

Exploring Collaborative Design Through Storytelling and Ideation

by

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ABSTRACT

Within the field of Human-Computer Interaction, researchers and designers have increasingly focused on collaborating with users across the design process. Researchers have explored various approaches to stakeholder engagement such as providing feedback on design concepts, need finding, envisioning, and prototype evaluation. Collaborative design as a method brings together individuals from various disciplines, backgrounds, and areas of expertise to co-create and ideate on current and developing technologies or experiences. These insights from community members are essential in creating and effectively implementing designs in different contexts and communities.

This dissertation aims to expand the current scope of collaborative design methods within the field of Human-Computer Interaction (HCI) by implementing design fiction techniques to inspire future-oriented ideation. By integrating storytelling and crowd-driven ideation within collaborative design methods, participants can ideate beyond what is currently feasible and communicate their desires and needs within their community. This research also utilizes two online platforms to support my collaborative design methods: Dream Drone and The Dream Collective. These platforms, inspired by creativity support tools, enable stakeholders to envision, re-mix, and iterate upon future products, spaces, and services at a larger scale.

I present my research focusing on using and expanding collaborative design methodologies within two different time frames. The first examines different methods to collaborate with local communities through workshops that aim to inspire actionable design interventions within shorter time frames (e.g., iteration over the course of a year). The second explores incorporating design fiction methods within co-design to inspire participants, both in person and online at scale, to envision future designs and their potential applications in the upcoming 5-20 years. Through these explorations I highlight the broader implications of utilizing collaborative design methodologies, augmented by design fiction, and online creativity support tools, to inform design.

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CHAPTER 1

INTRODUCTION

Within the field of Human-Computer Interaction, researchers and designers have increasingly focused on collaborating with users across the design process. Since the 1970s, users started having an active influence throughout the design phase; users would test or perform a task and provide their feedback on design concepts, evolving into user-centered design (Sanders, 2008). Over the following decades, researchers and designers explored methods to involve participants in all stages of design based on participants' expertise; from need finding (Ramirez and Coşkun, 2020), to envisioning (Ehn, 2008), to iterating on prototypes and evaluation (Clement, 1993) (Sanoff, 2011). As the notion of user participation grew, the landscape of collaborative design, also known as co-design, grew. Collaborative design specifically focuses on approaches to support collaboration between all stakeholders in the design process (Zhu, 2011), which can range from community members and users to researchers, designers, programmers, and engineers to name a few. For example, Vaajakallio *et al.* (2007), created a framework to improve aging workers' well-being at work. Through collaborative workshops, researchers were able to understand participant's needs, attitudes, motivations, and practices (Vaajakallio *et al.*, 2007). Within collaborative design, researchers have implemented different tools to support ideation and brainstorming. For example, they have relied on artifacts such as prototypes, design mock-ups, sketches, and collaboration in envisioning workshops (Ehn, 2008). Through collaborative design, participants are given the ability to express their ideas freely by empowering them to "paint a fuller picture" of how they envision a specific use of a product, or an interaction that may happen. For researchers, these insights from community members are essential in creating and effectively implementing designs in different contexts and communities.

This dissertation aims to examine and expand the current scope of collaborative design methods within the field of Human-Computer Interaction (HCI) by implementing design fiction techniques to inspire future-oriented ideation. By integrating storytelling and crowd-driven ideation

within collaborative design methods, participants can ideate beyond what is currently feasible and communicate their desires and needs within their community. This research also utilizes two online platforms to support my collaborative design methods: *Dream Drone* and *The Dream Collective*. These platforms, inspired by creativity support tools¹, integrate crowd-driven ideation and storytelling within their workflows and thus enable stakeholders to envision, re-mix, and iterate upon future products, spaces, and services at scale. On one hand, I examine different methods to collaborate with local communities through workshops that create potential design interventions within shorter time frames (e.g., iteration over the course of a year). Moreover, I examine incorporating elements of design fiction methods within co-design to inspire participants to envision future designs and their potential applications in the upcoming 5 - 20 years. The collaborative ideation workflow and methodology used within my research incorporates current collaborative design methods such as workshops, prototyping, and ideation sessions and expands on these by incorporating design fiction methods within them. By taking inspiration from design fiction, participants can ideate and co-design without being limited by their technical knowledge or current feasibility. The integration of online creativity support tools to support collaborative ideation allows researchers to gather insights from participants at scale, complementing in-person methods and enriching the design process.

Design fiction is a method used in HCI that is inspired by science fiction, a genre that depicts imaginative worlds and futuristic technology. It has been used in workshops to inspire participants to imagine speculative worlds, ask questions, and engage in critical conversations based on specific scenarios, stories, or artifacts (Dunne and Raby, 2013). To support this research, I co-created an online creativity support tool that allows collaborators to create, remix, and reflect on products, spaces, or services at a larger scale. By giving participants a space to ideate beyond what might be currently feasible, they can easily communicate their desires and needs within their community. My work thus focuses on exploring the following research questions: how can we actively engage users in the design process through collaborative need

¹ Creativity support tools refer to software applications, systems, or methodologies designed to enhance and facilitate creative thinking and problem solving. (Shneibderman *et al.*, 2006).

finding by implementing design fiction and storytelling methods? And what can designers learn from small and large-scale ideation and co-design with stakeholder communities?

To answer these questions, I collaborated with multiple communities in socially engaged work within the domains of community science, drone design, and design futuring around food and food systems. In chapters 3 and 4, I present my collaborative work with community science groups. Within HCI, community science research supports public participation in scientific research through collaborations with stakeholders, ranging from professional scientists, and hobbyists, to policymakers and the general public. These initiatives aim to better understand and improve the environment and human well-being. Within community science, community tools and communication between participants are of the most importance as it enables them to come together, share knowledge, collect data, and troubleshoot. Chapter 3 presents my work with food enthusiasts interested in solar cooking and climate-resilient food preparations. Chapter 4 presents our research with drone enthusiasts and hobbyists interested in using drones as a tool for community science research. Through this research, participants ideated and co-designed actionable functioning prototypes. Participants and researchers were able to reflect on this collaborative process highlighting positive and negative design implications. My research with drone enthusiasts used design fiction methods to inspire and examine community aspirations and concerns. The research presented in these chapters served as a starting point to implement collaborative design methods at scale supported by design fiction and online creativity support tools.

I thus shift to examine how stakeholders can participate in envisioning more futuristic systems and inform designs 5-10 years out. In Chapter 5, I present the development and deployment of Dream Drone, an online crowd-based storytelling and ideation platform situated at the intersection of online creativity support tools and design fiction inspired by our in-person workshop. Within HCI, creativity support tools have been used to collect feedback on designs, gather crowd-generated ideas from large audiences, and support rapid ideation and “re-mixing” of ideas. Our Dream Drone research highlights the importance of evaluating these co-created artifacts by all stakeholders; as well as understanding the critical opportunity that crowd-based

storytelling has in equitably supporting communities in envisioning new systems and proactively shaping futures.

Building on the Dream Drone research, we decided to expand our online crowd-based storytelling and ideation platform to any domain, beyond drones. In Chapter 6, I present The Dream Collective, an online tool that allows stakeholders to create, remix, and reflect on products, spaces, or services that they wish to envision on. Participants have the ability to add futuristic features to their creations and build from what others have created, as well as contextualize their ideas through storytelling. The Dream Collective allows for crowd-based iteration and exploration at different points in the future (e.g., actionable design within the next year, as well as futuring 5-20 years out). In Chapter 7, I present a specific project focused on Gen-Z perspectives on food and food systems. This project supports design futuring around ecological and environmental issues such as food waste management, food safety, technology used within food systems, as well as the cultural significance of food itself.

Lastly, in Chapter 8 I conclude by summarizing my overall contribution to the field of HCI, a reflection on the benefits and drawbacks of my research methods, and future challenges and opportunities for the field of collaborative design research through ideation and storytelling at scale.

CHAPTER 2

RELATED LITERATURE

This chapter summarizes prior work within the field of HCI that has influenced my research which draws from the domains of collaborative design, design fiction and storytelling, and online creativity support tools.

2.1 Collaborative Design

Collaboration within design has been thoroughly studied within the field of HCI. Gennari *et al.* (2000) describe the design process as “a human activity, involving communication and creative thought among a group of participants”. Others highlight the importance of collaboration and creativity within the design process. “Creative design is a social process that results from interaction and collaboration with other individuals” (Fischer *et al.*, 2004) Building on this notion, researchers have emphasized the importance of “the active engagement of all stakeholders within the design process” (Zhu, 2011). This collaboration can meet different types of challenges and it is up to the researcher to tackle issues such as communication between stakeholders, and different technological and cultural backgrounds. As such Triantafyllakos *et al.* (2008) state “The design process says a story; the story of a group of people, working together, trying to solve a problem.” Chatman (1978) also refers to the design process as a story. “The story of a collaborative design process and its ways or techniques of involving and empowering the participants in the process”. The design process is a collaboration, and within HCI this interrelation has been explored specifically within the methods of Collaborative Design.

Landoni and Diaz (2015) state “Collaborative design’s core principle is that users should have a central role in the design of tools and procedures for them to use”. Through these methodologies researchers and users have the ability to learn from each other’s experiences, expertise, and practices. Collaborative design, also known as co-design, works with specific

communities to solve a problem by engaging creatively with participants. Researchers such as Zhu, and Taylor state that “the larger the number of ideas produced, the greater the probability of achieving an effective solution”, highlighting the importance of collaborating with participants. Co-design has been applied in a range of domains from creating a better understanding foundation for art therapy (Lazar *et al.*, 2018), to a better design for conversational agents for sexual assault survivors (Park *et al.*, 2021) and re-envisioning an app for photographic expression (Frens *et al.*, 2021).

Collaborative design is “an approach to democratizing innovation in the design process by shifting the power dynamics between research and participants.” (Harrington *et al.*, 2019). Through workshops primarily, collaborative design focuses on empowering participants by giving them a voice and creative input within the design process. Collaborative design also focuses on participants from specific communities, allowing individuals who are directly impacted by the research topic to have a role in the design process. This means having community members as “co-designers with an equal say within the exploration and brainstorming of a design challenge” (Duarte, 2018).

Building on this extensive body of work, my research has focused on collaborative design workshops and tools to work with community members to ideate on future designs, contextualize their uses, and engage in a critical discussion on their creations. Through workshops, we have developed low-fidelity prototypes and narratives. My research expands on collaborative design methodologies by implementing design fiction techniques to inspire participants to ideate beyond what is currently feasible, or their own technical knowledge and communicate their desires and needs within their community. Reflecting on these community creations has enabled us, the researchers, to further understand participants’ experiences and aspirations.

2.2 Design Fiction and Storytelling

Within HCI, multiple design methods have been used to explore design questions and scenarios through prototypes and future worlds. Practices such as speculative design, critical

design, design fiction, and fictional probes explore these future scenarios and worlds enabling a critical discussion (Baumer *et al.*, 2020) (Bleeker, 2009). Auger (2013) highlights the difference between them: "...the word 'fiction' before design informs the viewer that the object is not real; 'probes' infer that the object is part of an investigation; and 'critical' reveals the intentions of the objects as an instigator of debate". In their book *Speculative Everything*, Dunne and Raby (2013) underline how speculative design "enables us to explore ethical and social issues within the context of everyday life". These design methodologies give us the opportunity to ask questions, spark a critical conversation, and inspire others with our designs.

Design fiction suspends our disbelief through stories while taking inspiration from science fact, and science fiction. Julian Bleeker states in *Design Fiction. A short essay on design, science, fact, and fiction* (2009) "Design Fiction creates socialized objects that tell stories... These are stories that speculate about new, different, distinctive social practices that assemble around and through these objects. Design fiction helps tell stories that provoke and raise questions." Design fiction is a form of design futuring that draws on science fiction to explore and critically reflect on possible futures. Science fiction has a long history of capturing our imagination and influencing technological developments in the real world (Venables, 2013), from Mary Shelley's use of electricity to resuscitate the dead in *Frankenstein* as it relates to the modern defibrillator (Shafer, 2018), to Captain Kirk using his communicator in *Star Trek* to inspire the mobile phone (Venables, 2013), and facial recognition and gesture tracking technology in *Minority Report* (Bird, 2022), to name a few examples. By presenting futuristic scenarios, science fiction allows us to speculate on different types of futures and reflect on the consequences of new technologies. Movies such as *Gattaca* and *The Matrix*, for instance, explore dystopian worlds where humans must adapt to new realities shaped by (bio)technology. In more recent years, the series *Black Mirror* has presented 22 episodes of speculative realities shaped by near-future technology, encouraging viewers to reflect on topics such as social media perception, privacy, virtual reality, and how we balance the role of technology in our lives.

Within HCI, design fiction research refers to a diverse set of practices and methods that envision and critically reflect on fictional technologies in future contexts (Blythe, 2014). For

instance, Cheon (2017) explored design fiction to examine future technologies in domains such as robot design, using narratives to understand how roboticists see themselves in the design process, and the role robots themselves have as machines. Lindley (2015) gave participants a space for discussion where, through design fiction, cryptographic currencies have become a norm in everyday lives. Merrill (2020) uses design fiction to create a role-playing game where developers can identify possible security threats, in possible future scenarios. Prost *et al.* (2015) used design fiction to explore sustainable design. Using a design probe, Prost *et al.* immersed users in a speculative world where participants lacked energy or water and through narratives explored how a day in that world would be. Critical reflection is a key aspect of these futuring practices, and HCI is increasingly exploring themes from Afrofuturism, Biodesign, biomimicry, and critical design to reflect on how design can address issues such as racial inequality, and environmental sustainability, to name a few (Hardy, 2022).

As an HCI research method, design fiction tends to be applied to individuals or small groups. For example, McVeigh-Schultz *et al.* (2018), implemented a VR prototype within a specific community where they conducted one-on-one interviews, guiding participants through a virtual story world that they created. Workshops have also been applied within design fiction. Lyckvi *et al.* (2018) structured workshops surrounding fictional worlds where nine participants were given a specific “fiction-developed task”. These types of ideation workshops allow for participants to be further engaged in the design fictions created and embody their roles. Merrill (2020) applied design fiction by prototyping a game where seven security specialists were able to play a game and identify security threats in this speculative world. These approaches are extremely valuable in prompting participants (usually 20 people or less) to create written narratives, films, sketches, and artifacts and use these to facilitate critical reflection. Prost *et al.* (2015), prompted participants to create a journal whereby participants would envision “a day in the life” scenarios of living in a dystopian world where energy resources were scarce. Ramchurn *et al.* (2019) had participants re-create a film, having their perspective create a new narrative. Recent work by Dalton *et al.* (2016), has begun examining opportunities to engage larger, online communities with design fiction through a wide distribution of a design fiction novel.

Within my research, I extend co-design methodologies by applying design fiction and storytelling methods to co-design workshops. Through these workshops, I observed that collaboration was a key aspect of iterating and reflecting on scenarios by participants, and I, therefore, set out to explore larger-scale, collaborative ideation workflows along with their benefits and drawbacks. My research builds upon and expands on co-design methodologies, design fiction, and storytelling by integrating online creativity support tools. Through the online collaborative ideation platforms I co-developed, participants can ideate, envision, and remix designs, bringing collaborative design ideation and storytelling to a broader scale.

2.3 Online Creativity Tools and Crowd-Based Design

By exploring crowd-based storytelling at scale, our research draws on online creativity support tools, which facilitate creative work across a range of domains. In the early 1990s, Fischer and Shneibderman realized the potential computers had to enhance human creativity (Frich *et al.* 2019). Creativity support tools started as a framework to help visualize data or identify items in a set, such as color coding, making patterns, and visualizing relationships between data points (Shneibderman *et al.*, 2006). Within HCI research, creativity support tools have been used to gather feedback on professional designs and crowd-generated ideas from larger audiences, as well as a way to support rapid ideation and “remixing” of ideas. For example, Ma *et al.* (2015) created an online need-finding tool that gathered feedback from participants through videos to inform designers on user needs during the early stages of the design process. Xu *et al.* (2014) focused on creating an online platform that allowed participants from any type of background to give feedback on selected designs. This crowd-generated feedback allowed designers to evaluate their designs and change them for clarity. Siangliulue *et al.* (2015) created an online tool that allowed users to build on each other's ideas and create an idea map. They based their research on the notion that being able to see what others had created can build creativity and inspire participants.

Prior work has also relied on tools such as Amazon's Mechanical Turk to evaluate how notifications affect the working environment (Ikeda and Hoashi, 2021). Amazon's Mechanical Turk is a crowdsourcing tool that allows researchers to collect data through tasks like surveys and gather insights from participants. This tool gives researchers the opportunity to apply crowd-based design without needing to develop an online tool themselves. Gadiraju *et al.* (2015) also relied on a third-party platform called CrowdFlower to understand the behavior of workers during certain tasks through surveys. Prior research has shown that such tools enable participants to maintain a level of anonymity and develop creative concepts without fear of judgment from other participants or pressure to satisfy researchers' expectations (Ma *et al.*, 2015)(Xu and Bailey, 2014). Moreover, online ideation systems can display a range of ideas and enable users to "re-mix" these concepts, which has been shown to lead to higher quality ideas in large-scale, crowd-based ideation (Siangliulue *et al.* 2015)(Yu and Nickerson, 2011).

Within our research, I co-created two online platforms Dream Drone and The Dream Collective that build upon this body of work. Our platforms are unique in that they integrate two aspects of design fiction methodologies within their workflow; creating an imaginary artifact and telling a story about a world where it exists. Unlike other creativity support tools, our platforms give participants the freedom to re-mix and collaborate on topics created by the research team as well as any other topic created by participants, or even create their own.

In this chapter, I presented the extensive literature that my research builds upon. Inspired by this previous research, I now present my work that examines how current and new co-design approaches can support stakeholders within the design process. I expand on previous research by implementing elements of design fiction and storytelling within co-design as well as an online creativity support tool to bring co-design to a larger scale.

EXPLORING COLLABORATIVE DESIGN AND IDEATION WITHIN COMMUNITY SCIENCE RESEARCH

In this next section I present two case studies utilizing collaborative design methodologies with two focus groups 1) food enthusiasts interested in solar cooking and climate-resilient food preparations; and 2) drone enthusiasts and hobbyists interested in using drones as a tool for community science research. These case studies explore the implementation of design fiction methodologies and reflection within collaborative design with local community members. This research focuses on research through in-person workshops supported by critical reflection and feedback between participants, as well as critical discussions on participants' creations.

CHAPTER 3

UNDERSTANDING COMMUNITY PRACTICES: A STUDY OF SOLAR COOKING

I now present a summer-long study on solar cooking as a climate-resilient food practice. Our work explores solar cooking as a way to use extreme heat, a rising concern as world temperatures continue to rise² and mitigate human impact on the environment. We collaborated with 7 food enthusiasts to build DIY solar ovens from scratch and experiment with solar recipes. These DIY solar ovens serve as a point of engagement with food and extreme heat, and a point of reflection on actionable design interventions. Within this research, participants ideated and co-designed actionable functioning prototypes which they then used to make solar recipes, as well as worked together to troubleshoot, share experiences, and ideate on how to improve their prototypes. Participants, and researchers, also reflected on this collaborative process highlighting setbacks, and future possibilities for HCI to support solar cooking. Sections of this chapter were taken from Kuznetsov, Rodriguez Vega, Long, 2022.

