extended Abstracts of the 2024 CHI Conference on Human Factors in Computing Systems (CHI EA '24)*. Association for Computing Machinery, New York, NY, USA, 1–9. https://doi.org/10.1145/3613905.3644065

[89] Zheng Zhang, Ying Xu, Yanhao Wang, Bingsheng Yao, Daniel Ritchie, Tongshuang Wu, Mo Yu, Dakuo Wang, and Toby Jia-Jun Li. 2022. StoryBuddy: A Human-AI Collaborative Chatbot for Parent-Child Interactive Storytelling with Flexible Parental Involvement. In *CHI Conference on Human Factors in Computing Systems*. 1–21. https://doi.org/10.1145/3491102.3517479

[90] Mi Zhou, Vibhanshu Abhishek, Timothy Derdenger, Jaymo Kim, and Kannan Srinivasan. 2024. Bias in Generative AI. https://arxiv.org/abs/2403.02726v1 Publication Title: arXiv.org.