3.1 Background

The world is projected to heat up and experience more extreme heat waves over the next few decades, presenting urgent challenges for human health and economy (Masson-Delmotte *et al.*, 2021). Food systems play a critical role in these trends as mainstream modes of food production, distribution, and preparation both contribute to and are impacted by climate change. Within HCI, human-food interaction research is increasingly focusing on climate resiliency by shifting consumer value systems (Heitlinger *et al.*, 2021), and incorporating both situated human and non-human stakeholders (Prost, 2021) and playful and speculative methods to envision alternative food futures (Dolejsova *et al.*, 2020), among many other approaches. Within this

² <https://www.nasa.gov/press-release/nasa-says-2022-fifth-warmest-year-on-record-warming-trend-continues>

research, we explored solar cooking as an alternative area of research on climate-resilient food systems and a point of reflection for food preparation and climate change. We frame solar cooking as a set of creative DIY activities that embody both adaptation to and mitigation of extreme heat. As an adaptation strategy, solar cooking helps retain cooler indoor temperatures and reduces the economic impacts of energy/AC bills, unlike indoor ovens which heat up indoor spaces. At the same time, solar cooking also mitigates environmental footprints by lowering electricity/gas energy consumption, reusing/upcycling materials, and reducing food waste (e.g., through solar dehydration and other food preservation methods).

Yet, while solar cooking is more affordable and less resource-intensive than indoor cooking, it has not been widely adopted in the USA, even in heat and sun-intensive Phoenix, AZ, where we conducted this research. In our city, temperatures regularly exceed 110°F, making it a particularly useful location to study both solar cooking and heat mitigation strategies.

Our research studies the motivations and experiences of food enthusiasts as they learn to harness the sun to cook. In doing so, we explore two central questions: 1) what are the capabilities and limitations of solar cooking as a means of sustainable food preparation? and 2) based on the challenges unearthed by our study, how can HCI lower the barrier to entry and support solar cooking amongst individuals and communities?

To examine these questions, we conducted a study with a community of 7 enthusiasts who designed their own solar cookers from low-cost materials and prepared foods ranging from slow-cooked pork and chicken to bread, kale chips, brownies, beef jerky, and fruit rollups. Participants shared their recipes, tips, and failures through a Facebook (FB) group, during our collective solar potluck at the end of the summer, and in follow-up semi-structured interviews. Our analysis of this data, which includes community Facebook posts and recordings of individual and group conversations, shows that solar cooking was creative, experimental, and fun for participants. At the same time, certain challenges such as gaps in information resources and the logistics of planning and monitoring the longer solar cooking process led participants to iterate on their recipe and oven designs and to approach solar cooking differently than their habitual food preparation. Our research contributions include the following: 1) insights into the requirements

and limitations of solar cooking as a systematic activity that enables heat mitigation in the home; 2) an understanding of community practices and motivations behind solar cooking; and 3) practical design considerations to support solar cooking as a habitual community practice through HCI.

3.1.1 Solar Cooking and Sustainable HCI

Solar energy has been used to prepare food for thousands of years. Some of the earliest known practices include warming wafers and dehydrating ingredients for preservation (Panwar *et al.*, 2012). People have been experimenting with solar ovens for centuries, and today DIY designs range from free or ultra-cheap set-ups (e.g., a car sunshade shaped as a funnel around a pot) to more intricate and pricey hobby projects such as sensor-enabled ‘smart’ solar ovens³. There are also commercially available products and kits, including box and parabolic designs⁴, costing anywhere from \$50 to \$400 or more. Many solar cooking recipes, ranging from simple (e.g., sun-dried tomatoes, granola) to elaborate (e.g., stews, baked goods), are widely available across solar cooking wikis, groups, and forums⁵, books⁶, and solar oven product websites, where recipes are tailored to specific solar ovens (e.g., recipes for the All-American Sun Oven⁷).

In our research, we focus specifically on how people make solar ovens from scratch to explore designs that could be replicated at low cost and without specialized fabrication skills. We then investigate community-based solar cooking practices, which are often slower and more iterative, and directly engage participants with extreme heat and climate change mitigation.

As a DIY practice, solar cooking is aligned with the longstanding sustainable HCI research on maker practices, such as studies of online communities and how-to websites (e.g.,

³ Solar Oven. A collection of designs on Instructables. <https://www.instructables.com/Solar-Oven-2>

⁴ All American Sun Oven. <https://www.sunoven.com/product/all-american-sun-oven>
CooKit on Solar Cookers International. <https://www.solarcookers.org/resources/cookit-purchase>
GoSun products. <https://gosun.co/products>

⁵ Recipes on Solar Cookers International. <https://solarcooking.fandom.com/wiki/Recipes>
Solar Cookers World Network on Facebook. <https://www.facebook.com/groups/scwnet>

⁶ Lorraine Anderson, Rick Palkovic. *Cooking with Sunshine: The Complete Guide to Solar Cuisine with 150 Easy Sun-Cooked Recipes*. Da Capo Press; 2nd edition (May 26, 2006)

⁷ Recipes. <https://www.sunoven.com/sun-cooking-usa/how-to-use/recipes>

Oehlberg *et al.*, 2015), explorations of relationships between makers and product developers (Tanenbaum *et al.*, 2013), and work at the intersection of maker practices and professional design (Fuchsberger *et al.*, 2016). In our study, participants' use of everyday materials to create solar ovens can be seen as a form of "everyday design" and "design-in-use" (Brandes, 2009) (Wakkary and Tanenbaum, 2009). Wakkary and Maestri (2007) discuss these concepts in the context of people artfully modifying available resources to fulfill everyday needs. Others have studied ad-hoc toolmaking in hackerspaces (Bardzell *et al.*, 2014), personalization of IKEA products (Rosner and Bean, 2009), digital collections of modifications (Kim and Lee, 2012), and creative reuse in the context of design fiction (Tanenbaum *et al.*, 2012). Similarly, our work examines how participants approached available materials to design, iterate on, and troubleshoot their solar ovens through reuse and upcycling.

More broadly, as sustainability research within and outside of HCI continues exploring hybrid strategies for adaptation to and mitigation of climate change (Klein, 2007) (Ylipulli *et al.*, 2014), we frame solar cooking as a climate-resilient food practice that both adapts to and mitigates extreme heat. We contribute to this body of work by focusing on an alternative means of food preparation—solar cooking—which has not been previously explored in HCI. Solar cooking relies on aspects of neoliberal systems (e.g., upcycling commercial materials for solar oven construction or sourcing food ingredients from grocery stores), but at the same time bypasses or reduces reliance on the electric power grid during meal preparation. Moreover, solar cooking relies on complex relationships among environmental actors (e.g., sun, heat) and materials comprising the oven and the food ingredients, therefore decentralizing humans in the process ideas (Heitlinger *et al.*, 2021). Lastly, given the playful aspects of DIY solar cooking, we draw particular inspiration from workshops by Dolejšová *et al.* (2020) and Wilde, *et al.* (2021), which explored creative and imaginative strategies for supporting climate-resilient food practices. Similar to the experimental design strategies in these workshops, in our study, cooking proved to be a playful prompt for critical reflection on (un)sustainable modes of food preparation and our relationship with extreme heat.

To summarize, solar cooking has a long history and spans a variety of information resources, DIY practices, and commercial products. Against this backdrop, we situate our inquiry within related sustainable HCI work on DIY and maker communities, as well as research on sustainable human-food interaction. We continue by presenting our study methods and limitations.

3.2 Methods

To explore the challenges and opportunities of solar cooking, we conducted a summer-long study with local food enthusiasts. We recruited 7 participants, none of whom knew each other before the study (3 male, 4 female; ages mid 20's to late 60's) through various local food groups. At the beginning of the summer, participants were invited to attend an introductory workshop where they ideated solar cooker designs and brainstormed the types of meals they would cook. Participants were provided with a range of common materials to prototype solar ovens during the workshop (e.g., reflective tape, foil, wood, cardboard, bricks) and were also offered a ~75\$ budget to spend on additional construction materials over the summer. Participants were also provided with safety resources, including the FDA guidelines for minimum cooking temperatures of various foods, an oven thermometer, an internal food thermometer, safety gloves, a food/recipe journal to keep track of their experiments, and several thermal cameras to be shared amongst the group.

Over the summer, participants experimented with solar cooking recipes, iterated on their oven designs, and shared their experiences on the group's Facebook page. The study did not require a minimum number of meals, and to encourage open experimentation among the group, we offered \$15 to cover the costs of ingredients of each failed or successful cooking attempt that was shared on FB. At the end of the summer, the group re-united at a solar cooking potluck, hosted at the home of one of the participants, to which everyone brought or prepared a solar-cooked dish to share.

At the end of the summer, we also followed up with participants through semi-structured interviews. During these interviews, we first discussed participants' general cooking practices

(e.g., whether they tended to cook alone or with other people, how often their meals involved indoor oven use, and what types of meals they prepared on a daily basis). We then asked participants to walk us through their solar oven design, why they chose that particular design and what information sources they used, and any iterations they made to their ovens over the course of the summer. Then, using content from participants' FB posts as prompts, we asked them to describe each of their solar cooking projects in more detail. In regard to each solar cooking project, we asked participants how they came up with the idea/recipe and what resources they used to research/troubleshoot what it would involve; whether it turned out as they expected, and how the experience compared to other cooking projects they've worked on; as well as what they learned from the project and what (if anything) they would do differently next time. Lastly, we asked participants about the general benefits and drawbacks of solar cooking and ideas for making it more accessible.

Each interview was tailored to and guided by participants' summer-long FB posts as prompts. Our discussions during workshops and interviews were both grounded and wide-ranging, eliciting diverse insights into solar cooking motivations, practices, and challenges. Audio from all events and interviews was recorded and transcribed, and the researchers repeatedly read and revisited the transcripts alongside our field notes and photographs to draw out underlying themes using open coding. We also cross-checked the emergent themes with participants' Facebook posts. The themes were then clustered using affinity diagramming, with similar concepts merged and relationships between themes drawn out. Our findings broadly fall into four major thematic categories: motivations for solar cooking; approaches to solar oven design; types of solar cooking experiments (low-temperature cooking and hybrid oven use); and solar cooking challenges (gathering knowledge, planning, and monitoring).

3.2.1 Research Limitations

We did not explicitly define what constitutes a "failed" or "successful" solar cooking attempt for participants. Instead, these judgments were made by participants themselves in their

Facebook posts (e.g., with comments such as “failed attempt”, or “mushy”, “terrible”, etc.). In general, failed projects seemed to be meals that were exceptionally under or overcooked, while all other projects were deemed as having variable degrees of success based on the taste and texture of the food.

We chose to reimburse participants for both failed and successful cooking projects to encourage more attempts, iteration, and “risk-free” experimentation. However, this could have potentially put less ‘stake’ in each attempt, and sunk costs have been shown to sometimes encourage more radical design changes (Viswanathan and Linsey, 2011). Nevertheless, we chose to fund our study this way because we wanted to ethically redistribute the material cost of experimentation, and we did not want participants to incur financial costs for any failed attempts. As our findings show, this supported very creative ideas and new oven and recipe approaches. It is also worth noting that all our participants were already interested in solar cooking, so there is a self-selection bias in our study.

We continue by presenting participants’ motivations for solar cooking, their DIY oven designs and cooking experiments, and how the challenges they encountered shaped their practice.

3.3 Findings

From the onset, all participants considered themselves proficient cooks, whether through decades of at-home food projects such as brewing (e.g., P2), fermenting and pickling (P1, P7), cooking daily for their family (e.g., P4, P5, P6), or by training as a professional chef (e.g., P3). Participants’ motivations for solar cooking spanned 3 areas: 1) sustainability, 2) experimenting with food, and 3) fun. In regard to the first, participants wanted to use a natural energy source:

“Anything we can do to lessen the resources is the better, we’re not using as much gas or electricity and that it’s all right here—the sun’s out, the oven’s on. It’s all here.” P4

“You’re saving efficiently in two ways: inside from unwanted heat, and then outside utilizing the sun for the cooking.” P7

These quotes are indicative of the larger fact that all participants were drawn to solar cooking as an energy-efficient process. In addition, participants saw solar cooking as a form of “intentional cooking” (P6) and an opportunity to practice and experiment with different cooking methods, recipes, and flavors. Moreover, participants were interested in solar cooking to experiment with recipes that were not feasible in the summer due to excess heat produced by indoor ovens (e.g., solar dehydrating: “*you just throw it out in the sun, it’s easy*”, P5; or braising: “*anything that you can braise will work pretty well in the solar*”, P3). Finally, upon reflecting on their experiences at the end of the summer, all participants emphasized that they enjoyed being part of the solar cooking community and described the group as “fun” and “supportive”. Most participants also described the process of solar cooking itself as interesting and fun (e.g., “*it’s fun, it’s been real fun*”, P5; “*a fun challenge*”, P6).

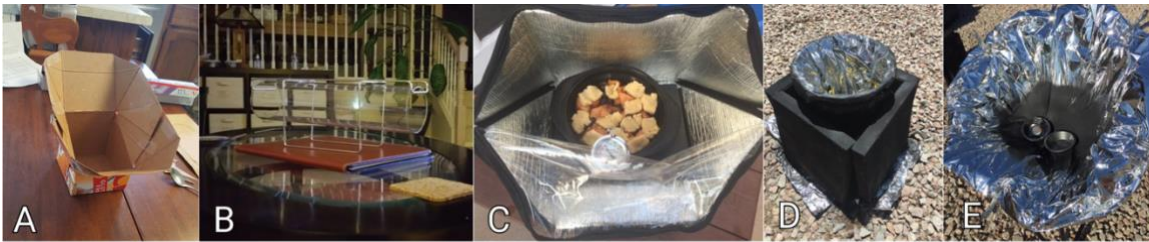


Figure 1 Participant's Solar Oven Designs

A and B emulate commercial solar ovens using cardboard and an acrylic tube; while C, D, and E emulate DIY tutorials using a car sunshade, camp chair, bricks, an emergency heat blanket, and black spray paint, which was purchased for the study.

All participants wanted to design their ovens using primarily the materials they already had on hand, despite the study budget we provided. In this way, the available materials in each household seemed to guide the design process, and the ‘device design goal’ shared by all participants was to reach a consistent, high temperature using whatever they had on hand. To design their DIY solar ovens, participants looked at commercial products, online tutorials (on Instructables and the Solar Cooking Wiki), the designs shared on their Facebook group, and their own trial and error (e.g., “*I looked at a few [designs] online. I also looked at some of the successes and failures of the rest of the people in our group*”, P1). Participants selected and

adopted ideas they saw online to incorporate the materials they already had on hand, sometimes purchasing a few additional, low-cost parts (Figure 1). Starting points included the following items: a chair lined with reflective foil, a car sunshade staked to the ground in a curved shape, a trash can lined with a reflective wilderness rescue blanket, discarded election signs assembled into a box and covered with reflective tape, a wooden box lined with mirror acrylic, and a black spray-painted box. Participants reported baseline temperatures of 130-165F.

“If you wanna control it, you have to understand it. It’s not just about aiming at the sun and hoping things’ll happen. You have to devise how it’s gonna happen.” P6.

The above quote reflects participants’ desire to understand and improve on their designs. Everyone iterated on their ovens, usually by modifying one particular aspect and measuring the effect on the cooking temperature. For instance, three of the participants (P1, P2, and P5) found that they could raise the air temperatures by 15-20 degrees by adding a black surface to the bottom of their cookers (either spray-painted directly or by adding a black platform). Others (P2, P3, and P7) achieved additional gains by sealing their cookers with clear acrylic or plastic. Meanwhile, P6 further improved performance by moving his solar cooker onto the roof of his house, which increased the temperature by 10-15 degrees. Participants also discovered that the containers they used to cook in were important in achieving higher temperatures (e.g., slower heat-up time for cast iron, faster heat loss with aluminum). In fact, P3 went as far as to test his cookware with a thermal camera to learn how “different blacks reflect infrared and absorb infrared.” While P3 was perhaps the most thorough, all participants added tweaks and iterations, using temperature monitoring and the quality of prepared foods to gauge their oven performance. Moreover, P1, P3, and P6 reported plans to expand their projects to include energy-efficient solutions in other contexts (camping, low-income residents on a Native American reservation, and aquaponics).



Figure 2 Solar-cooked kale chips and fruit rollups

3.3.1 Solar Cooking Experiments

All participants were able to cook at least one food item that they considered successful, with the majority having 4-5 successes, and one person (P2) creating 10 successful solar dishes. Most participants began by experimenting with simple recipes they had previously tried with regular ovens—a strategy that led to varying degrees of success. Although some were able to cook corn (P4) or oatmeal cookies (P2) on their first attempt, others experienced initial failures ranging from a watery omelet (P6) or rubbery pizza (P5) to mushy sweet potato chips (P5), bread that didn't fully rise (P2), or a BLT where “nothing happened” to the bacon after 2 hours in the solar oven (P7). Failures led participants to iterate on their oven designs (as outlined above) and to experiment with different cooking methods.

Many participants tried slow-cooking recipes to utilize the relatively constant but lower temperatures in their ovens.

“I knew that I could get my oven to 150 pretty regularly, I was like, well, what cooks at 150? I started Googling that and I was like, literally what cooks at 150 degrees Fahrenheit? Through that trail, I found that most of those recipes were dehydration recipes.” P5.

Above, P5 describes how she arrived at dehydration as a cooking method for her solar oven, which led to many successful attempts, ranging from banana chips, sun-dried tomatoes, and kale chips to fruit roll-ups and beef jerky. P6 used a similar method to create dehydrated blueberries, apple chips, and carrot chips. Other low-temperature recipes included toasted bruschetta (P7) and yogurt (P2).

Participants also adopted highly acidic recipes to ensure food safety during slow, low-temperature cooking. For instance, while making coq au vin, a French braised chicken dish, P1 described feeling “little afraid, because this is my first with the new oven, but the wine is acidic enough to make it relatively safe”. Similarly, P3 used a combination of lime juice and beer in his slow-cooked pork recipe, stating: *“If you have no temperature at all, and you just can it in that broth, it’s the acidity that takes care of it.”*

In addition to using specialized recipes, all participants described instances when they tried a combination of regular cooking appliances and their solar ovens to prepare complex items such as meats. For instance, P3 first seared pork shoulder on a grill, then put it in marinade, left it in the solar cooker for “pretty much all day”, and in our interview described the result as his “most tasty” dish. Others prepared meat dishes such as beef bourguignon, rib eye, beef jerky, and roasted chicken by implementing what they called a “two-step” method:

“I tended to use a two-step method where I brought the main ingredients, especially in a chicken, to food-safe temperatures before I finished it in the [solar] oven.” P1.

“It [beef jerky] hit 140 within two hours. It was at 150 within four. After four hours I put it in the oven to cook it up to the 165 that it needed to be at to be at to heat. It didn’t make us sick at all. We both ate it. It was great.” P5.

In the above, P1 and P5 describe how they deliberately used hybrid cooking (regular and solar ovens) to prepare successful slow-cooked dishes. The “two-step” method was also used to “fix” solar cooking “failures” (e.g., microwaving a pot of beans that did not fully cook outside, P4).

3.3.2 How Challenges Influenced Practice

The unique challenges for solar cooking—specialized knowledge, particular weather conditions, and monitoring food while cooking—led participants to further iterate on their projects and cooking practices.

All participants noted that they had trouble finding information sources for beginners, or information on how to adapt recipes to their particular ovens:

“A challenge is just not knowing what the result would be... When I did the beef jerky I was like, is this safe? There was some nervousness there.” P4.

“I haven’t found a website that specifically says at 160 degrees, cook all this stuff. At 170 cook all this... I couldn’t really find a good resource for that.” P5.

Here, participants reference the fact that many solar cooking recipes require a specific cooking temperature, which are not always reached by the solar ovens they constructed. Lack of information on how to adapt recipes or check for food safety was a challenge, and sometimes led participants to doubt their projects. To address this, participants drew on a variety of sources, integrating knowledge from solar and regular recipe websites, food safety guidelines, information shared on their FB group, and their own prior cooking experiences.

Many participants encountered wind and shade as challenges: P5’s apple chips flew away; a tree cast a shadow over P3’s solar oven during a rice cooking attempt; clouds ruined P7’s zucchini pizza attempt. In addition, since the time of day was important for attaining the highest cooking temperatures, all participants noticed a temperature drop of 10-15 degrees after 5 pm. These experiences led participants to actively pre-plan for their solar cooking day ahead of time based on weather forecasts and their routines that day. Participants checked the forecasted hourly sun conditions and organized their daily schedules to begin solar cooking around noon.

Most participants checked their solar ovens every 15-20 minutes to track the temperature or to reposition their cookers towards the sun. For some, there was a degree of curiosity (e.g., *“I was kind of anxious to see what it was gonna do”*, P7); while for others, it was a matter of food safety:

“It took a lot more attention to detail because of food safety. I would have to go out every 20 minutes to change the angle of the oven and do periodic temperature checks.” P1.

P1’s comment reflects the experiences of most participants who frequently monitored their cooking projects and repositioned their ovens throughout the day.

3.4 Discussion and Implications

This research outlined participants' motivations for solar cooking, which spanned sustainability, food science, and fun. We then detailed how participants creatively designed their solar ovens from everyday materials and experimented with solar-cooked meals. Participants designed their solar ovens based on the materials they had on hand, and the low-fi nature of their designs raises interesting questions around the immediacy, discard-ability, and thus transience of the ovens designed. Participants did not view their solar ovens or cooking projects as final "products". Rather, both the solar ovens and the recipes were seen as works in progress to be iterated upon throughout the course of the summer, whether to optimize cooking temperature, food flavor, or the safety and efficiency of the cooking process itself. These iterations led participants (and researchers) to discover the pros and cons of designing DIY solar ovens, and solar cooking, and we continue by discussing the capabilities and limitations of solar cooking, as well as its implications for sustainability. We then conclude with practical design considerations and actionable guidelines for supporting solar cooking as a community practice within our current food and information systems.

3.4.1 Capabilities and Limitations of Solar Cooking

Our participants were able to cook dishes they deemed successful either when their ovens kept consistent, high temperatures; or when their recipes were adapted for lower temperatures. Accordingly, the study suggests two main practical take-aways. First, regular cooking methods (boiling, frying, etc.) are harder to achieve in solar ovens but can be possible when high temperatures are consistently maintained. High temperatures, in turn, are best achieved by ovens that use highly reflective materials and are repositioned throughout the cooking period to direct sunlight onto the cooking container (every 15-20 minutes). Second, in cases when the ovens operate at lower temperatures, low-heat cooking methods can still be successful through techniques such as curing, solar dehydrating, or sous vide, to name a few.

Moreover, low temperatures can be used in a two-step method where foods are prepared in solar ovens and then finished in short cooking sessions in a regular oven.

Furthermore, whether solar cooking is being used for high-heat or low-heat recipes, our findings reveal that a degree of planning is necessary to prepare the meals. Before cooking, participants researched recipes and ways to adapt them to their solar oven or low-temperature cooking, gathered the ingredients, and consulted the weather forecast to ensure sunny conditions on the day of cooking. In addition, participants tried to cook during the hottest, sunniest part of the day (usually 11 am-3 pm) and had to plan to be home for several hours to monitor and adjust their ovens during this time. In our study, participants did not view this as a limitation and reported this process to be interesting and fun, however, the planning requirements could potentially deter people with less free time or availability to be home. To mitigate this constraint, HCI could provide planning tools (e.g., recommending recipes based on weather forecasts) and support solar cooking as a community practice to share the planning responsibilities amongst groups of people.

Our research also revealed several environmental and practical limitations of solar cooking. Many of the “failed” attempts were due to inconsistent or low temperatures in the solar ovens, either from changes in weather conditions (e.g., clouds); the orientation of the oven (not directly facing the sun); or, in some cases, the designs of the ovens themselves (not using enough reflective material, not angling the material to direct sunlight to the cooking container). While our study was conducted in Phoenix, AZ over the summer, it is likely the oven design and cooking methods would be different in other locations with less direct sunlight, lower ambient temperatures, or higher humidity. Although speculating on how solar cooking would work in different climates and geographical locations is beyond the scope of this paper, it’s important to note that solar cooking practices would vary depending on those factors. As more knowledge is developed in different regions, HCI can intervene to support information sharing and community-building around solar cooking.

3.4.2 Supporting Solar Cooking Through HCI

Our study revealed how the various challenges of solar cooking led participants to approach food preparation with more intention, from iterating on their ovens to “*devise how it’s gonna happen*” (P6), to pre-planning for weather conditions, monitoring the cooking process, experimenting with flavors, and iterating on recipes. These unique practical challenges and creative workarounds suggest several touchpoints for HCI.

First, there are many opportunities to innovate how solar cooking knowledge is captured, analyzed, and shared. On one hand, while there are thousands of solar cooking recipes and tutorials across different media⁸, our study revealed how participants often struggled to find information that was relevant to their ovens, weather conditions, and cooking goals. Participants drew upon hybrid knowledge sources to inform their practice, ranging from online tutorials to personal trial and error and the experiences shared by other community members on Facebook. Here, new tools for aggregating and visualizing solar cooking recipes could help users compare cooking methods and find recipes that best match the weather conditions of a particular day. Future systems and analysis tools could visualize solar cooking recipes by parameters such as the method (e.g., dehydration, “two-step” cooking, slow cooking, sous vide), maximum required temperature, duration, ideal time of day, and food safety tips (e.g., raising the pH). Moreover, the tools involved in the solar cooking process could be re-imagined to capture and share tacit knowledge. Recent research has emphasized the importance of embodied knowledge during cooking (Baurley *et al.*, 2020), and likewise in our study, we saw how participants drew on highly specialized and diverse knowledge, which was validated through trial and error. Similar to concepts for networked kitchen objects (sensor-enabled utensils, etc.), future solar oven technologies could capture user interactions during cooking and generate online recipes based on temperature, time, and care during the food preparation process. New interactive platforms

⁸ All American Sun Oven. <https://www.sunoven.com/product/all-american-sun-oven>
Recipes. <https://www.sunoven.com/sun-cooking-usa/how-to-use/recipes>
Recipes on Solar Cookers International. <https://solarcooking.fandom.com/wiki/Recipes>

could also allow users to collect and share their first-hand expertise in building and using solar ovens.

Finally, our study focused on solar cooking as a community practice, through both the online Facebook group interactions with other participants, and with the shared community potluck at the end of the summer. Participants underscored the value of this social support, and we see future opportunities to design for solar cooking as a community practice. Indeed, prior research has highlighted the importance of community in sustainable food preparation and suggested approaches to facilitate communal meal preparation through coordination apps and meal-sharing schemes (Adrian *et al.*, 2013). Similarly, in the domain of solar cooking, HCI could explore community support tools that enable people to connect with solar cooking enthusiasts in their area, pre-plan their meals, solar cook together, or take turns cooking for each other—especially in cases where not everyone is able to plan or commit time to solar cooking. Moreover, HCI could also explore systems that enable real-time live sharing and troubleshooting during solar cooking in different locations. These rich interactions between members could support solar cooking as a community practice and scaffold larger-scale food science learning and collective dialogues around extreme heat.

3.5 Conclusion

This chapter reported insights from a summer-long study whereby 7 food enthusiasts built solar ovens from scratch and experimented with solar recipes, ranging from kale chips, jerky, and fruit rollups. We framed the participants' iterations on their solar oven designs as examples of iterative design-in-use and highlighted the importance of community feedback when iterating on them. Our findings suggest several opportunities for HCI to support solar cooking through systems that capture, aggregate, and visualize solar cooking knowledge, as well as tools that scaffold community-based practices.

CHAPTER 4

DREAM DRONE: A DESIGN FICTION WORKSHOP

In the previous chapter, I presented a study with food enthusiasts focused on exploring solar cooking as a climate-resilient practice. Within our study, we noted that community feedback within the participants' design processes was essential in building successful prototypes. Our research also presented opportunities for future work within HCI to create tools that scaffold community-based practices.

In this chapter, I shift my focus to drones as a tool for community science. Building upon the previous chapter we partnered with a local community, this time to explore future community uses of drone technologies. Here, we applied design fiction methods as a way to examine community aspirations and concerns. Participants brainstormed, sketched, and narrated future scenarios that envision community science drones and contextualize their uses. By contextualizing their creations in future worlds, participants critically reflected on the drawbacks and benefits of their creations and discussed how we can design drones that address their aspirations and concerns. Sections from this chapter were taken from Rodriguez Vega, Kuznetsov, 2024.

4.1 Background

Consumer-level drones are an emerging and often contentious design space, and there is a pressing need to broaden stakeholder participation in the design process. Current drones have become increasingly available and customizable for a variety of personal applications such as photography, delivery, exploration, racing, and media art, to name a few. A growing body of research examines human-drone interaction in cultural and social contexts (Blaytas, 2019), and within domains such as somaesthetic interaction (LaDelfa, 2020), and firefighting (Khan,2019). At the same time, drones present a contentious design space with growing public concerns around

surveillance and privacy (Uchidiuno, 2018), and related work has examined public perceptions of drones (Ljungblad, 2021), and applied critical design to drones in domestic settings (Gamboa, 2021). In our research, we explore a workshop where stakeholders were prompted to express their aspirations and concerns about drones through futuristic scenarios.

4.2 Workshop Participants

We hosted the workshop at a local library in Chandler, Arizona which had a community of drone and citizen science enthusiasts affiliated with it. Eight participants (3 female, 5 male, ages'40s to late 50s) took part in our workshop: 3 participants were drone hobbyists who were interested in learning more about drones and the kind of data they could collect; 2 were photographers (one of them had prior experience with heat cameras); and three were active citizen science enthusiasts who wanted to know more about drones (e.g., P3: "*What kind of information can I collect with drones?*").



Figure 3 Workshop with local drone hobbyists and enthusiasts

4.3 Workshop Activities

Our workshop consisted of an envisioning activity whereby participants, working in 3 groups, collaboratively sketched out fictional drone concepts (“dream drones”) and augmented them with new features or “superpowers”. To seed visionary ideas that were not constrained by technological feasibility, we provided participants with a set of cards that contained imaginary superpowers such as “Lie Detecting Microphone”, “Invisibility”, or “Ability to Speak Human Languages”, and invited them to create their own. Each group was then asked to develop stories (scenarios) about where their imaginary drones would fly and what they would do in those locations. This envisioning activity and story creation was inspired by past design fiction methodology as mentioned in chapter 2. In contrast to past design fiction research, we asked participants to create teams and together, envision a new dream drone. This was further supported by our research presented in Chapter 3, where we observed how community feedback led to finer designs.

Participants were also asked to mark the flight paths of their drones on a large, printed map of the neighborhood around the library (approximately a 10-mile radius). Afterward, participants presented their drone concepts and scenarios, often contributing to and discussing the implications of each other’s ideas (as we detail below). Audio from the workshop was transcribed and coded to themes along with the researchers’ notes and observations using thematic analysis.

4.4 Workshop Findings

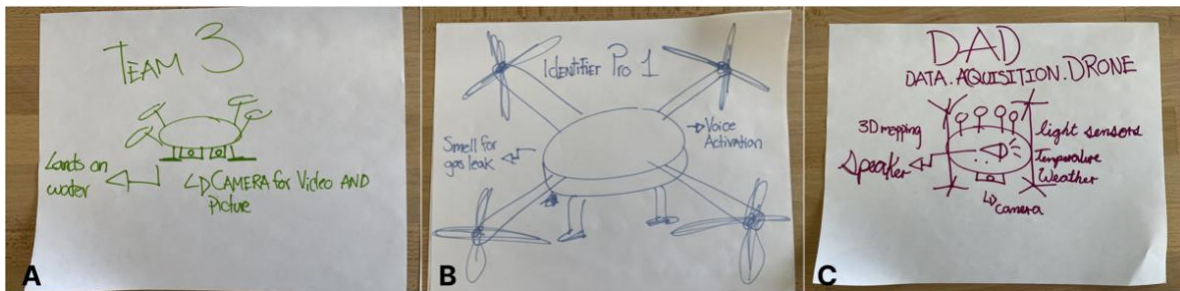


Figure 4 Dream Drone Concept Sketches

4.4.1 Drone Concepts

Our in-person workshop resulted in 3 dream drone concepts developed by participant groups. The dream drone “Team 3” (Figure 4, A) was created by two drone hobbyists, who envisioned their drone with audio and video recording capabilities and a “shield so that it doesn’t hurt anybody or gets damaged. It would have a shock absorbing mechanism and be able to land on water” (P2). This group discussed a scenario where their drone flew over parks and hiking trails to take photographs which they could then share online. The second group in our workshop created the dream drone “Identifier Pro 1”, (Figure 4, B), as P3 explained: “One of the features we gave it was voice activation. Filming cannot be activated until the person gives permission through voice activation. It will also have a smell capability that it may notify if there is a gas leak”. This team envisioned their drone flying inside of buildings and around neighborhoods in order to detect gas leaks in these areas. The third group named their drone “D.A.D: Data Acquisition Drone (Figure 4, C), which was equipped with a camera, microphone, light sensors, temperature sensors, weather sensors, wind, humidity, and pressure sensors. Participants also gave it a light and laser for 3D mapping, and P8 explained:” *Our dream drone would be able to receive and produce sounds depending on the situation. In case of an emergency, it could detect audio and send for help. But it can also produce “sounds” and change color. Drones look scary, so we wanted it to change colors depending on what it is doing, to send a message depending on what*

it is doing.” This group presented scenarios where their drone would fly near freeways to gather environmental data such as the amount of heat or air pollution produced by traffic.

4.4.2 Collaborative Ideation and Reflection

Throughout the workshop activities, we observed participants collaboratively refining and iterating on their initial drone designs and scenarios to better address their community needs and aspirations. For instance, participants collectively envisioned new contexts for their drones, including community-operated drones that report toxic emissions from industrial sites, as well as drones that fly autonomously to record and broadcast extreme weather events. Participants also discussed their concerns about privacy and security around unfamiliar/unmarked drones flying over people and neighborhoods, and many of the dream features they developed reflected these issues. Focusing on these concerns, several workshop discussions revealed design directions for improving the physical appearance of community drones, such as communicating the owners’ identity and intent and giving the drones a friendlier look and feel (e.g., as per P8, “*The drone would also have to be a different color. It looks really scary being black. I would like for it to be rounder; it would change the military feel it has.*”). Moreover, participants reflected on the types of data that could be collected by drones and how this data would be accessed and shared, as illustrated by the following exert from a discussion about the drone “Identifier Pro 1”, which detects gas leaks in a neighborhood:

“I think that transmitting the data in real-time is important in order for authorities to get there in time”, (P3)

“I would have no problem with this as long as the neighbors know it is flying and for the drone to only be sensing smell, not recording video or audio”, (P7)

To summarize, during our workshop, we observed how through collaborative ideation participants iterated on, combined, re-mixed, and refined their concepts together. Participants also engaged in group discussions that led to reflections on broader issues around drone use, privacy, and security.

4.5 Exploring Collaborative Ideation and Storytelling at Scale to Inform Design

Findings from our in-person workshop led us to consider how we could support broader participation in drone ideation and storytelling beyond our local library, and how the data collected at scale could inspire reflection and inform design. During our workshop, we observed that collaboration was a key aspect of iterating and reflecting on scenarios by participants, and we therefore set out to explore larger-scale, collaborative ideation workflows along with their benefits and drawbacks. We ultimately developed Dream Drone, a novel crowd-based storytelling platform situated at the intersection of crowd-based storytelling and creativity support tools.

EXPLORING COLLABORATIVE STORYTELLING AND IDEATION TO INFORM DESIGN AT SCALE

In this section, I now examine how stakeholders can participate in envisioning more futuristic systems and inform designs 5-10 years out. I first present Chapter 5, the development and deployment of Dream Drone, an online crowd-based storytelling and ideation platform situated at the intersection of online creativity support tools and design fiction inspired by our in-person workshop. In Chapter 6, I present The Dream Collective, an online tool that allows stakeholders to create, remix, and reflect on products, spaces, or services that they wish to envision on. I present the data collected within the Dream Collective as well as workshops with participants that further reflect on the data collected within our website. In Chapter 7, I present a specific project focused on Gen-Z perspectives on food and food systems. This project supports design futuring around ecological and environmental issues such as food waste management, food safety, technology used within food systems, as well as the cultural significance of food itself.

CHAPTER 5

THE DREAM DRONE ONLINE PLATFORM- EXPLORING CROWD-BASED STORYTELLING

In Chapter 4, I presented our design-fiction in-person workshop with drone hobbyists, the findings from our workshop led us to consider how we could support broader participation in drone ideation and storytelling beyond our local library, and how the data collected at scale could inspire reflection and inform design. As such we developed Dream Drone, an online tool that enables users to envision new drone technologies and create narratives about future contexts of use. We explore online, crowd-based storytelling and ideation as a playful approach to elicit community values, aspirations, and concerns at scale. Our data includes 52 drone fictions and reveals community needs and speculations about drone features and application areas, as well as aspirations, concerns, and critiques around emerging technologies in general. We reflect on our findings to discuss the benefits and drawbacks of crowd-based storytelling and suggest design implications for future drones and technologies across other domains. Our work also raises critical questions around power and representation in crowd-based design futuring and leads us to consider how crowd-based storytelling can equitably support communities in envisioning new systems and proactively shaping our futures. Sections from this chapter were taken from Rodriguez Vega, Kuznetsov, 2024.

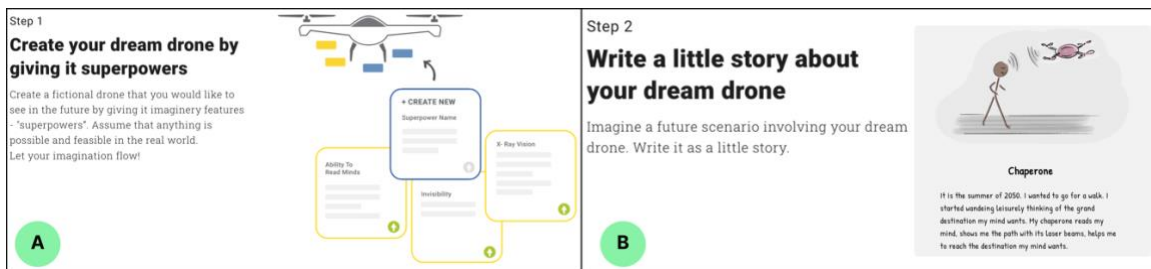


Figure 5 Dream Drone workflow
Steps to add superpowers to a dream drone (A) and describe a fictional scenario (B).

5.1 Platform Design

Based on our in-person workshop with drone hobbyists, we modeled our website design around the design fiction-inspired ideation activities that were conducted during it. Dream Drone invites users to build on each other's ideas to envision drones with new capabilities or "superpowers" and imagine how these drones would operate in alternative fictional worlds. We decided to use the term "superpower" instead of "feature" to encourage participants to think speculatively beyond feasibility and reimagine what is possible. This is also consistent with how science fiction works often credit superheroes with inventions of new tools or technologies, such as DC's Batman's creation of the Batmobile and Shuri's invention of the EMP Beads in the Black Panther series. Inspired by design fiction methods, we adopted two aspects of design fiction into the Dream Drone platform—creating an imaginary artifact and telling a story about a world where it exists (Blythe, 2017) (Mcveigh-Schultz *et al.*, 2018). The Dream Drone platform is hosted on Amazon AWS.

5.1.2 Platform Workflow

The resulting simple online workflow consists of two steps (Figure 5):

Step 1: Create a Dream Drone by Adding Superpowers

The users of our platform can start creating a fictional drone by first adding up to four superpowers (or features) to their dream drone—the drone they are envisioning (Figure 5, A). Here, users can create their own superpowers and/or select superpowers that were submitted by previous users. We also seeded the platform with a list of superpowers generated by the researchers and our library workshop participants. This step aims to support ideation by enabling users to combine, remix, and build upon the ideas of others (Yu and Nickerson, 2011). We decided to have the interface support up to 4 superpowers for each dream done based on our workshop observations where participants mostly used 2 to 4 superpowers and to nudge the contributors to proceed to step 2.

Step 2: Write a Dream Drone Story

After adding superpowers, the second step of our platform prompts users to create a meaningful name for their dream drone. Users are then asked to write a dream drone story (a scenario about their drone) describing the world it operates in, the locations it flies, and who it interacts with (Figure 5, B). We decided to use stories because of the significantly lower interaction overhead (vs sketching on a digital screen, uploading images, creating short videos, etc.). At the end of each contribution, users are also prompted to optionally share their demographic information.



Figure 6 Storyboards on the landing page of the Dream Drone Platform

These steps are introduced to users on the landing page of the Dream Drone platform, which shows a brief narrative in the form of four storyboards (Figure 6). We use these storyboards to: a) establish a 'ground truth' about what a drone is and what it can do (e.g., giving the users a shared understanding that a drone can fly and be controlled so they don't have to add "flight" or "remote control" as superpowers); and b) playfully and creatively introduce the workflow of our tool (Figure 6). We intentionally used a simple and colorful aesthetic to encourage creative and wild ideas from users, with the hope that the fictions would not be constrained by the current technical capabilities of drones. Users also have the option to view the dream drones others created before or after they submit their ideas.

5.2 Dream Drone Deployment and Data Analysis

We made our platform publicly available online and disseminated it among drone enthusiasts through several social media channels. These included Reddit threads [r/diydrones](#),

r/drones, r/dji, r/drone_photography, r/design, and the online UAV Coach Community forum. Out of the 52 responses we collected, 28 remained anonymous and 24 shared the following data: 21 identified as male and 3 identified as female; 9 indicated being between the ages of 18-25, 7 between the ages of 26-35, 5 between 36-45, 3 between 46-60, and 1 participant 60+. Participants self-identified as having a range of backgrounds including drone hobbyism, engineering, design, and environmental science, to name a few. Participants self-reported to be from all over the world, including the USA, Netherlands, United Kingdom, Serbia, Russia, France, India, Sri Lanka, and New Zealand.

Over the course of 6 months, we collected 52 responses resulting in 92 superpowers and 52 unique dream drone stories. The length of the stories varied from 12 to 400 words with an average of 54 and a standard deviation of 63 words. The researchers first independently read and thematically grouped the drone superpowers generated by online contributors. We then analyzed our codes and thematic clusters together, identifying common themes and eventually agreeing on 6 superpower clusters based on the types of drone behaviors and interactions the superpowers enabled, as well as their relationship to existing drone features (e.g., whether they were improvements on existing technologies or entirely new capabilities). Likewise, we each first independently analyzed the dream drone stories using open coding and clustered the narratives based on what community needs they expressed, and the types of aspirations and challenges they revealed about drones and other technologies. We then held a series of meetings/workshops within our research team where we discussed our codes and story clusters together and used emergent themes from the data to reflect on the present and future of (drone) technologies in social and political contexts. Ultimately, we grouped the dream drone stories into 7 clusters, which ranged from scenarios that address very specific current problems, to new contexts for future drone use, as well as, and perhaps most surprisingly to us, aspirations for other technologies beyond drones. We continue by presenting themes from our findings and discuss the insights and critical reflections that emerged throughout our data analysis sessions.

5.3 Findings

In this section, we present the findings that emerged from crowd-based ideation and storytelling in the domain of drone design. First, we present an overview of the drone superpowers collected across our platform, which broadly envisioned 1) improvements to existing drone features and 2) new drone features. We then discuss the dream drone stories, which are the written narratives participants created depicting their dream drones in futuristic scenarios. We broadly grouped these into two themes: aspirations for future drones and aspirations for future technologies, and we detail how these categories served as touchpoints for critical reflection within our research team.

5.3.1 Dream Drone Superpowers

Improvements to Existing Drone Features

Many of the superpowers created by participants were inspired by current drone capabilities and suggested improvements to existing drone features. We broadly categorized these superpowers into vision, piloting, and accessibility. Superpowers related to drones' vision focused on improving the ability to navigate and sense their surroundings including “*Long Range Zoom*”, “*Ultra-High Definition*”, “*Night Sight*”, “*Telescope*”, and “*Wide Range Vision*”. In total, 48 of the dream drones created by participants utilized at least one of these features, which suggests an aspiration for better drone-based cameras. Moreover, some vision-related superpowers went beyond suggesting improvements to regular cameras and imagined additional sensing capabilities that would enable drones to complete specific tasks. With these types of superpowers, participants envisioned their dream drones to have “*Thermal Vision*”, “*X-ray Vision*”, “*Night Vision*”, “*Search & Rescue*”, and “*Mapping*”. These superpowers were then used in tasks such as “*Detecting landmines*”, “*Finding missing people*”, and “*Guarding prisons*”.

Closely tied to improvements to drone-based cameras and sensing, participants also envisioned improvements in drone piloting. These ranged from incremental changes in current

piloting interfaces, to completely new ways of communicating with drones. Among the improvements to current piloting interfaces, superpowers often focused on better video displays. For instance, one superpower suggested that *“the ground station’s video display is bright enough to work in high noon-desert sunlight”*. Other superpowers presented entirely new communication modalities between the pilots and their dream drones. Two examples of this communication were *“Speaking”* and *“Talk”*, which imagined users being able to control their drones through verbal cues or by having a conversation with their dream drone. With these and other similar superpowers, participants conceptualized dream drones that could be controlled by human speech and drones that could even talk back to the pilot. A more speculative, related set of superpowers envisioned human-drone communication through thoughts. Superpowers such as *“Mind Reader”* and *“Brain-Drone Interface”* examined these forms of communication by describing ways to link the pilot’s mind to the drone. These types of superpowers reflected aspirations for new modes of communication with the drone during piloting.

Finally, participants also highlighted the importance of making drones more accessible to users. To this end, they included superpowers such as *“Self-Explaining,” “Open Source,” “Built on the Field,”* and *“Cheap”*. These superpowers revealed aspirations for lowering financial and technical barriers to owning and operating drones.

New Drone Features

In addition to superpowers that built on existing features in commercial drones, participants also imagined entirely new capabilities that have not yet been integrated into consumer-level drones. These superpowers broadly fall into three themes: autonomy, shooting, and the ability to change appearance.

Superpowers within the autonomy theme foresaw drone activities that did not require human involvement at all. For example, *“Automatic Landing System”* and *“Fly by Itself”* were attributed to 12 of the created dream drones, giving these drones the ability to land and even fly autonomously. Similarly, the superpower *“Ninja Reflexes”* described the ability to react to any event around the drone and dodge any obstacle within its path, *“no matter the capability of the pilot”*. Interestingly, 15 of the created dream drones also had the power of *“Intangibility”*, which

was defined as “*the ability to go through walls and obstacles*”. Other autonomous superpowers included “*Self-Repairing*” and “*Self-Destruction*”, which gave drones the ability to fix any damage, or to dismantle themselves automatically. In some cases, autonomy was also reflected in terms of longer or infinite battery life, as noted in superpowers “*Unlimited Power*”, “*Limitless Power*”, and “*Self-Sustained*”, which were used by 42 dream drones.

28 of the dream drones in our dataset also had futuristic shooting capabilities, and these superpowers were used in scenarios related to security and defense within their corresponding drone stories. These imagined features included a “*Stun Gun*”, the ability to “*Shoot Lasers*”, and even features such as “*Ultimate Freeze*”, and “*Breathe Fire*”, which enabled the dream drones to “shoot” with extreme temperatures. Finally, participants focused on giving their dream drones the ability to change their appearance. Examples of these capabilities include “*Shape Shifting*”, “*Bulletproof*”, and “*Weightless*”, which enable the dream drones to change how they look.

In short, participants created superpowers that improved on current drone features such as communication during piloting, accessibility, and vision, and imagined entirely new capabilities themed under autonomy, shooting, and changes in appearance. We continue by describing how these enhancements were contextualized in participants’ dream drone stories.

5.3.2 Dream Drone Stories

The dream drone stories created by users consisted of short narratives depicting imaginary future scenarios about their drones. When analyzing this data, we categorized the stories into themes that reflect participants’ aspirations for future drones and aspirations for future technologies beyond drones. We present these categories below and use them to critically reflect on current and future (drone) technologies in social contexts.

Aspirations for Future Drones

Sixteen of the dream drone stories show aspirations for future drones in contexts that we categorized as entertainment and art, search and exploration, and defense and surveillance. The drone narratives under the theme of entertainment and art depicted scenarios where the dream

drones were mainly used for racing or photography. By adding superpowers such as “*Ultra Camera Range*” and “*Telescope*” to their dream drones, participants created futuristic narratives that enhanced what is currently available. One example is “*Hobbyist Dream*”, a drone with “*Ultra Camera Range*” and “*First Person View*” superpowers that were contextualized in a scenario where the drone was used for “*extreme photography and to get people into FPV racing*”. When analyzing this and other thematically similar stories, we (the researchers) discussed how the subset of art/entertainment dream drones reflects current hobby drone use and aspires to improve on the artistic and fun aspects of drone flying. We also discussed how these types of scenarios comprised the smallest subset of the stories we collected, with only 4 dream drones, possibly because many consumer-level drones are already being used for this purpose.

A larger set of 10 dream drone stories envisioned new contexts for drone-based search and exploration. Within this theme, some stories depicted dream drones looking for very specific items, while others described drones acting autonomously for open-ended exploration. For example, in one narrowly focused search scenario, the dream drone “*Laundronay*” looks for dirty laundry as it “*hovers in the bathroom, watching for stray clothes, [and] dumps them into the laundry basket. Then, it carries the basket when it's full to the washing area. It even loads the clothes into the washer.*” Another example of a focused search drone is the “*Food Element Drone*”, made to help the user find the perfect restaurant: “*This drone is able to find the best food location for whatever you are craving. With its sense of direction, smell detection, and X-ray vision, nothing will get in its way to find the best restaurant for you*”. In a more open-ended exploration scenario, an autonomous drone, “*Cambo*”, was created to “*fly to remote places like forests and beaches and help hikers scout the environment*”. Another exploration narrative focused on a versatile dream drone “*S.U.H.A.S*”: “*It flies where the wind takes him. The main purpose of S.U.H.A.S is collecting rocks from space while spraying flames at enemies.*” Reflecting on this set of stories, we saw a variety of desirable use contexts for exploratory drones, which range from focused searching for specific items to open-ended mapping and exploration. These stories led us to critically consider the limitations of current drone search capabilities, as

well as potential privacy and legal concerns around future drones that might be able to search and map resources more precisely/autonomously.

Finally, participants' stories revealed aspirations for future drones that performed defense and surveillance tasks. On one hand, some of these narratives depicted dream drones for personal protective use, such as the story about the drone named "*The Surveillance Eye*": "*I would use the drone in order to detect bad persons or intruders trying to get in a property. So, once the drone detects these guys it can send a signal to another surveillance device such as security cameras or recording drives, etc. Then I can call security personnel or even the police.*" On the other hand, users also envisioned drones for larger-scale defense operations, as depicted in this story about the drone named "*Humanity's Last Hope*": "*The year is 4004 and the alien overlords have invaded Earth. This is Humanity's Last Hope to destroy all Aliens with its lasers. It is virtually indestructible and bulletproof to deflect all of their attacks.*" Reflecting on these stories, we discussed how they exemplify perceived cultural 'threats', ranging from human intruders to alien invaders, and how our present-day news narratives and science fiction works serve to amplify these fears (e.g., War of the Worlds, The Matrix, Terminator, Altered Carbon, Total Recall, Minority Report, Blade Runner, MCU The Avengers, to name a few). We also discussed how dream drones in this category reflect different human aspirations for protection, including personal safety systems and large-scale defense initiatives.

Another exciting scenario that led to discussions around a range of issues was about a drone named "*Mines Flagger*", with the following story:

"A kid who lost a leg in a minefield receives a kit with a bunch of easy-to-assemble parts and some drawings on how to build a flying structure from plastic bottles. Soon his drone flies above an area where mines are suspected. It automatically maps the field and sends its findings through the internet satellite constellation, and updates a map accessible from any smartphone, from a danger warning app, or from the tiny computer that he received with the kit."

This story depicts a world where drones are easy to assemble and operate to show landmine locations to the public. This story led the research team to discuss and critically reflect on current barriers for building and using drones, as well as the bigger issue of landmines, which

are invisible to humans and can affect children. Interestingly, the story presupposes that even though “*Mines Flagger*” lowers barriers for access, users still have to use smartphones to view the data, which led the researchers to consider the limitations of high-tech solutions in general (drone piloting software often requires smartphones or tablets).

To summarize, about one-third of the stories in our dataset depicted aspirations for future drones, detailing scenarios in which drones served to entertain, protect, search, and explore. Stories in these categories led the researchers to discuss a range of complex issues, including how present-day social, political, and technical systems impede basic human needs for safety and resources and in some cases amplify our fears and concerns. Moreover, these stories revealed how drone innovations may have both desirable and undesirable societal consequences, and we present actionable design implications that emerged from our reflections in the Design Implications section.

Aspirations for Future Technologies Beyond Drones

While the stories gathered across our platform primarily focused on drone scenarios, they also, unexpectedly to us, provided insights into participants’ aspirations for other future technologies beyond drones. Within our findings, narratives themed around personal services and public services/infrastructures explored new scenarios for drone use and also portrayed aspirations for other types of new technologies across those domains.

14 stories, which we broadly categorized under personal services, envisioned the drone as a companion to the user. Interestingly, these narratives depicted drones with anthropomorphic characteristics, human names (e.g., “*Daisy*”, “*Chip*”, “*Dr. Sparky*”, “*Thomas*”, and “*Boris*”), and in some cases, even human personalities. In one example, a participant discusses their dream drone, “*Chip*”, as a playful companion: “*I want Chip to fly around with me and play with me like a flying toy. Chip can chase the dog and play around with other animals without crashing. It can talk to me as we are playing.*” Similarly, the story about the dream drone “*Boris*” highlights human friendship with technology: “*Boris only flies inside buildings but can recharge itself continuously so can fly forever. It likes to make friends with people and will follow them around.*” Another participant created “*The Ultimate Snack Maker*”, which serves as a companion that cooks and

delivers food. *“This drone is able to make cookies at any moment, any time, and deliver them to you as fast as possible. It is the ultimate companion to your late-night study sessions”*. These and other similar stories in our findings led the research team to reflect on human desires for more personal and playful relationships with technology, which have long been explored by a large body of science fiction works (e.g., Blade Runner, Ex Machina, I, Robot, and many others). We also talked about how such drone stories reflected aspects of existing companion systems (e.g., virtual assistants, IoT home devices) and how future versions of such technologies (which may not necessarily be drone-based) may indeed facilitate more playful and/or intimate relationships with humans.

In addition, 12 of the drone stories explored scenarios around public transportation and law enforcement. For instance, a drone named *“Monty”* performed transportation of confidential items: *“Monty [flies wherever] you want, it can be used [for] security or [to] transport difficult things. The aircraft itself can repair itself and can freeze anything that tries to endanger it. The invisibility of the aircraft would be as useful for its protection and control of confidential items.”* Reflecting on this story within our research team, we discussed the writer’s desire for secure transportation and how drones could meet this need and other types of systems to ensure confidential delivery of items (e.g., secure infrastructures, mail workflows, and transportation routes).

Similarly, in the domain of law enforcement, a story about the dream drone *“Hot Pursuit”* touched on several issues around broader policing technologies beyond drones:

“It is early morning in New York City. NYPD just received a call about a bank robbery and the suspect driving a blue Mustang along Interstate 86. NYPD deploys 20 hot pursuit drones over the highway. One of the drones then detects the Mustang and starts to follow. NYPD officers [watch] the live footage from the long-range feed and command the drone to emit its laser beam. The drone emits the beam at the right time, car engine stops. No one is harmed, no one can move. NYPD catches the suspects.”

While the dream drone is the protagonist (as prompted by our platform), we saw this story as a reflection on other policing technologies beyond drones, such as, for instance,

surveillance tools (e.g., street, or aerial cameras) and new law-enforcement interfaces (e.g., IoT devices in cars). Although this particular story depicts how new technologies might support more humane policing practices, we discussed the many possible negative consequences of such tools, including increased surveillance, imbalance of power, excessive use of force, and the potential of such tools to create a more militarized state, among others. This story also led us to more broadly reflect on how crowd-based design ideation and storytelling might be used to explore present-day issues around law-enforcement practices, including racial biases, use of force, and (lack of) accountability, as well as the role technologies play in shaping public perceptions around these issues in the USA (where this research was conducted). Scenarios around policing technologies in our data led us to consider how crowd-based narratives might be used as an approach to foreground relationships between police and community stakeholders, and how scenario-based futuristic worldbuilding might serve as a tool for envisioning technologies that expose and subvert systematic power structures.

A somewhat related story about a drone “*Tracker Jack*” explored the implications of new technologies on the future of international security:

“The [Tracker Jack] model was initiated by the US Federal Department of National Security in 2040. Its main objective was to track and retrieve wanted targets in remote areas with dangerous terrain, harsh weather conditions, etc. The problems started about 2 years later when the wrong people got their hands on this tech and found out how to use it... Drug trafficking is up 60% illegal firearms trafficking is up 45% and there were 12 times as many kidnappings this year than the last decade combined... It's been recently reported that the manufacturer of the drone has been selling blueprints and codes [internationally]...”

This story depicts unintended uses of defense technologies and envisions a future where such tools destabilize national security. On one hand, this story led us to reflect on the harm associated with military technology due to error or misuse, as in, for example, civilian casualties in controversial US military drone strikes⁹. Moreover, we discussed how laws and decisions

⁹ <https://www.nytimes.com/2021/09/10/world/asia/us-air-strike-drone-kabul-afghanistan-isis.html>.

around such technologies often lack transparency, and this scenario from our data further amplified the harm that could result from such tools falling into “the wrong hands”. The scenario also prompted us (the researchers) to more broadly reflect on the impacts of technological innovation in data acquisition and tracking. For instance, this scenario is reminiscent of ongoing inquiries into how companies acquire data and with whom it is shared¹⁰, as well as the recent use of social media records to investigate and persecute people seeking healthcare in the USA¹¹.

To summarize, this section presented stories from our data that revealed contributors’ aspirations and at times concerns regarding companionship, secure transportation, and safe policing when envisioning new technologies in these domains. At the same time, these stories also offered a critical lens for the research team to engage with a host of contentious issues including intimate human relationships with technology, as well as the role technologies play in policing and (inter)national security. The scenarios and our reflections suggest new opportunities for future drone and non-drone technology design, as well as implications for using crowd-based storytelling as a method for critical reflection.

5.4 Discussion and Implications

In our research, we set out to explore the challenges and opportunities of leveraging crowd-based design ideation and storytelling to reflect on present and future drone design. Focusing on drones as an increasingly available, yet somewhat contentious technology, we developed an online platform for drone ideation and storytelling, which was inspired by insights from our in-person design fiction workshop with local drone hobbyists. We distributed our platform to online communities of drone enthusiasts, inviting them to build on what others created and/or envision new drone superpowers, as well as to speculate on future scenarios in their dream drone stories. Our data revealed the needs, aspirations, and fears of the drone community,

¹⁰ <https://www.nytimes.com/2022/08/19/technology/tiktok-browser-tracking.html>.

¹¹ <https://www.npr.org/2022/08/12/1117092169/nebraska-cops-used-facebook-messages-to-investigate-an-alleged-illegal-abortion>.

ranging from new or improved drone features to different contexts and scenarios for drones, as well as desires and concerns about new technologies beyond drones. Throughout our data analysis, the emergent themes served as touchpoints for critical reflection amongst the research team to consider issues around human relationships with anthropomorphic technologies, as well as systems for security, surveillance, policing, and transportation. At the same time, our online data collection approach offers interesting trade-offs when compared to other design fiction and design fiction-inspired research, which relies on smaller participant groups in settings such as workshops, interviews, and prototyping sessions. We continue by reflecting on the questions we posed at the beginning of our paper and discuss: 1) the benefits and limitations of crowd-based ideation and storytelling as inputs for design; and 2) actionable implications for the design of drones and other technologies based on our findings.

5.4.1 Benefits and Drawbacks of Crowd-based Design Ideation and Storytelling

Our approach scales up scenario development and storytelling and presents a point of comparison for smaller, in-person design fiction methods such as workshops and interviews. Among its benefits, is the fact that the Dream Drone platform reached contributors across a wide range of ages (18- 60+) who self-reported a diversity of educational backgrounds from engineering to environmental science, and design. Moreover, the participants were from all over the world, including the USA, Netherlands, France, Serbia, United Kingdom, Russia, India, Sri Lanka, and New Zealand, to name a few. This resulted in a breadth of concepts and narratives from a distributed group of drone enthusiasts, which would be much harder to achieve using in-person data collection methods. Most importantly, the Dream Drone platform supports crowd-based “re-mixing” of stories and drone designs by creating a pool of superpowers to choose from and build upon, as well as by enabling users to view the narratives that others have created.

Beyond suggesting new drone features, our findings revealed a range of speculative scenarios for future drone use as well as aspirations for technologies beyond drones. Through these scenarios, users were able to explain the context for their design concepts without relying

on domain-specific knowledge about how these technologies might be implemented. Thus, storytelling could be an important facet of how users contextualize the final design by exploring dynamic elements (e.g., the experiences and interactions they described in their stories) and revealing aspirations within both narrow and broad tech domains.

However, as with many other online data collection methods (e.g., Luther *et al*,2015), our approach gave us, the researchers, less control over the data collection process, as anyone with access to our platform could participate in the research (e.g., we could not confirm that all participants were drone hobbyists or users, nor validate the self-reported demographics). We also could not ensure that each story was written by a unique participant, as the website allows users to create as many superpowers and stories as they want. Moreover, while our platform reached more participants and collected a breadth of perspectives, our approach does not yet support all aspects of collaborative and critical reflection that might happen in person when participants work with physical materials or engage in live discussions and critiques.

It is also important to note that while we (researchers) examined the scenarios as prompts for critical reflection on the present and visions for alternative futures, it is unclear whether the online contributors themselves reflected on these aspects beyond what was written in their stories. As design workflows continue to embrace online and hybrid modalities, future work can explore how online ideation platforms such as ours might support live discussions and critical reflections on design fiction scenarios. Features such as live commenting and reflection prompts, as well as post-participation surveys might elicit more critical reflection amongst contributors, and we discuss our own research towards this in the future work section. Lastly, the data analysis and clustering of themes were done manually by the researchers, but with more participants and larger numbers of stories, this systematic analysis can become tedious or not feasible by humans. Future research can explore how natural language processing methods and thematic clustering algorithms (e.g., Tanenbaum *et al.*, 2012) could assist researchers in extracting common patterns from stories.

5.4.2 Implications for Designing Drones and Other Technologies.

On a practical level, our findings reveal user aspirations for drone features that could be implemented in consumer-level drones. Dream drone superpowers collected across our site range from enhanced cameras and sensing (e.g., superpowers such as “*X-ray Vision*”, and “*Mind Reading*”), to new modes of human-drone communication, as well as autonomous drone behaviors, and the ability to change drone appearance. These features, which improve on existing drone capabilities and in some cases imagine features that aren’t available in consumer-level drones, present new opportunities to develop drones that better suit community needs. For example, the majority of the dream drones included new communication modalities beyond what is currently available in drone piloting software (e.g., superpowers such as “*Speaking*” and “*Mind Reading*”). Based on these ideas, as well as the many superpowers aimed at lowering technical barriers for drone use, future drone systems could leverage speech-based piloting interfaces. Moreover, future drone development might integrate cutting-edge ideas from the emerging field of Brain-Computer Interfaces (BCI) (e.g., Ramchurn *et al.*, 2019) and explore how piloting commands could be directly communicated by the pilot’s brain, as well as any potential negative consequences around such interfaces. Inspired by these superpowers, designers can also consider creating different ways for drones to “talk” back to users when doing tasks (e.g., through direct speech, as well as ambient sounds or color changes as many current drones are already equipped with LEDs).

Our findings also highlight opportunities to design drones for specific contexts. For instance, dream drones were depicted in the home (e.g., assisting with laundry), in outdoor search scenarios (e.g., helping hikers scout their surroundings), as well as in various defense situations (e.g., locating intruders). These narratives suggest new opportunities to develop context-specific drones, by, for instance, implementing additional sensing and object recognition capabilities for search drones, or alarm systems for drones in security domains. More importantly, scenarios about these contexts highlight the social, ethical, and cultural consequences of having autonomous aerial vehicles in spaces such as the home, natural habitats, or seemingly “unsafe”

urban areas. These narratives also raise questions about potential privacy and legal issues around future drones that search and map resources more precisely/autonomously. Future HCI research can continue to leverage co-design methods to reflect and speculate on the implications of drones in such domains.

The dream drone stories also revealed aspirations for technologies beyond drones as participants envisioned new personal and public service systems. Several of the dream drones were imagined as personal companions who followed users and offered “playful” and “friendly” assistance. Such stories revealed aspirations for human-like interactions with autonomous agents that inhabit indoor and outdoor spaces. Science fiction and popular culture works have been exploring different types of human relationships with AI and robotic systems for a long time (e.g., films such as *Blade Runner*, *A.I. Artificial Intelligence*, *The Terminator*, *Short Circuit*, *Ex Machina*, etc.), and our online design fiction platform further elicited this type of envisioning. While in our work, users imagined human-like qualities in drone companions—which could be implemented and supported by HCI—these types of aspirations might also reflect aspects of other personal assistant systems (e.g., Google Home, Amazon Alexa, Siri). Here, designers can continue to explore people’s desires and concerns around human relationships with autonomous agents, leveraging (crowd-based) storytelling, design fiction, and other research methods for critical reflection on the types of futures these personal and sometimes intimate connections might support.

Beyond personal companionship, some dream drones were also discussed as public service tools for safe transportation and ethical policing. While the Dream Drone platform encouraged participants to explore how these needs could be addressed by drones, our findings point to broader concerns around other contentious security and surveillance technologies. For instance, the aspirations for and concerns around policing and safe spaces are reminiscent of other surveillance technologies such as street or body cameras, IoT devices that might safely disarm or stop a vehicle (Hamid *et al.*, 2020), or even self-driving cars. The contexts and technologies that participants envisioned prompt us to reflect on what “safe and ethical policing” means to different stakeholder groups and how it can be done effectively. Crowd-based

storytelling can serve as a timely and critical approach to exploring different visions and questions around these issues. For example, how might crowd computing be used to elevate under-represented voices and concerns around policing? Could crowd-based systems be used to subvert current power structures and foreground community visions around more equitable futures? Also, what are some potential unintended negative consequences, such as, for instance, a crowd-ideation system being hacked or hijacked to spotlight a particular rhetoric around security/surveillance, and (how) can such impacts be mitigated?

HCI research can and should continue to explore these questions around representation and power in crowd computing systems. On one hand, crowd-based design futuring platforms can shift public perception and understanding of complex scenarios, elevating different voices in the discourse about privacy, security, and data control. At the same time, such systems can propagate misinformation or deep fakes in our current political climate¹². HCI can continue to explore how crowd computing can ethically foreground narratives about alternative futures and technologies that accurately reflect stakeholder aspirations and address community concerns.

5.5 Conclusion

In this chapter, I presented a crowd-based design ideation and storytelling platform that operates at the intersection of design ideation, storytelling, and online creativity support tools research. I detailed the implementation and deployment of Dream Drone, an online platform inspired by our design fiction workshop, as well as our data collection process, and insights from the dream drone superpowers and stories we collected. We reflected on our findings to discuss the benefits and drawbacks of using an online platform to gather design scenarios from distributed users, as well as future directions for crowd-based design research.

Finally, as some dream drone stories expressed aspirations around other types of technologies beyond drones, we are extending our platform to include options to collaborate on

¹² <https://ars.electronica.art/center/en/obama-deep-fake/>.

fictions about Dream Products, Dream Spaces, and Dream Services. This will enable distributed communities to imagine and reflect on new possibilities around systems that might shape our future. More broadly, we see online crowd-based concept development and storytelling as an approach for playfully inspiring stakeholders and researchers to critically reflect on possible worlds and alternative technologies. At the same time, our work also raises critical questions around power, representation, and equity in crowd-based design futuring. Working at the intersection of crowd computing, creativity support tools, and design fiction, we will continue to examine how crowd-based storytelling can equitably support communities in envisioning new systems and proactively shaping our futures.

CHAPTER 6

EXPLORING CROWD-DRIVEN STORYTELLING AND IDEATION FOR DESIGN RESEARCH- THE DREAM COLLECTIVE

Building on the research presented in the previous chapters, I now present my research that incorporates collaborative design methodologies -with design fiction aspects- and *The Dream Collective*. *The Dream Collective* is an online crowd-driven storytelling and ideation platform situated at the intersection of collaborative design and online creativity tools. Our website gives participants the opportunity to reimagine and envision new products, spaces, and services and contextualize them through short narratives. Participants have the ability to add futuristic features to their creations and build from what others have created, as well as contextualize their ideas through short narratives. The Dream Collective allows for crowd-based iteration and exploration at different points in the future (e.g., actionable design within the next year, as well as futuring 5-20 years out).

Within this chapter I first present the design and implementation of our platform, our in-person workshops that built upon the designs created in The Dream Collective, and our ongoing research with Gen-Z perspectives on food and food systems.

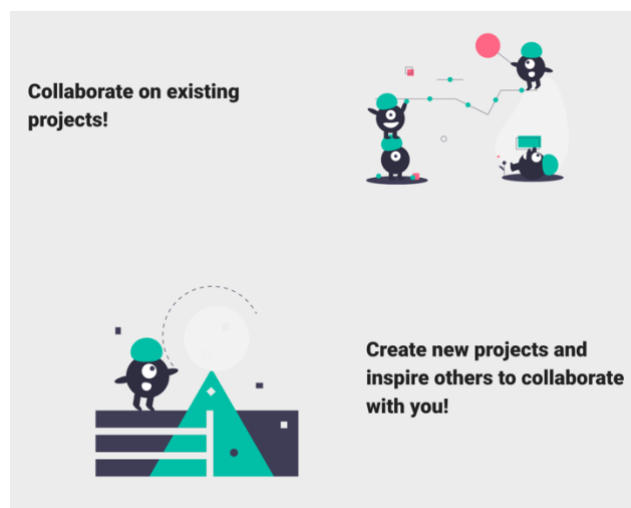


Figure 7 The Dream Collective Landing Page

6.1 The Dream Collective Online Platform

The Dream Collective was inspired by our previous work, our online platform *Dream Drone* (chapter 5). Based on the data collected we decided to create a new platform broadening our research scope that allowed participants to envision the future of products, spaces, and services. Similar to our work with *Dream Drone*, our platform was inspired by previous design fiction research where participants can create an artifact and a short story surrounding it.

Unlike past research, the *Dream Collective* allows participants to create their own Dream project on any technology, space, or service, or add to an existing one. Our platform expands on past collaborative design research, design fiction research, and creativity support tools by allowing participants to create any project beyond the scope of the researchers' focus. Each project gives participants the opportunity to ideate new *dream features* or select from those that have been created by others, “re-mixing” new designs, and contextualize their creations through a narrative or short prompt.

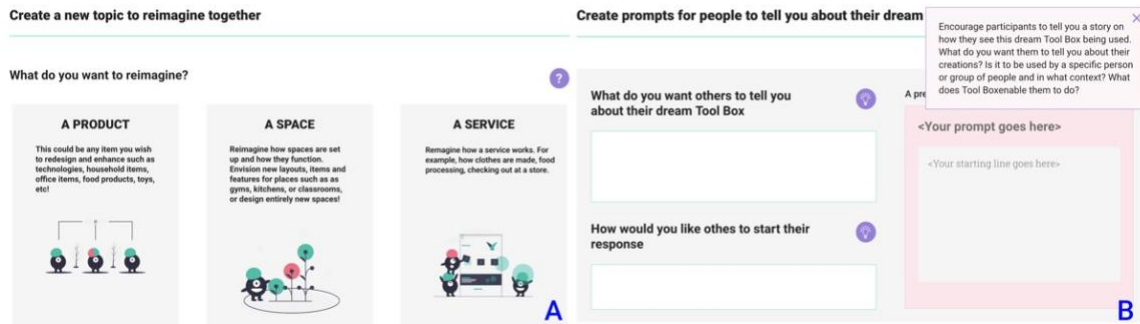


Figure 8 The Dream Collective Workflow

Creating your own Dream Project

When creating their own project, participants must select between three categories (Figure 8 A), a product, space, or service. These categories serve as starting points to help participants define a topic that they wish to have reimaged. Once a category is selected

participants are then prompted to give their project a name as well as a small description contextualizing what they are reimagining. This small description and name will be visible to all participants once the project is created. In the next section, the creator of the project must then input three *dream features* that participants will be able to choose from. These features can be an improvement on existing capabilities or new futuristic traits. We use the term dream to encourage creative ideas that are not restrained by what may or may not be currently possible. The last step of creating a project is to write a small prompt that encourages others to write a short story (Figure 8 B), projects can have multiple prompts depending on how the creator wants participants to envision and contextualize the dream project selected. Throughout the whole process, users can click on question marks and lightbulb icons for clarifying text, as well as suggestions on how to write prompts.

Collaborating on Existing Dream Projects

Users can contribute to any existing project within the *Dream Collective*. Once a project has been selected, participants are able to see all the creations that others have envisioned, alongside their dream features and short stories. This gives participants the opportunity to gather knowledge on what has been envisioned and gives them the possibility to “remix” these ideas or use them as inspiration for their own creations. When participants start their own creation, they are asked to add at least one dream feature to the project they selected, this can be a completely new feature that they create, or they can select an existing one created by others. Participants have the capability of combining different features as they can select up to 4 new dream features. Lastly, participants are then prompted to write a short story contextualizing their creation.

6.2 The Dream Collective Platform – Creating Projects with Participants

During our research we held 3 online 30-minute workshops, these workshops focused on having participants explore the Dream Collective’s workflow and understand how projects were made. Participants were then encouraged to collectively create dream features and add a story to a project of their choice. Our main goal was to give participants the opportunity to explore the

Dream Collective and voice their thought process as they created new projects or features. To recruit participants, we distributed workshop fliers to ASU's departments of design, arts, English, film, and local maker spaces within the area. In total, 12 participants took part in our workshops, 3 participants had a background in design and prototyping, 1 participant specialized in pedagogy, 6 participants worked for the Department of Innovation, and 2 participants had a background in architecture. During our walkthrough participants voiced being excited to be heard within the design process of future designs, an opportunity that they had rarely been presented with. P4" *It is a bit frustrating when these questions (what features would you want?) aren't being asked when new spaces are built, since ultimately, we are the ones that end up using them*".

Following our workshops, we made our platform publicly available by distributing it through newsletters at our university, social media, and maker spaces within our area. Over the course of 6 months, we gathered over 15 unique Dream Projects. Each project has its own subsets of creations made by other participants with a total of 40 collaborations. The stories contextualizing each dream project varied in length from 22 to 209 words, with an average of 50.73 and a standard deviation of 33.12.

6.2.1 Findings

The Dream Collective: Spaces

The majority of the projects collected on the Dream Collective were labeled as a space by the creator, with 8 projects falling under this description such as the Dream Classroom, Dream Health Space, Dream Garden, and Dream Fitness Center. These projects also had the most collaborators and dream features. Within the description of each of these projects, the creator emphasized the space being re-imagined and the experience of using it as well. For example, the Dream Dialogue space had the following description for others to see. "*Many spaces within colleges and lecture halls are structured with the idea that one person has all the knowledge within a room. Let's deconstruct that, making a space where collective thinking and collaboration is prioritized.*" This framing gave users the ability to equip this reimagined space with new

technologies (e.g., a storytelling AI), and rethink how the space was designed in general. With dream features like *rounded shapes* and *comfort food* participants envisioned a new dynamic with how the space could be used. One of the participants created the following narrative for their Dream Dialog Space: “*The dream dialog space eliminates the hierarchy dynamics within democratic discussions. The set-up of this room provides more feedback from participants making a more engaging conversation.*” This story gives us an insight into the importance of layout and power dynamics.

Another project was that of the *Dream Dinner*: “*Creating a dream dinner for 2050 that doesn’t result in continued unjust labor practices or unsustainable farming approaches*”. One of the collaborators specifically focused on the social and working dynamics that go into a Dream Dinner. “*We have a large farming class that sustainably farm instead of factory farming and are assisted by the government, so they do not fall into poverty easily if their crops do not make enough return or fail.*” This short narrative gives us an insight into social and economic dynamics that can affect how a space is created.

The Dream Collective: Products

The second biggest category was that of a product with items like a Dream Toolbox, Dream Pillow, Dream Scissors, Dream Piano, Dream Mobile Phone, and the Dream Coffee cup. The majority of the dream features envisioned by participants were focused on enhancing the current design of these products. For example, in the Dream Coffee Cup participants envisioned features such as *perfect temperature*, *nano brewers*, and *extra hot*. In the project, the Dream Pillow participants suggested features such “*as a pillow that never goes flat, always stays cool, and has an ingrained alarm clock.*” The stories surrounding technologies focused more on the immediate use and gratification of using this new object. “*The way we sleep was revolutionized when the Dream Pillow was created because it enabled people to feel more refreshed in the morning! Making human life a lot more productive.*”.

The Dream Collective: Services

One project fell under service, and it was one focused on smart parking. Our team was able to collaborate with a group of government officials and engineers to reimagine parking.

Interestingly, the dream features suggested for this project were not directly linked to parking spaces but the experience of finding a parking spot. With features like *real-time parking updates*, *traffic updates*, and a *smart kiosk* to highlight nearby businesses and events, the features complemented the activity of parking a car and not the parking spot itself. For example, “*A visitor has just been in an event and notices intense traffic flow. The services available alerts and activity suggestions lets the user know in advance where to go next instead of sitting in their car for 3 hours. Once the user is done with their activities, they are able to locate their car through the "car location alerts"*.”

6.3 The Dream Collective Prototyping Workshops

The second part of our research focused on in-person workshops with designers, makers, and world builders. Our first workshop had 6 participants, and our second workshop consisted of 7 participants. During the workshop, the researchers presented The Dream Collective website and navigated through some of the projects created. They were then given information on one of the projects from the Dream Collective, the Dream Coffee Cup. We prompted participants to think of dream features different from those that can be found on our website and, participants were then given paper and pencils to draw their Dream Coffee cup. They were asked to implement at least one dream feature made by an online collaborator and a dream feature they had previously brainstormed. Upon completion, each participant talked about their design and the uses they envisioned.

The second part of our workshop asked participants to pair up and were again given a prompt taken from the Dream Collective, the Dream Classroom. This time they were asked to create and write down features with the person they were paired with. Once they decided on what features they wanted in their Dream Classroom, participants were asked to build their classroom. They were provided with Legos and materials such as magnets to build a classroom and sticky notes to label the features. These workshops were audio recorded and transcribed by the researchers and the low fidelity prototypes were labeled and photographed.

We analyzed the data using open coding, the researchers thematically grouped the data into three major themes: technology, space, and services. We then, clustered the new attributes participants had given their creations and the short narratives participants had written. Our workshops were transcribed, and our analysis drew emergent themes from the data gathered.

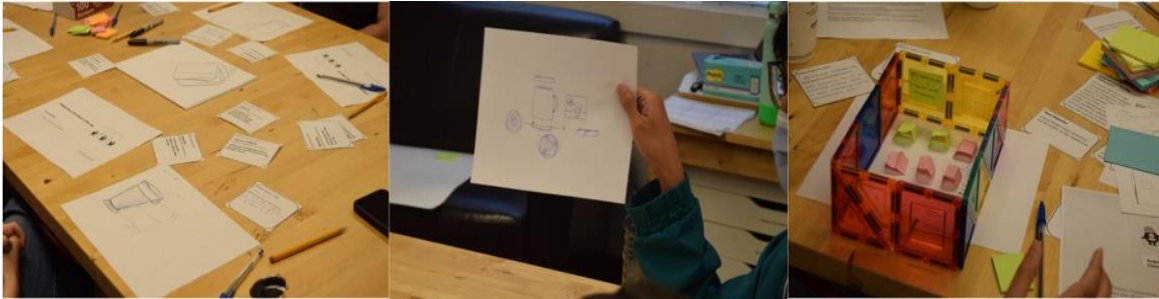


Figure 9 Low-Fidelity Prototypes from In-Person Workshops

6.3.1 Findings

Our in-person workshops focused on using the creations from the Dream Collective to inspire makers and designers to create low-fidelity prototypes. As mentioned above, we focused on two specific projects the *Dream Coffee Cup* and the *Dream Classroom*.

The Dream Coffee Cup.

During our workshop participants focused on one specific question when it came to making a low-fidelity prototype of the Dream Coffee Cup which was, *what is its purpose?* This question was not given to the participants by the researchers but a common theme that was reflected in each creation. Participants were encouraged to ask themselves what made a coffee cup unique, the social dynamics that surround drinking out of a coffee cup, and its overall use. This question of *what is its purpose?* was answered by the designers and makers in three different ways. The first was the physical design of the cup, as they all emphasized the importance of holding liquid successfully. This led to dream features such as a *wide rim*, *shatter resistant*, or *safe to consume* to name a few. (Figure 9) The second approach that the participants took was focusing on the consuming aspect itself. They envisioned a cup that had features such as the *right ingredients*, the *perfect size of a “sip”*, and the overall convenience of

using the cup itself. P1 "*I thought about the weight of the coffee. So, like adding a feature that could measure how much coffee actually goes into your mouth.*".

Lastly, participants focused on coffee as an experience. Within the discussion themes such as *connecting people, warmth of the cup itself, and eating and drinking* shaped the designs that participants envisioned. P3 "*I made a cup for long-distance relationships that could connect people. So, for example, when you touch the handle of the cup the other person can feel the haptic feedback. Or their body heat from the other person will warm up the coffee cup. I was also thinking about having the coffee cup change the color of the drink based on the material of the cup.*"

The Dream Classroom.

The low-fidelity creations of the Dream Classroom had two key themes. Enhancing the environment of the classroom with technologies and, changing the space of the classroom itself and how we experience it ("*What do we consider a classroom?*"). Enhancing the classroom focused on dream features such as *soundproof walls, AR/VR capabilities, holographic technologies, adjustable light, and movable furniture* to name a few. Participants highlighted the importance of being able to learn with the space with the help of technology. An example of this was "*In math, we shouldn't be learning about 3D objects in a 2D space, we could use holograms for students to better understand these concepts in 3D*". Participants also mentioned the importance of having fun while learning, emphasizing that having soundproof walls and being able to move around the classroom would make for a more fun and dynamic classroom.

The second theme focused on how students experience a classroom in general. The discussion of power dynamics and the solitary nature of classrooms was a common theme that participants aspired to change. P4 "*Back in elementary school we would have these walls that you could pull out that could split the room in half, so now you had two separate rooms. So you would have walls on a rail that would go from the floor to the ceiling that would allow for a variety of shapes. Especially making the classroom into a circle. It would have to be the size of a gym in order for there to be enough space to divide the classroom in a variety of ways. It would take away the solitary nature of schools.*" Participants also emphasized the importance of having

students engage with each other and making classrooms accessible to everyone. P5 *"I feel like sometimes it's good to learn in unconventional settings, especially for creative students. Also having natural light adds to a more comfortable setting. We cultivated a classroom with nice acoustics for music majors. We focused on them because they are usually put in auditorium-like settings that can be very enclosed and cut off from the world, who practice for hours on end and it can be very draining."* These designs highlighted the importance of making students feel comfortable and inspired to learn.

Throughout our workshop participants were asked to reflect on the design process enabled by the Dream Collective. We asked them to evaluate the importance of gathering data from crowd-driven storytelling, synthesizing that data, and providing it to makers and designers as a foundation for community needs and aspirations. P4 *"These prompts really served as building blocks which was nice. It gave us direction, but they were also open enough that you didn't feel constrained into creating something that someone else might have envisioned but instead felt inspired by it."* Participants were also able to take our approach into other areas that went beyond the workshop activities. P3 *"I think the road system here could also benefit from this design process. Because when we start thinking about the amount of labor and funds that goes into the road system it could really be better. From clarity of signaling, and how the budget from our taxes is put into the design and layout of the roads. The driver's input should also have a say in this. making information more accessible so people want to be informed and get informed because it is really easy to hide bad decisions behind bad design. Information design might have to be reimagined."* Participants highlighted the importance of having a critical conversation within the design process in aspects beyond the Dream Collective. Accessibility, transparency, and user needs were noted as potential areas that can be explored through a crowd-driven storytelling design process.

6.4 Discussion and Implications

Within our research, we set out to explore what designers can learn from online crowd-driven storytelling and ideation. We created an online platform that gives participants the opportunity to explore a product, space, or service they wish to reimagine. Users can then add to projects and collaboratively create dream features that enhance their creations. Our online platform enables users from different backgrounds to contribute to any project, making it an interdisciplinary collaborative process. Users were able to deconstruct and analyze spaces and voice their desires through the narratives they created. From these narratives, designers, and makers created low-fidelity prototypes and reflected on the creative details they chose to implement.

Storytelling is a critical feature of our design process as it provides users the opportunity to explain their design without relying on specific knowledge of how something is made or functions. Our process also revealed that storytelling is an important facet of the final design itself. Our data shows that users desire dynamic elements in a design—not just the product but the experience—or story—that surrounds it.

While crowd-based ideation allows for broader feedback, one drawback of this method is it provides researchers less control over the data. We were also unable to ensure that participants on The Dream Collective platform engaged in critical reflection on their creations and uses. Another factor that we must consider is the use of language. We actively focused on using terms such as “dream” when encouraging users to envision new products, spaces, or services. Our choice of words was focused on inspiring participants to think beyond current capabilities and portray their desires and needs. However, the use of dystopian language can also be an effective way to inspire participants and gather data and narratives that may communicate different social, political, and economic dynamics within our society.

The Dream Collective workshops gave participants and researchers the opportunity to critically reflect on the present and future of the collaborative design process, supported by our crowd-driven inputs. The narratives and reflections portrayed within the Dream Collective platform

were critically discussed within the workshop. Designers explored themes such as power dynamics, social safety, and accessibility when thinking about how they were designing, the experience surrounding a design, and the user. Our methodology provides a broader perspective on the field of collaborative design, connecting researchers and designers with diverse, interdisciplinary voices, and enriching the design process.

CHAPTER 7

THE FUTURE OF FOOD: DESIGN, TECHNOLOGY, AND CONSUMER INTERESTS IN COLLABORATION WITH ASU STARBUCKS

In chapters 5 and 6, I presented the creation and deployment of two online collaborative design ideation platforms that allow stakeholders to envision futuristic systems and inform design at scale. I also presented workshops with designers and worldbuilders whereby participants reflected on the data collected from the *Dream Collective* and used those inputs to inform their own designs.

I now present a specific project focused on exploring collaborative design methodologies and ideation through storytelling in in-person settings and through the *Dream Collective*.

7.1 Background

In collaboration with the ASU-Starbucks Center for the Future of the People and the Planet, and researchers from the College of Health Solutions, the School for the Future of Innovation in Society, and the School of Arts, Media and Engineering we set out to explore the current and future interests of Gen-Z consumers as it relates to food and beverage choices, product design, attributes, and flavors. We focused on Gen-Z as our stakeholder group because past research from our collaborators underlined a growing desire within Gen-Z to have experiences that are mindful of a more sustainable future, incorporate digital engagement, and speak to their emotional, and physical needs. As such, we set out to explore and co-design future-oriented scenarios, and low-fidelity prototypes with Gen-Z participants to further explore and situate consumers' interests, concerns, and desires related to food choices now and in the future (Figure10). Our research began with a co-design ideation session with participants interested in sustainability, food production, and food design focusing on what the café experience would look like 35 years from now, titled Café 2057. We then situated the themes that

emerged from Café 2057 as they relate to Gen-Z in an in-person ideation session. Building upon our ideation session two projects were then created within the *Dream Collective*: The Dream Café Order, and The Dream Café. These projects were first seeded through an in-person workshop with Gen-Z whereby participants were able to re-mix, envision, and create their own Dream Café Order, and Dream Café. These projects were then further distributed to the broader Gen-Z population to gather insights from participants at scale. Based on our in-person data collection, and the online data collected I then conducted interviews with professional coffee makers and baristas. The goal of these interviews was to further explore how large-scale ideation and co-design can be used to inform future actionable design. During these interviews, the professional coffee makers and baristas used the envisioned dream features created by Gen-Z as starting points to create future features within a Dream Café. Finally, I conducted a final set of workshops with Gen-Z participants to ideate and develop a low-fidelity prototype of the Dream Café. Participants used the dream features that emerged and developed throughout our research as inspiration or starting points to co-design their prototypes. Through our collaborative design methodologies and ideation through storytelling in in-person settings, and supported by the *Dream Collective*, Gen-Z participants were able to engage in critical discussion on their interests, concerns, and desires related to food choices now and in the future.

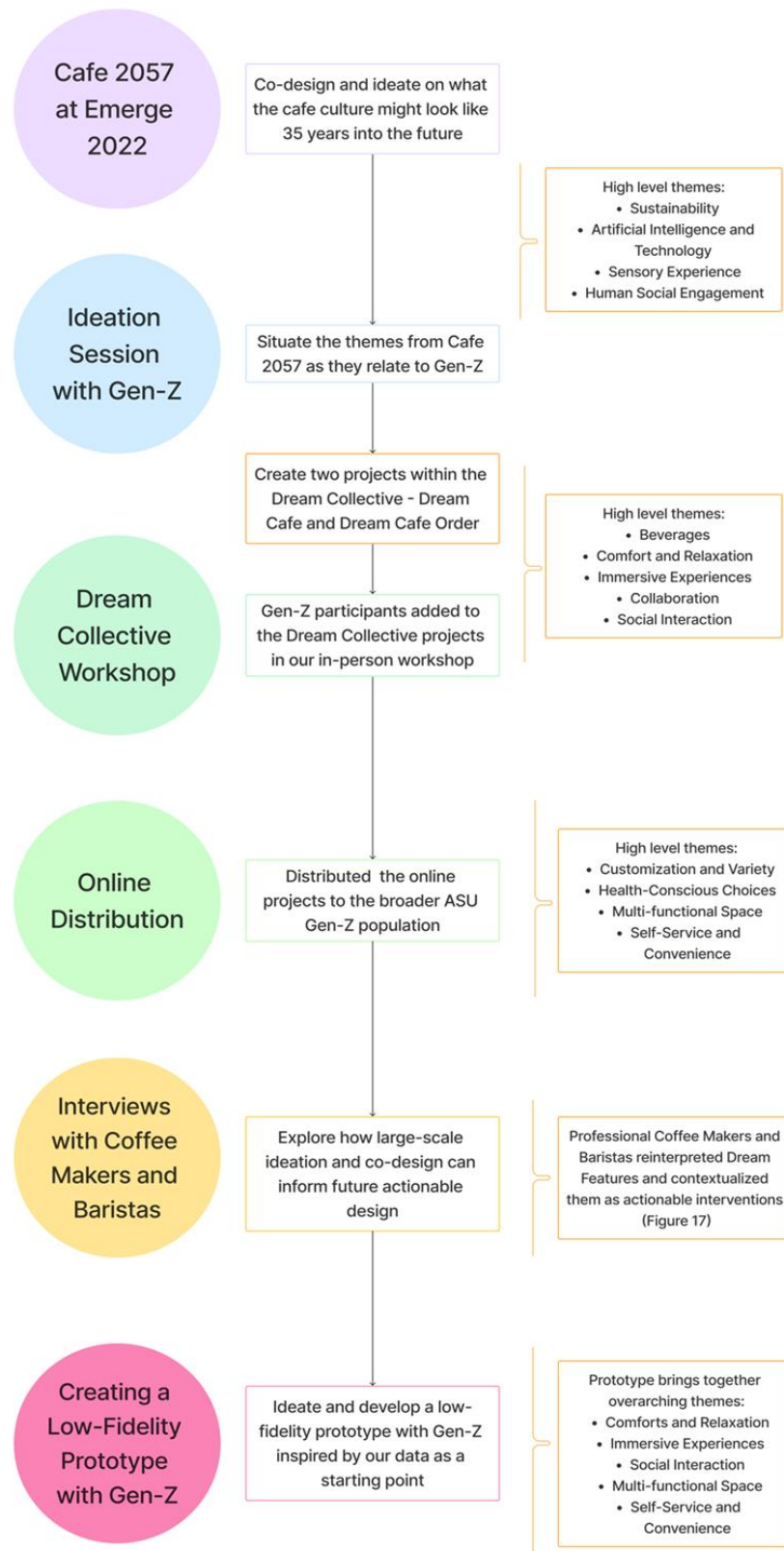


Figure 10 Methods used within the Future of Food project

7.2 Café 2057 at Emerge 2022

We first hosted a workshop at Emerge 2022: Eating at the Edges - A Festival of Food Futures hosted by the School for the Future of Innovation in Society at ASU. The festival invited participants to explore the future of food through talks, screenings, and workshops:

“Emerge explores the future in evocative ways. This festival offers imaginative and hands-on experiences of the future—exposing the latest inventions from ASU and beyond, and asking how we might shape and adapt them in surprising ways. Together, we will think and taste our way through asking what alternative forms of food production, distribution and consumption we should consider to build a more inclusive, equitable and delicious culinary world.”¹³

As such, we saw Emerge as an opportunity to co-design and ideate with participants with a diverse background on food, food production, and sustainability on what the café culture might look like 35 years from now. Thus, we created Café 2057¹⁴, a workshop where participants were able to create experiential future scenarios on what the future café experience would look like.

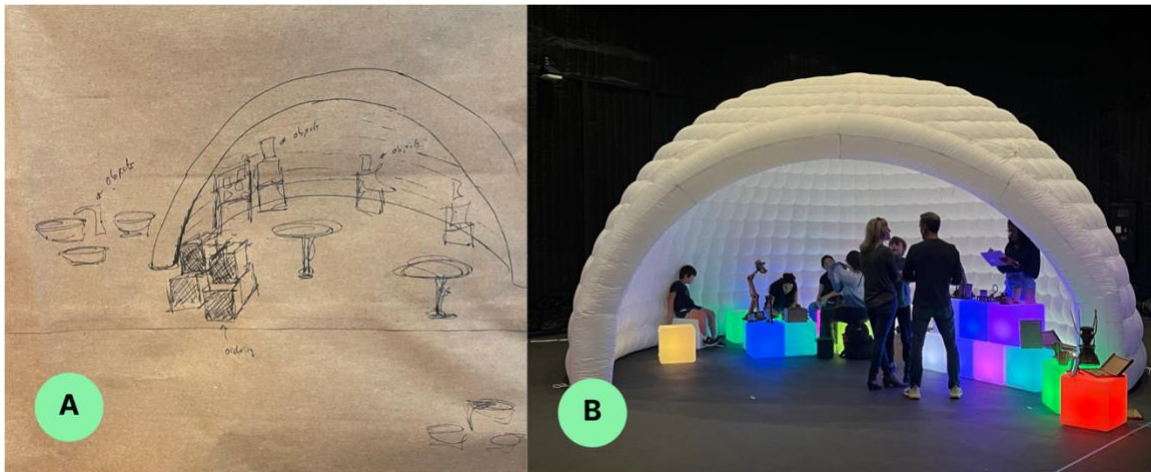


Figure 11 Cafe 2057

11 (A) shows the initial sketch of how the space would be set of for Café 2057 within the Black Box. 11 (B) shows the resulting layout of Café 2057.

¹³ <https://emerge.asu.edu/about/>

¹⁴ <https://emerge.asu.edu/2022/emerge/cafe-2057/>

7.2.1 Café 2057- Workflow

We hosted the workshop in a “black box¹⁵” (Figure 11), as it gave us the freedom to fully customize the experience participants would have upon walking into the space (in comparison to a traditional classroom or a conference room). We also partnered with two designers to create low-fidelity artifacts used to inspire participants on what future technologies might look like in a café 35 years from now (Figure 12). As mentioned in Chapters 5 and 6, when ideating and envisioning with participants we encouraged participants to co-design future spaces, technologies, and experiences without being restricted by what is feasible or their own technological knowledge. The design of the workshop space as well as the low-fidelity prototypes, were built on this notion to inspire participants and fully immerse them in a café of the future.



Figure 12 Low-fidelity artifacts used in Café 2057

Within our workshop, participants had the opportunity to envision, discuss, and critically reflect on three aspects of Café 2057: the menu, ordering process, and overall café experience. Each station had a researcher who served as a mediator providing prompts to participants, encouraging discussions, as well as clarifying questions. The prompts given to participants consisted of short introductions to each station.

¹⁵ <https://www.wisageek.com/what-is-a-black-box-theater.htm>

Menu: *We are 35 years into the future, what do you think might happen to your favorite foods and/or ingredients? What would you order?*

Ordering Process: *How would your order be taken 35 years into the future? What technologies might be involved?*

Café Experience: *What do you think the café of 2057 would look like? Who would you go with? What experience would it provide?*

Over the course of 4 hours, 70 participants took part in our workshop. Each station held ideation sessions that lasted between 10 and 15 minutes, with groups of 4 to 7 participants at a time. It is important to note that because of the open nature of the space, some participants did not take part in all three activities. It is also important to highlight that since our workshop was part of a food festival focused on alternative forms of food production, distribution, equity, and sustainability, there is a self-selection bias in our study. Because of the nature of the event, participants from all demographic backgrounds were encouraged to take part in our workshop therefore the data collected was not exclusively from Gen-Z participants. Data from the workshop was audio recorded as well as written down by the researchers.

7.2.2 Café 2057- Findings

The data from the workshop was thematically clustered and analyzed in Excel and Atlas.ti by our collaborators from the School for the Future of Innovation in Society.

Café 2057 – Menu

Within the menu category, the high-level themes that emerged were sustainability, nutritional facts, sensory experience, human-social engagement, and artificial intelligence. Participants emphasized minimizing waste when designing a menu, as well as developing technologies, and regulations that support the use of recycled materials. Moreover, a desire to use Artificial Intelligence to inform participants on the nutritional aspects of food was also envisioned by participants. These speculative futures created questions about how AI might affect

human interaction in the making of food 35 years from now. For example, with the rise in the use of AI, some participants speculated on how high-end restaurants could offer human-social engagement as a luxury service.

Café 2057 – Ordering Process

When ideating on the future ordering experience, the majority of participants focused on futuristic food delivery technologies (e.g., such as drones) making for a “stress-free” experience. Participants specifically highlighted the use of Artificial Intelligence to further automate the ordering and delivery system. This automation raised questions, and reflections on what the future human-social engagement would look like within a food experience in general and was further explored by participants in the last step.

Café 2057- Café Experience

Unlike in the two previous stations, in the *Café Experience* participants were asked to further describe the *Menu* and *Order* they had envisioned as well as actively voicing their concerns, dislikes, and desires. The majority of participants voiced a need and concern for what the human-social engagement would look like. Participants acknowledged the rise in technological systems within the food experience however, they also voiced a desire for meaningful social engagement. For example, some participants envisioned being part of the food preparation process alongside professionals with the aid of technology. Alongside human-social engagement, another theme that emerged was that of “sensory experience”. Here participants highlighted the reasons behind going to a café (e.g., relax, meet up with friends, wanting to go somewhere cozy), and how this could be further emphasized in the future. For example, some participants envisioned future food experiences as a means to trigger nostalgia, and happiness or boost your mood.

This section outlined our workshop within Emerge 2022 whereby participants envisioned on the future menu, ordering process, and general experience of Café 2057. I detailed how participants were prompted to ideate through speculative scenarios, as well as taking inspiration from the space and artifacts around them. Over the course of 4 hours, we had 70 participants take part in our workshop. High-level themes such as sustainability, artificial intelligence, sensory

experience, and human-social engagement emerged throughout the three stages of our workshop.

7.3 Ideation Session with Gen-Z

After our first workshop at Emerge 2022, we then held an ideation session with a Gen-Z focus group. Our goal was to further situate the themes from *Café 2057* as they relate to Gen-Z consumers and their interests in the future of food. These themes would later serve as starting points to create projects for online data collection within the *Dream Collective*.

Our workshop with Gen-Z followed our collaborative design workflow inspired by design fiction, 1) prompt participants with a scenario focused on a *Dream Café Order*, and 2) give participants the opportunity to add *dream features/superpowers* to their creations. We, the researchers, collaboratively ideated on scenarios that would further prompt Gen-Z participants to ideate on a product that fulfilled their emotional needs. Thus, four prompts were created (Figure 13). The design of the prompts enabled participants to playfully envision on each scenario as a *Café- to go Order*.



Figure 13 Prompts used in Ideation Session with Gen-Z

After participants received a scenario, they were then given a couple of minutes to browse and choose up to 4 superpowers or create their own (Figure 13). These superpowers were created by the researchers based on the high-level themes that had previously emerged in *Café 2057*. Superpowers included *Mood Booster*, *Energy*, *Soothe*, *Global Adventure*, *Nostalgia*, *Friendship Booster*, *Cozy*, and *Mood Lighting* to name a few. Participants were then asked to state the superpowers they selected and why.

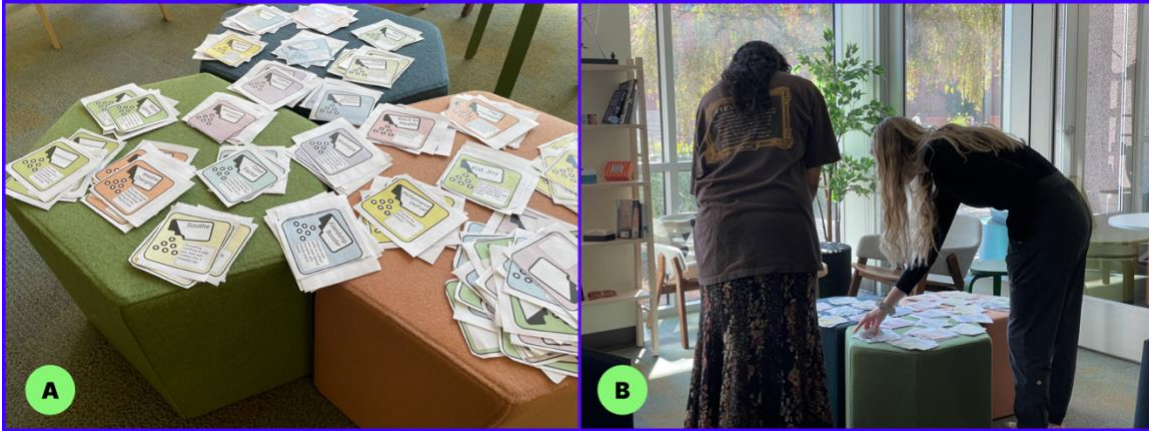


Figure 14 Superpowers Used with the Gen-Z Focus Group

7.3.1 Ideation Session with Gen-Z – Findings

Participants were prompted with four different scenarios to speculate on and envision their own *Dream Café Order* (Figure 13). They were able to further enhance their order with up to 4 *superpowers*. Each scenario depicted the participant in different settings:

1. Feeling optimistic about their day.
2. Looking forward to meeting up with a friend.
3. Enhancing a previous Café Order
4. Getting some challenging news

Interestingly, although each scenario depicted different emotions both participants chose similar superpowers to enhance their café order throughout the workshop. *Energy* and *Mood Booster* were used by both participants in each scenario. When given the scenario to meet up with a friend participant 1 stated the following. P1 “*I chose mood booster and the reason for this is that I want something that's going to help me engage in meaningful conversation with my friends.*” When given the prompt of receiving challenging news participant 2, also chose *Mood Booster* to enhance their order. P2 “*I chose mood booster. Because I want something that's calming, that makes me feel happier, or at least a little bit less stressed out. So maybe it won't, like make my mood a whole lot better. But at least it'll be a way for me to kind of deal with it.*” Surprisingly to us, participants were inclined to make their *Dream Café Order* enhance their emotions and

provide a relaxing experience, no matter the scenario given. Both participants also chose *Mood Lighting* in 3 out of 4 scenarios. Interestingly, this superpower was the only one provided to participants that changed the Café space itself and not their order.

P1 “*And then I chose mood lighting. When I'm like getting coffee with my friends, I really feel that the ambiance is like a big thing for me, and like my surroundings. So yeah, I want to make sure it's like a calm area. So I can engage in a conversation.*”

7.4 Dream Collective Workshop at AME Showcase

Based on our initial workshop of *Café 2057* and the ideation session with Gen-Z we then created two Dream Collective projects, 1) the *Dream Café Order* and 2) the *Dream Café*. Each project was seeded with 21 *dream features*. The features created built upon our ideation session with Gen-Z, focusing on participants' emotions, and enhancing them. For example, in addition to the superpowers mentioned above, we also added *Reassurance, Coping, Cool Factor, Self-reflection, Acceptance, and Back to Health*.

As mentioned in Chapter 6, the *Dream Collective* allows for any participant to collaborate, re-mix, add to existing projects, and even create their own. However, as mentioned at the beginning of this chapter, the goal of our project is to explore the current and future interests of Gen-Z consumers as they relate to food and beverage choices. To ensure our online participants were from the Gen-Z demographic, we thus conducted an unstructured workshop at the School of Arts, Media, and Engineering. During this workshop, participants had the opportunity to contribute to both the existing *Dream Café* and the *Dream Café Order* (Figure 15).

Within their creations, the majority of participants chose *dream features* such as *Human Intelligence DJ*, *Energy*, *Perfect Temperature*, and *Global Adventure*. The *Human Intelligence DJ* specifically focuses on enhancing a space based on an individual's musical preferences. This feature echoed the importance of the "mood" and "ambiance" that was brought up with our Gen-Z focus group. Interestingly, features such as *Energy* and *Perfect Temperature* had also previously been selected in our initial workshop with the Gen-Z focus group to describe their *Dream Café Order*. However, participants within our workshop at the AME showcase, also chose those attributes within a *Café* space, broadening the applications these dream features could have.

Because of the nature of our workshop participants were able to communicate with each other while envisioning their own *Dream Café* or *Dream Café Order*. As explored in Chapter 6, we had not actively given participants the opportunity to do so when contributing to the Dream Collective. As such, the stories created within our workshop at AME had a thematic overlap, as well as projects being created under the incorrect main category. It is unclear to the researchers if participants were confused with the interface of the *Dream Collective*, or if they wanted to envision and ideate alongside their friends and disregarded the initial prompt. The stories were analyzed and categorized into 4 themes: *Beverages*, *Comfort and Relaxation*, *Immersive Experiences*, *Collaboration*, and *Social Interaction*.

A total of 14 stories created fell under the category of comfort and relaxation. These stories mentioned the desire for a comfortable, relaxing space to unwind, with features like cubby spaces, yoga mats, and calming music. *I would want it to have little cubby spaces or bug booths so you can relax and focus on work.*

Closely tied to comfort and relaxation, participants also envisioned a space with immersive experiences. These stories described cafes that gave participants opportunities beyond just drinking coffee, such as DJ sets, interactive exhibits, and petting animals. *There would be a stage where the DJ set would be playing and have a wide open area for people to dance and hang out. In the back and the sides would have tables set up for the people to chill and work and talk.*

Participants also envisioned stories that highlighted collaboration and social interaction. Depicting a café as a space to meet new people, collaborate on projects, and enjoy social interaction. The *Dream Café's* under this category were also envisioned as a space to support local artists, with artwork for sale and space to display their work. *I would allow a lo-fi DJ to be playing live while guests could order coffee, tea, kava specialty drinks, and more, while also being able to come here to meet new people, enjoy local art that could be featured in the space, and study/complete work.*

Lastly, the stories depicted under *Beverages* explored a variety of drinks, including coffee, hot chocolate, smoothies, and Italian sodas. The descriptions often emphasize the taste (e.g., cherry flavored) and the level of caffeine. Some stories also included unique or unexpected elements of the drink. *This Special Juice is A murky green liquid with a goo-like viscosity. Clumps pool at the bottom of your cup, with a taste that surprises and excites!*

In this section, I presented our 2-hour in-person workshop with Gen-Z participants focused on populating the *Dream Collective* projects. During our workshop, 33 unique dream features were added, and 15 *Dream Café* and 19 *Dream Café Orders* were created. Over the next three months, we further distributed our online projects to Gen-Z participants within the ASU community.

7.5 The Dream Collective- Online Distribution

After our workshop with Gen-Z participants at the AME showcase, we were able to fully distribute our online projects to the broader ASU Gen-Z population. Over the course of 3 months, participants re-mixed, built upon, and envisioned their own *Dream Café* and *Dream Café Order*. We collected a total of 16 *Dream Café Orders*, and 13 *Dream Café's*. It is worth noting that participants were prompted to contribute to any project of their choosing and were not given a limit on how many stories they could create. A total of 38 *dream features* were re-mixed and envisioned throughout our summer data collection.

7.5.1 Online Distribution- Findings

Dream Features

Unlike our previous data collection with our in-person Gen-Z participants, our online participants chose *dream features* that envisioned changing the cost of a café order and a café experience (Figure 17). For example, the dream features titled *No Additional Cost*, *Affordable*, and *Auto Refills* were selected in 19 of the stories created. Participants also emphasized features that gave the user health benefits. Features such as *0 Calories*, *Caffeine Regulator*, *Health Boost*, and *Healthy Coffee Co* were selected in 15 dream stories.



Figure 17 Dream Features Created by Online Participants

Dream Café Orders

The Dream Café Orders created by our summer online participants fell under two major categories, *Customization and Variety* and, *Health-Conscious Choices*. The stories depicted under Customization and Variety expressed a desire for drinks that were aligned with their specific preferences, moods, and health needs, and fully customizable. This meant being able to choose flavors, adjust ingredients, or have drinks specifically tailored to their liking. *This is the perfect drink that has no errors and enriches your day and life. With a caffeine regulator it gives*

you just the amount of caffeine needed. It also changes flavor based on how your tastebuds respond. Some stories included help from AI to further create the perfect drink: I would have ordered a drink that fits my mood on that day. The AI mind reader would be able make me what I want. Participants also highlighted the importance of being able to make customizable drinks with no additional cost. The cup auto refills: I can drink my favorite drinks many times, so I feel happy and gained. no additional cost: I can make my original drinks, so I feel that I want to try many kinds of drinks. affordable: I rarely go to cafes because sometimes I feel that drinks are a little bit expensive, so I wish drinks would become more reasonable.

The stories categorized under *Health-Conscious Choices* highlighted the importance of health aspects when ordering a drink. This included stories focused on low-calorie options, superfoods, and having access to healthy options when creating their café order. *With this café order when you feel tired or like something is wrong, you can make an order and since it is connected to your health information and AI searched it, it would recommend you a menu that matches your health and condition.*

Dream Café

The stories envisioned within the *Dream Café* were thematically clustered into two categories, the first was *Multifunctional Space*, and the second being *Self-Service and Convenience*. The stories depicted within *Multifunctional Space* depicted a café where visitors could engage in different activities such as doing homework, relaxing, petting animals, and connecting with friends. *I think that there would be a lot of comfortable seating, neutral decorations, and nice, warm lighting to make it cozy. There would be a separate room for those who enjoy animals (so as not to bother those with allergies or who do not want them) and every place possible would have electrical outlets so that as many people who want to can work freely.*

The stories categorized under *Self-Service and Convenience* focused on self-serving machines, and digital stations that allow for users to design their own food, as well as enhancing the efficiency of the ordering process. The make-it-yourself station highlighted being able to make your drink yourself and personalizing it for your own preferences. *I imagine a techno station to be*

like designing food on a digital space and it would be created and catered to your individual wants and needs.

In this section, I presented the online distribution and data analysis of our *Dream Collective* projects to the broader Gen-Z population at ASU. Our data revealed needs and aspirations concerning the future *Café Order* and *Café* space. The dream features generated by participants underscored the significance of improving and fostering an emotional, healthy, and interactive experience.

7.6 Interviews with Coffee Makers and Baristas

Throughout our research, we successfully held three in-person workshops that enabled participants to envision on the future café order and café experience through collaborative ideation and storytelling. These workshops served as a starting point to seed and then deploy our online projects to the greater Gen-Z community. Once we collected this rich amount of data, I then conducted one-on-one interviews with professional coffee makers and baristas. The goal of these interviews was to further explore how large-scale ideation and co-design can be used to inform future actionable design. I thus reached out to coffee shops located in Tempe, Arizona to gather participants.

7.6.1 Interview Questions

The interviews had two separate components. The first entailed having each participant go through the *Dream Café Order* and select one or two creations that stood out to them before the interview. The interview itself consisted of four sections. 1) A brief overview of our research goals: envisioning and co-creating the future café order with Gen-Z, regardless of their background or technical knowledge. 2) Ask interviewees to describe their background. 3) Prompt participants to talk about the features they selected and why they picked them. And 4) ask them

their opinion on the overall concept of the Dream Collective as a way to inform the creation of new food items.

7.6.2 Interview Findings

I conducted 5 interviews with professional coffee makers and baristas. 4 participants identified as male, and 1 participant identified as female. All participants were between the ages of 25-35. Two participants had 4 years of professional experience, and three participants had 2 years of professional experience. Two of the participants reported working in a local coffee shop, and three participants reported working for major chain coffee shops. Interviews were audio recorded and transcribed, and major themes were selected through thematic clustering.

Within the interview participants specifically selected dream features and were asked to reinterpret them. Although participants were not asked to make the dream features feasible, all interviewees interpreted them in a way that they could further explore (Figure 18).

Original Dream Feature	Professional Coffee Maker Reinterpretation
Any Size- No limited sizes for drinks, such as small, tall.	Explore a drink's details like texture and taste to the fullest, without being limited by size. The contents and the barista determine the drink, size not the consumer.
Health Boost- Flavorful drinks with natural ingredients and a choice to add a supplement.	Train baristas with dietary knowledge that will then be communicated to consumers.
Tasting Corner- You can drink and taste before buying every drink you want.	Customers rarely feel inclined to try something new, but they could ask the barista for inputs and create a personalized drink.
Caffeine Regulator- Perfect amount of caffeine that you actually need.	Caffeine regulation is a big concern- it would be nice to not rely on "guesstimation".
Cup Auto Refills- Once you buy a drink for a day, you get the same drink automatically refilled for 24 hours.	Auto-refill can be environmentally friendly- give an incentive to purchase on cup per day and reuse. Refill based on the cup, not the drink.

Figure 18 Table Depicting Barista Reinterpretations of Dream Features

Participants were also asked to reflect on our collaborative ideation method and crowd-generated inputs to inform future food designs. P1 and P2 suggested using the crowd-generated inputs as future guidelines to inform future orders and create new experiences.

P1 *“The crowd-generated inputs can be used as a guide- that can direct the coffee maker. Customers are looking for an experience that will last (sometimes insatiable - which keeps them coming back).”*

P2 *“Consumers want new things- and for those with a daily order who might not want a big change - these new features could compliment their order- make it better.”*

Interviewees saw the benefit of giving consumers a voice where they can express their needs, and desires without technical limitations. *“A lot of customers know what they want, and if not it is only because they lack knowledge.”* P4

Participants also mentioned the limitations of implementing changes due to regulations. *“I can’t really go outside of the coffee store guidelines; I would love to have more creative freedom when working”* P3. Interestingly, Participant 5 voiced a concern of giving consumers an open platform to ideate on with no limitations. They stated, *“Some stories seem to fall under quite niche categories and might need to be conscious of the vocal minority.”* P5. Although our data collection and website distribution went to specific members of our community, participant 5 voiced an important design implication when utilizing crowd-based data collection and the risks of creating an echo chamber¹⁶. More discussion on this topic will be provided in the design implication section of this chapter.

7.7 Creating a Low-Fidelity Prototype with Gen-Z

Based on the interviews with participants, and the data collected throughout my research I then held a final set of workshops with Gen-Z participants to ideate and develop a low-fidelity prototype. During these workshops, participants were given an overview of our research

¹⁶ <https://edu.gcfglobal.org/en/digital-media-literacy/what-is-an-echo-chamber/1/>

methodology and a prompt to envision the future dream café. We provided participants with the dream features from Figure 18. This gave participants an opportunity to build upon futuristic ideas or choose to select the interpretation by baristas. Participants were paired up and asked to sketch or create a story that showed what their *Dream Café* looked like. Once completed, participants then presented their designs to the rest of the group and provided clarifying questions on their designs.

7.7.1 Low Fidelity Prototypes

Our low-fidelity ideation sessions consisted of 2 workshops. The first workshop was with 3 participants, and the second had 5 participants. 4 participants identified as male, and 4 participants identified as female. 4 participants reported being 18 years old, and 4 participants reported being 19 years old at the time of the workshops. All the participants were undergraduate students at ASU focusing on civil engineering, chemical engineering, computer science, family and human development, design, and biomedical science.

Both groups presented desires to automate and involve technology in their Dream Café. Group 1 created a scenario where participants would be able to order from a full digital kiosk in store (Figure 19). The kiosk would allow customers to fully customize an order without interacting with someone. It would also display the current top 5 drinks of the week.

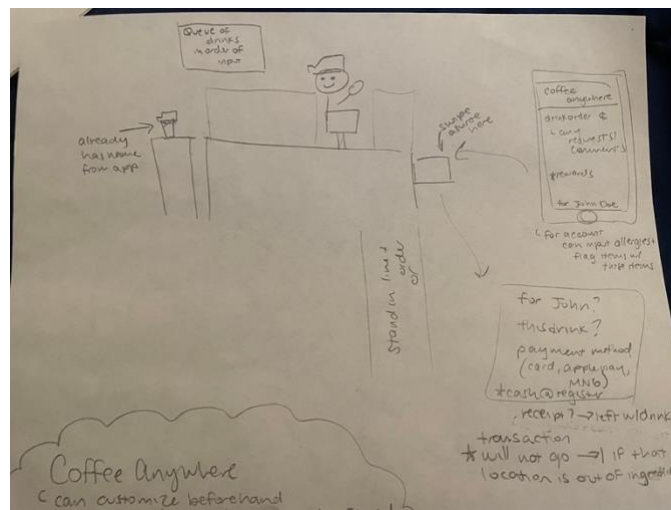


Figure 19 Low fidelity prototype of a dream café

Group 2 also presented an automated scenario; however, they envisioned it as a Make it Yourself station where customers can make their own drinks (Figure 20). “And if you don’t like what you made, that’s on you” P2. This station would also allow participants to see every ingredient that goes into their drink, providing full transparency in what a consumer would be ingesting.



Figure 20 Self-Serve Station

Interestingly, this design echoed the design concepts presented under the themes of Self-Service and Convenience that emerged from our online data collection. As mentioned in the previous section, these participants did not have full access to the Dream Collective projects and only built upon the 5 dream features we provided them with as well as their own desires, needs, and expectations.

The two groups also voiced a desire to have a more personal experience with Baristas. They envisioned a place where one could have a one-on-one experience that would result in a fully personalized drink based on your preferences. Participants voiced a desire to have baristas who are “*really passionate about coffee*” P3 and were willing to pay a higher cost for this experience. The setting for this coffee experience would take place in a lounge, where you can relax, do homework, and hang out with friends. This experience was similar to the stories labeled

under the *Multifunctional Space* within *The Dream Collective*, as well as the attributes chosen by participants in our first workshop with Gen-Z.

Based on the low-fidelity prototypes created in collaboration with Gen-Z, and the data gathered from all our collaborative ideation methodologies, and the *Dream Collective*, I created the following *Dream Café* prototype (Figure 21).

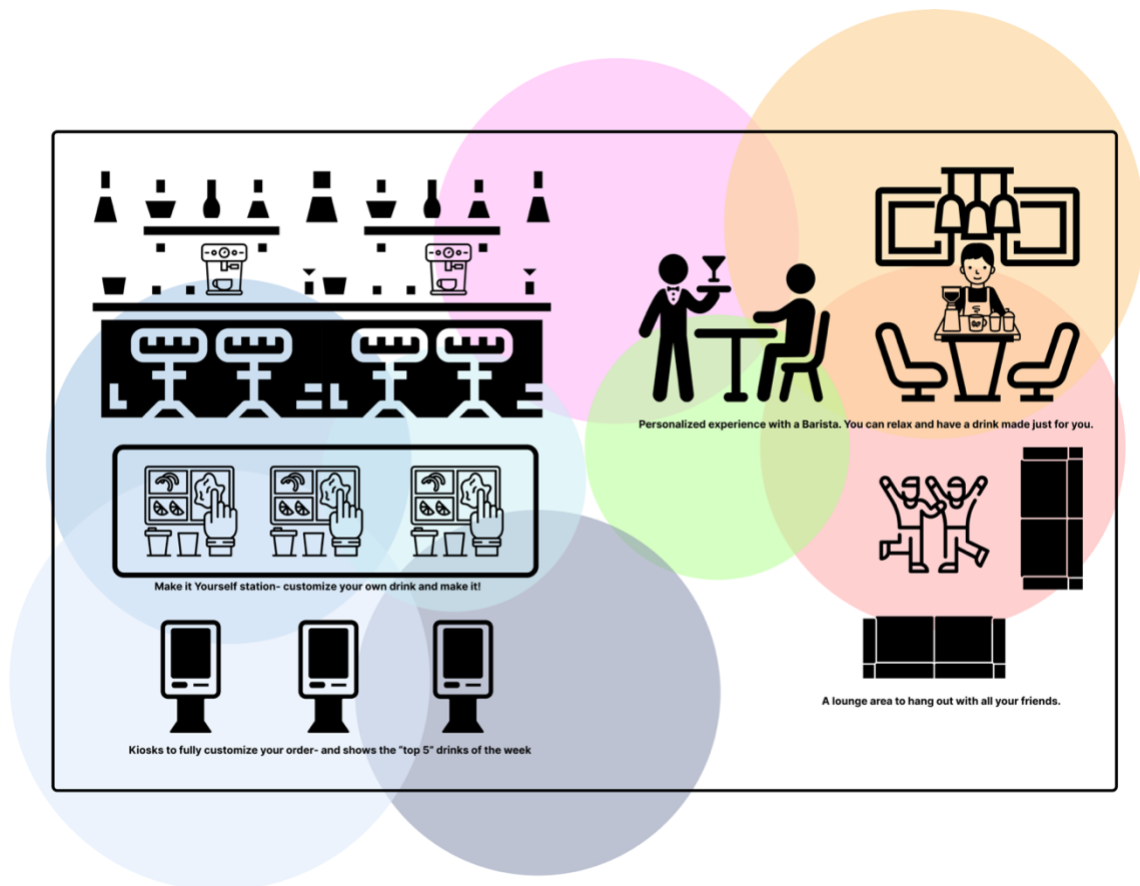


Figure 21 The Dream Café as Envisioned by Gen -Z

The Dream Café prototype highlights a space where consumers can have a fully automated experience through a digital kiosk or a make-it-yourself station. It also includes an area for social gatherings, personalized experiences with baristas, and relaxation. This prototype brings together the overarching themes of *Comfort and Relaxation*, *Immersive Experiences*, *Social Interaction*, *Multifunctional Space*, and *Self-Service and Convenience*, that emerged

through our research. This prototype can thus serve as a starting point to build the future Café and inform designers, researchers, and stakeholders within the food industry.

7.8 Discussion and Implications

Collaborative design engages participants to be active agents of the design process through ideation, creativity, and collaboration. As Duarte (2018) states, it gives community members the opportunity to become “co-designers with an equal say within the exploration and brainstorming of a design challenge”. Lundqvist et al (2018), also mention the different attributes collaborative design gives participants, specifically focusing on in-person workshops. “Collaborative design enables participants with different backgrounds and skillsets to contribute on equal footing to the development of new design concepts. Through principles such as no prerequisite skills, mutual learning, collaborative ideation, combinatorial creativity, and externalization of ideas.” These principles explored by Lundqvist et al (2018) highlight the importance of sharing ideas to inspire creativity and how artifacts (e.g., cards and sticky notes) can facilitate idea generation and inform others. Building upon this body of work by integrating crowd-driven ideation and storytelling at scale supported by our own collaborative ideation tool, I set out to explore the current and future interests of Gen-Z consumers as they relate to food and beverage choices, product design, attributes, and flavors. More specifically, we co-designed future-oriented scenarios with participants to explore consumers’ interests, concerns, and desires related to food choices now and in the future. Alongside my collaborators, we first conducted a large-scale in-person ideation session at Emerge 2022 to explore the general themes participants ideated when thinking about the café menu, ordering process, and general café experience. Based on the themes that emerged, we then conducted a workshop to further situate participants’ desires, needs, and motivations of the future café and café order of Gen-Z specifically. Our in-person workshop and the data collected from Emerge helped us seed the two *Dream Collective* projects, *The Dream Café* and *The Dream Café Order*. We then distributed our website to both in-person and online participants to gather data at scale. Our findings from the Dream Collective resulted in 4 overall

themes: *Self-Service and Convenience*, *Multifunctional Space*, *Customization and Variety*, and *Comfort and Relaxation*. Building upon this data collected I then held interviews with coffee makers and baristas to further situate the envisioned features and stories as starting points for actionable design. Finally, I conducted two workshops with Gen-Z to create a low-fidelity prototype, this design reflects the themes that had emerged throughout our research and can serve as a blueprint or starting point to inform future Café designs.

7.8.1 Design Implications

Throughout my research participants were prompted through short scenarios to collaboratively speculate and ideate on the future café and café order. Taking inspiration from design fiction methodologies (Blythe, 2014), these scenarios allowed participants to ideate beyond what is currently feasible and communicate their desires and needs. Regarding our in-person prompts, participants were given scenarios that highlighted a specific mood or in the case of *Café 2057*, a very specific setting. (e.g., *What do you think the café of 2057 would look like? Who would you go with? What experience would it provide?*) These scenarios were open-ended in that they allowed participants to envision features and the overall experience based on their expectations and desires. Unlike previous design fiction research (Prost *et al.* 2015, Lyckvi *et al.* 2018), the scenarios that participants were prompted with did not have a specific connotation. For example, even though we framed our research to be 35 years from now, we did not specify if the café and café order that participants were envisioning would be affected by global warming, sustainable practices, technology, etc. Within our in-person workshops, these open-ended scenarios were further supported by clarifying questions from the researchers as well as the critical discussion between participants. Future collaborative ideation research can take further inspiration from design fiction and provide participants with scenarios that highlight specific events or characteristics that can inform and influence their creations based on current social, political, and economic concerns.

Our online data collection was also affected by our open-ended prompts as it led to participants envisioning equally broad creations. For example, a *Dream Café Order* created by a participant stated the following: *This is the perfect drink that has no errors and enriches your day and life. It would change flavor and have a caffeine regulator.* Although this order highlights specific features that they would like their drink to have the participant does not specify what type of ingredients or type of drink it would be. In another example for the *Dream Café* a participant wrote the following: *There would be a quiet space with yoga mats and props where people could have a place to be mindful for a moment/multiple minutes.* This short story depicts a place where people can relax, however, it does not specify what “props” could be used for people to unwind and be mindful. Future collaborative design envisioning and ideation research can further build upon integrating creativity support tools that allow for feedback between participants that further encourage a critical discussion about their creations, as well as clarifying questions and details about their envisioned features and stories.

Finally, one of the professional coffee makers that I interviewed voiced a concern regarding the online distribution of our collaborative ideation tool. They stated, “*Some stories seem to fall under quite a niche category and might need to be conscious of the vocal minority*”. The concern of the vocal minority within online behavior has been a long-studied phenomenon within HCI research. Within their research Gong *et al.* (2015) focused on online reviews and explained how there is a “high propensity to rate a product among consumers that experience extreme satisfaction or dissatisfaction, as compared with those who like or dislike the product only moderately”. This notion has thus raised questions and concerns about a self-selection bias of those who are more likely to participate in and voice their concerns in online forums. (Hu *et al.* 2009). Within our research, we specifically shared our website with the Gen-Z ASU undergraduate population over the course of a summer. Participants who took part in our research were provided with financial compensation, once they provided proof of their creation. As with many other online data collection methods (Luther *et al.* 2015, Ma *et al.* 2015), we could not ensure if participants were fully interested in our research and creating features or stories that they desired or were simply taking part in our data collection for monetary gain.

Past research also highlights participants' notion that online decorum can influence what and how they post (Taylor 2013). *The Dream Collective* was made purposely as a research tool and as such the website has a built-in research statement and an IRB-approved consent form. This consent form informs participants of the research taking place, how the data is being collected and for what purpose (e.g., research publications, academic papers, etc.), and who can view their responses. Our website also has a gibberish and profanity filter that will not allow participants to submit stories or features that include harmful language. By submitting a response to our website participants are inherently agreeing to the consent form provided. These filters could have also provided a selection bias for those who wished to participate in our online data collection and influence the stories they created.

CHAPTER 8

CONCLUSION

This dissertation aims to build upon and expand collaborative design methodologies within the realm of HCI by incorporating design fiction techniques and employing collaborative ideation tools to support my research. I first examined co-design methods within two community scientist focus groups. This research explored collaborating with stakeholders interested in solar cooking, and drones to create prototypes that tackled community science interests. My research with community scientists interested in the future of drones explored my implementation of design fiction techniques within collaborative design. These design fiction techniques prompted users to speculate on the future of drones and create their own without being limited by their technical knowledge. During this research the use of speculative scenarios was fundamental in ideating and co-designing for participants as it allowed them to co-create without being limited by feasibility and current uses, lowering the barrier for involvement in community science design and research. Drawing on design fiction techniques, a critical discussion was held between participants to further reflect on the benefits and drawbacks of their creations and refine them. Collaboration was a key aspect of iterating and reflecting on scenarios by participants, and thus I set out to explore collaborative ideation at a larger scale.

I then co-created two online creativity support tools that integrated collaborative design at scale inspired by design fiction methodologies, *Dream Drone* and *The Dream Collective*. These websites allow participants all over the world to create and envision their own future drone, or future technology, space, or service. By taking inspiration from design fiction, participants are not limited by their technical knowledge or current feasibility when creating their envisioned artifacts. These websites give participants the ability to re-mix, combine, and build upon the ideas of others.

I then presented my research with Gen-Z stakeholders whereby I conducted collaborative ideation methodologies with design fiction techniques, prompting participants through scenarios

to co-design, speculate, build upon each other's feedback, and critically reflect on their creations. This research was further supported by *The Dream Collective*, where two specific projects were created to allow for in-person data collection and online data collection at scale. Emergent themes from my methodologies reflected Gen-Z's overall desires, expectations, and emotions as they related to food and beverage experiences without being limited by their background, and current technical knowledge. The data gathered from the in-person workshops echoed and complimented the online data collection culminating in themes and a low-fidelity prototype that researchers and stakeholders can further build upon and inform future actionable designs.

Through my research, I have shown the potential collaborative design methodologies, supported by design fiction techniques and creativity support tools, have of engaging people from different backgrounds, areas of expertise, and locations, to critically envision complex spaces, technologies, and services. My collaborative ideation workflow allows participants to take part in the design process alongside experts and voice their desires, concerns, and community needs. Through scenario building and storytelling, participants have the ability to contextualize their needs and provide insights into their emotions, as well as expectations and concerns of future designs and experiences. This also allows for stakeholders at all levels of the design process to engage in a critical discussion and reflection on how we are designing, and for whom. Collaborative design supported by design fiction techniques lowers barriers for participants to be involved in the design process, this can open doors for future researchers within industry and academia to allow participants to be more than a "user" or "consumer". This methodology also gives researchers the flexibility to tailor scenarios and online projects at any speculative point in the future. Within industry and academia, researchers have the ability to collaborate with community members with different technical knowledge, involvement, and backgrounds and have them come together, co-design, learn from each other, and be actively involved in the design process. The integration of online creativity tools to support collaborative ideation allows researchers to gather insights from participants at scale, complementing in-person methods and enriching the design process. By utilizing collaborative design and ideation techniques

researchers can encourage participants to speculate and ideate on technologies, services, and experiences that can in turn inform actionable design in the near future or 5-10 years out.

It is important to note that because of the open nature of my collaborative design workflows and the online platforms I co-created this can allow for potential negative consequences or misuse by both participants and researchers. By allowing participants to freely ideate and create their “dream” service, space, or technology without any restrictions the question of whose “dream” we are designing and ideating for comes into question. The opportunity to create and envision a future that is not ideal, or scenarios that can go against participants’ desires, expectations, and needs is something that can emerge from integrating design fiction techniques into co-design methodologies in both in-person settings and at scale. Thus, it is important to reflect on the use of language when prompting participants, potential regulations and moderations within ideation sessions, and the importance of critical reflection and discussion when we are co-designing with stakeholders. It is through these conversations that stakeholders can fully express their design process when ideating as well as their needs, desires, or fears that inspired them.

Collaborative design supported by crowd-based storytelling and ideation at scale encourages stakeholders and researchers from any field, background, or area of expertise to design and collaborate with each other. By engaging in a collaborative critical discussion all stakeholders can come together and reflect on how design has the power to impact, inform, and shape the future. Collaborative ideation, supported by online creativity support tools, allows stakeholders to collaboratively shape the future of design, ensuring that it is aligned with community needs and aspirations. Future co-design research can continue involving diverse perspectives through collaborative ideation and storytelling at scale to address the evolving needs and challenges of stakeholders.

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APPENDIX A

ASU IRB APPROVAL OF USE OF HUMAN SUBJECTS FOR THE DREAM DRONE RESEARCH

NOVEMBER 2019- DECEMBER 2022 107

EXEMPTION GRANTED

[Anastasia Kuznetsov](#)
[HIDA: Arts, Media and Engineering, School of \(AME\)](#)

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 kstace@asu.edu

Dear Anastasia Kuznetsov:

On 12/4/2019 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Exploring Online Crowdsourcing as a Tool for Drone Co-Design
Investigator:	Anastasia Kuznetsov
IRB ID:	STUDY00011013
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	<ul style="list-style-type: none"> • Dream Drone IRB, Category: IRB Protocol; • Interview Consent Form, Category: Consent Form; • Online Consent Form, Category: Consent Form; • Recruitment Email, Category: Recruitment Materials; • Study Instruments. Platform Steps, Category: Other;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 on 12/4/2019.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

APPENDIX B

ASU IRB APPROVAL OF USE OF HUMAN SUBJECTS FOR THE DREAM COLLECTIVE

RESEARCH MAY 2020- MARCH 2024

APPROVAL: MODIFICATION

[Anastasia Kuznetsov](#)

HIDA: Arts, Media and Engineering, School of (AME)

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kstace@asu.edu

Dear Anastasia Kuznetsov:

On 3/18/2024 the ASU IRB reviewed the following protocol:

Type of Review:	Modification / Update
Title:	The Dream Collective. Exploring online crowd-generated fictions to shape future technologies, spaces, and services.
Investigator:	Anastasia Kuznetsov
IRB ID:	STUDY00011974
Funding:	Name: Starbucks, Grant Office ID: AWD00036296
Grant Title:	None
Grant ID:	None
Documents Reviewed:	<ul style="list-style-type: none"> • Collaborative Imagination Workshop Breakdown, Category: Other; • Collaborative Imagination Workshop Consent Form, Category: Consent Form; • The Dream Collective IRB - with Collaborative Imagination Workshop, Category: IRB Protocol;

The IRB approved the modification.

When consent is appropriate, you must use final, watermarked versions available under the “Documents” tab in ERA-IRB.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator