

BLACK MIRROR: A NOVEL APPLICATION OF SPECULATIVE DESIGN TO FACILITATE CONTEXT-AWARE DESIGN THINKING

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ABSTRACT

As design thinking became popularized, practitioners in the field pointed out that design thinking rarely takes stakeholders and contexts into account as a result of focusing solely on end-users. We believe such a limitation can be complemented with speculative design, which critiques the future that an idea depicts and interrogates relationships with social, cultural, economical, and political systems. This paper, through pilot interviews with 10 participants and a thematic analysis on interviews with 12 participants, explores possible interaction between design thinking and speculative and critical depiction of the future. Speculative and critical inquiries allowed the participants to consider various social contexts and stakeholders, and further helped them shape and brainstorm the ideas' potential values and challenges faced during adoption. The overall critical speculation influenced various steps of the design thinking process. The paper contributes to the literature by reporting a novel application of speculative design to the conventional design thinking process. In the future, we hope to further explore other elements of speculative design and their impact on design outcomes.

Keywords: Design methodology, Design practice, Design process

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1 INTRODUCTION

1.1 Design thinking and its limitations

Design thinking, an iterative and interactive process to solve complex problems (Razzouk and Shute, 2012), has gained popularity among not only designers but also professionals from various fields, ranging from information technology to business (Dorst, 2011). Though design thinking has different meanings based on context (Johansson-Sköldberg et al., 2013; Kimbell, 2011), IDEO bloomed the concept of design thinking within the management discourse by detailing the steps and toolkits, introducing design thinking to a larger audience including business professionals and social innovators (Johansson-Sköldberg et al., 2013).

However, practitioners in the field have reported its limitations and highlighted the gap of current design thinking practice from the original intention of design thinking. Limitations of design thinking can be seen through the lens of CDIO (Crawley et al., 2011), engineering education framework that emphasizes the entire engineering cycle of Conceive-Design-Implement-Operate with systems thinking (Taajamaa et al., 2016). One of the criticisms is that design thinking practice conducted in the field does not consider the social, economic, and political context of ideas (Fiell and Fiell, 2019), as it focuses extensively on the end-users (Plattner et al., 2010; Tschimmel, 2012). The narrow focus on only the end-users during the conceiving and designing phase can render the engineering designers to neglect the societal context and systems (Crawley et al., 2011).

Although characteristics of design thinkers include human and environment-centered design and systemic vision (Razzouk and Shute, 2012), the current usage of design thinking gives more emphasis on the user than on other stakeholders (Collins, 2013; Kolko, 2015; Plattner et al., 2010; Tsoi, 2021). Also, critics say that design thinking in current practice over-simplifies the problems, and designs are only based on the best-case scenarios, neglecting possible negative outcomes that the idea may bring in the real world (Tsoi, 2021). Therefore, Bjögvinsson et al. (2012) have noted that designers should design “Things,” (socio-economic assemblies) and not “things” (objects).

1.2 Speculative design and its criticism

Speculative design is a subsidiary of critical design that speculates on future and alternative scenarios to provoke debate and discussion on the implications of decisions (Dunne and Raby, 2013). It is an activity of making conjectures, hypothesizing and conceptualizing the effect of future products and systems, and thereby questioning the status quo. By shedding lights on the mindless decisions that humans make, it aims to guide humanity to a more desirable, responsible path (Dunne and Raby, 2013). Starting with the origin of speculative design, such as social issues, technological projects, or cultural trends, speculative designers extrapolate and make speculation on alternative presents, corporate futures, and more (Mitrović et al., 2021).

However, one of the critical comments is that speculative design, in practice, fails to address underlying structural problems. Furthermore, speculative design, originally intended to provoke debate and discussion from the public, is criticized for only sparking debate among closed design communities (Malpass, 2013; Ward, 2019). The criticism that speculative design practices only echo inside the design community goes hand in hand with the “gallery problem,” (Hanna, 2019) which points out that speculative design projects only lie in academia and gallery without engaging with the real world.

1.3 Speculative design and design thinking

At a glance, design thinking and speculative design seem to concern different values at different levels. Design thinking is centered around building a concrete service or product with feasibility, desirability, and viability, through a deep understanding of users (Chasanidou et al., 2015). On the other hand, speculative design focuses on future scenarios involving multiple stakeholders in a larger system and brings ethical thinking into the equation, removed from the design’s usefulness or profitability. (Wong and Khovanskaya, 2018). Both ways of thinking, however, share a deep consideration for the wicked problems - dynamically complex problems with no straightforward

solution (Rittel and Webber, 1974). Based on its deep concern for wicked problems, speculative design aims to open up new perspectives to those, and design thinking aims to solve and tackle those (Plattner et al., 2012; Dunne and Raby, 2013).

The criticism towards design thinking, including its limited consideration of multiple stakeholders and societal-level implications, can be addressed by speculative design, as speculative design “considers the environment and context in which speculative future products or services would exist” (Auger, 2013). Furthermore, acknowledging the “gallery problem” criticism, there have been attempts to bring speculative design out to the real world including business and management context, especially with the help of design thinking (SpeculativeEdu, 2019; Wong and Khovanskaya, 2018). These attempts to bring speculative design as methods to innovate and engage with the real world are “largely seen as positive, reinforcing the versatility of speculative design approaches across various contexts” (Hanna, 2019).

However, the role of speculative design within design thinking is a path less explored and backed with research. We believe that there is value in dynamically and practically harmonizing speculative design with current design thinking practices as it would strengthen the ultimate vision to bring on better futures for humanity.

This paper aims to apply the speculative approach to design thinking steps, especially the model from Stanford d.school (Stanford d.school, 2018), one of the main proponents of current design thinking (Carlgen et al., 2016), and explore the potential interaction that the speculative and critical inquiries play in the process of design thinking.

This brings the following research questions:

- How do speculative and critical inquiries benefit or hinder the Stanford d.school’s five-step design thinking model (Stanford d.school, 2018)?
- Which roles can the speculative approach play in design thinking?

2 METHOD

This qualitative study explores the possible roles of critically-oriented speculation in design thinking through thematic analysis (Maguire and Delahunt, 2017) of semi-structured interviews with 12 interviewees. The interview was held in the form of a design exercise to test the role of speculative thinking in design thinking. This was preceded by a pilot study with 10 participants from diverse backgrounds. Participants were people of various acclaimed educational levels who were interested in discovering a new way of thinking critically. Participants were collected through online recruitment and snowball sampling (Parker et al., 2019). Further explanations on interviewee sampling, data collection, and analysis are described below.

2.1 Pilot study to develop design exercise

For the pilot study, we recruited 10 participants consisting of females (n=6) and males (n=4) whose highest level of education was divided between undergraduate (n=8) and masters (n=2). Their current or future career was diverse, including software developer (n=4), UX designer (n=3), design manager (n=1), technology academic (n=1), and working at NGO (n=1). Three of the participants had experience with design thinking; three of the participants have not had experience thinking of future impact of the product; seven have had personal experiences thinking about the future impact but not in the structured form. Throughout the pilot interviews with 10 participants, a preliminary interview guide was field-tested (Kallio et al., 2016). We integrated repetitive questions, re-ordered questions, and made changes to the User Persona and How Might We Question (Stanford d.school, 2018) prompt to promote more open-ended ideas and clarity. To accelerate creative thinking (Wolcott et al., 2020), we added a warm-up activity before the main module. The pilot interviews verified that the prompt was comprehensive without professional knowledge and enabled effective ideation.

We considered the participants’ inexperience with speculative design and developed speculative questions (Artefact, 2019) accordingly. The questions aided participants to re-imagine alternative presents and futures (Auger, 2013; Dunne and Raby, 2013). Additionally, participants speculated on the unintended future scenario of ideas in a different social, economic, and political contexts (Wong and Khovanskaya, 2018) and critiqued their original ideas.

2.2 Design exercise and data analysis

Following the pilot interviews, we administered a design exercise conducted through 12 participants of females (n=6) and males (n=6) with levels of education ranging from an undergraduate, graduate, or industry experiential level. Their current or future career was diverse, including UX design and product design (n=4), software engineering (n=2), data science (n=2), computer science (n=1), finance (n=1), robotics (n=1), and engineering management (n=1). Nine out of the twelve participants had experience with design thinking. Additionally, only one out of the twelve participants had prior experience with speculative design. Participants for this study were acquired through online communities. Interviews took an average of 45 minutes to an hour via Zoom. The interviews were semi-structured with questions designed beforehand through internal testing and field testing (Kallio et al., 2016) to excavate deeper insights from the participants. The entire interview process was pre-approved by the university's Institutional Review Board.

Table 1 describes the overall flow of the design exercise, of which steps were grounded on Stanford d.school's five-step design thinking model (Stanford d.school, 2018). The speculative phase of making conjectures about the unintended future scenario was named Black Mirror, inspired by the Netflix series by Charlie Brooker that satirizes the unintended consequences of over-innovative technology on modern societies (Black Mirror, 2011). Interview questions in the Black Mirror module (Table 1) stretches the imagination about the possible consequences of the technology or product just like the successful Black Mirror Netflix series, an example of speculative design, does (Stals et al., 2019). To focus on the Ideation and Black Mirror modules, we shortened the Empathy and Define modules (Stanford d.school, 2018) and provided a pre-designed user persona and a How Might We question to the participants.

After the design exercises, the interviews were transcribed using otter.ai. For analysis purposes, each participant was assigned a code name from A to L. The data analysis was held concurrently with the data collection. The authors initially performed line-by-line coding of the interview transcripts from the ideation session to the feedback session and noted patterns, themes, and exceptions. Then, based on the themes that emerged from the interview data, the authors re-coded the entire data.

Table 1. Flow of the design exercise

Modules	Directions
Icebreaker Activity (2 minutes)	<ul style="list-style-type: none"> • Write down the usages of a brick as much as possible • Quantity over quality.
User Persona and How Might We Question (1 minute)	<ul style="list-style-type: none"> • <i>Prompt: Here's 26-year-old Rumi, living alone. She is a big foodie. However, she comes home very late from work and doesn't have the energy to cook food herself. How can we design an ideal dinner, product, or service for Rumi? How might we radically improve the dinner experience of a professional exhausted from a long day at work?</i>
Ideation (10 minutes)	<ul style="list-style-type: none"> • Ideate as radically as possible, a minimum of 5 ideas • Quantity over quality • Facilitation tools: Substitute, combine, modify, magnify, minify, eliminate, reverse the element.
Black Mirror (25 minutes)	<ul style="list-style-type: none"> • What would using your idea too much look like? • What is the worst headline about your idea you can imagine? • When you picture your user base, who is excluded? If they used your idea, what would their experience be like? • What happens when 100 million people use your idea? • Who or what disappears if your idea is successful? • If the environment was our client, how would your product change?
Feedback (20 minutes)	<ul style="list-style-type: none"> • How do you perceive your original idea? • Do you think this idea should exist? • Do you think the former process of thinking about the impact of your idea helps before prototyping? If so, in what way? If not, why? • Are you willing to use the Black Mirror process later in your life of designing, developing, and ideating products or systems in the real world?

3 RESULT

3.1 Themes emerged

From our exploratory analysis of the 12 interviews, we identified a variety of roles that speculative design played through the design exercise. Overall, the Black Mirror exercise brought shifts in the way the participants thought about their users, ideas, and impact. In Table 2, we summarize the seven major themes that arose. Count refers to the number of occurrence of each theme in the interview dataset. The seven themes are grouped into three broad categories and are explained below.

3.1.1 *Increased awareness of context and stakeholders*

The act of speculating on the future consequences of the idea led the participants to view the impact of their ideas from three perspectives: user persona, unintended stakeholders, and societal-level consequences (Table 2). The participants critically speculated and raised awareness on their ideas on the three different perspectives. (Table 2).

First, in the most narrow sense, the participants speculated their idea in user persona's point of view. This included both positive and negative outcomes that might arise in the lives of the end-users. For example, participant B imagined beneficial consequences where the user persona's "cooking could be faster and easier, save time and energy," and participant F speculated a dystopian future and remarked, "once [my recommendation system] knows what [user persona] likes, it can continually reinforce ... so if [user persona] only likes cheeseburgers, then [user persona] might only eat cheeseburgers for the rest of [user persona]'s life."

Second, unintended stakeholders included groups of people with needs and pain points different from those of the original user persona. For example, participant G explained a perspective of a possible user, saying "if [a user] is vegetarian ... she has to break out of her comfort zone and try new things ...". Other stakeholders also included people from diverse professional backgrounds who were not considered initially but could still be impacted by the idea.

Third, societal impacts included categories such as lifestyle, public health, industry, service, institution, infrastructure, ethics, culture, tradition, environment, economics, and policies that could be impacted by the brainstormed idea. For example, participant B brought up the ethical issue of privacy, stating "there might be privacy concerns because this product would need cameras." In terms of public health, participant C speculated that their idea might "cause an obesity epidemic in America." As in the perspective of culture and tradition, participant I conjectured that "appreciation for certain recipes, for example, family recipes ... that are too complex for people in our generation to replicate might disappear." As an example of environmental considerations, participant G speculated that "if we go back to livestock issue, the device lowers the amount of methane because a lot of cows produce a lot of methane." The participants also speculated the impact on institutions including culinary schools, FDA policies, and many infrastructures including kitchen appliances, delivery services, cloud kitchens, meal-prepping companies, and more.

3.1.2 *Reductive and constructive sculpting of the idea*

The speculation process helped participants sculpt the idea in both reductive and constructive ways. Participants reductively carved out certain details from the idea as they scaled down and added boundaries to prevent users from using the product too much. They sometimes went as far as completely abandoning the original idea. For example, participant B scaled down the idea "in terms of like, size of it, cause I originally imagined it to be like a really big screen with multiple compartments ... so if we just scale it down to a smaller screen with just a measuring skill in it ... the product will require fewer parts and power" (See Figure 1). Similarly, Participant K, after considering accessibility concerns, was able to radically change the idea from an application to "a device that attaches to the pot and stirs ... It would come in a button, something that would be easier for people to use, and that doesn't need to be tied to any other accessibility requirements."

As a constructive idea shaper, speculation played several different roles. Participants developed a clearer vision of the idea as they re-thought the purpose of the idea. This was demonstrated clearly

through participant H who remarked, “a designer has to have a clear conceptual model ... this [process of speculating] can be really helpful in narrowing down what this product is supposed to do and what it is supposed to look like.” The participants also came up with a concrete user journey. Participant L thought out loud, “first, [Rumi] joins the program, gets to know the person who is running the program, feels like a good friendly relationship, they go to the grocery store together ... Then she meets other people in the program...”

Through such a process, the participants built upon their original ideas. Speculation’s role as a constructive idea shaper is demonstrated in detail through participant I’s interview:

“I think it initially started off as a product which would have a set number of recipes ... But we developed features like, one, you could input your own recipes, two, there could be a public profile where you could share your recipes online, and three, we went as far as to say like you could have like a blog where you talk about the importance of these recipes, how it tastes like, how filling it is, making it even to a social media type of thing.”

Both the reductive and constructive idea shaping sprouted from speculating on the dystopian or utopian futures that the idea might bring. The goal was to then mitigate negative consequences and reinforce the positive consequences.

3.1.3 Discovery of potential values and challenges

The process of speculation sparked the participants to uncover the potential of their ideas in a positive and negative way. As a potential value finder, critically speculating inspired the participants to come up with completely novel usages of their idea hidden prior to speculating. This was supported by participant K who stated, “talking it out that it could potentially be very useful for many people makes me more excited about the idea.” The participants also thought of potential challenges that had to be overcome to create a successful product with more benefits than harms. For example, participant G determined that their product, a robot chef, required high maintenance with its many working parts having high potential of getting clogged. The participants also discovered factors that may hinder people from accessing or using the idea. For instance, participant H realized that not everyone had access to the internet or cell phones, which were required for their solution to be adopted.

Table 2. Themes emerged, count, and examples from the interviews

Themes	Count	Examples from the interviews
Stakeholder Awareness: User Persona-level	56	“[My idea] may ruin the nutrition of the customers by end up trying to cook the same kind of food all the time” (See Figure 1)
Stakeholder Awareness: Unintended Stakeholders-level	37	“[My idea] would stem bunch of different professions, like plumbers are less relevant whereas robot technicians are more useful for those kitchens” (See Figure 1)
Stakeholder Awareness: Societal-level	56	“[My idea] could make people more isolated when they eat food ... this encourages you to eat your own food, which is individualistic” (See Figure 1)
Idea Sculpting: Reductive	10	“We would have to scale it down, maybe like remove automatic preparation of the ingredients, especially like the cutting part, cause that part requires a lot of resources” (See Figure 1)
Idea Sculpting: Constructive	87	“A lot of knowledge sharing (recipe sharing) between the network of Robo Chefs ... maybe there's an element of exploration that's added and if one robot does end up making the recipe really good, now automatically all other robots have this update” (See Figure 1)

Discovery: Potential Values	44	“If you use this to solve world hunger, it can be a survival solution ... if you give this to organizations like UNICEF or world hunger organizations, that could be very beneficial...then, you can move on to other world issues like climate change or social issues” (See Figure 1)
Discovery: Potential Challenges	71	“It could have a problem of overheating ... because it's such a big machine, it might not be able to just connect to a regular outlet. It might need several outlet and that might be something we might overlook in our experiments when we are creating it” (See Figure 1)

3.2 Role of black mirror in design thinking process

To assess the effects of critically-oriented speculation on the overall design thinking process, we mapped the emerging roles onto the five pre-existing steps of the Stanford d.school’s design thinking model (Stanford d.school, 2018) in Figure 1. The “Speculate” step refers to the Black Mirror exercise in Table 1. The Black Mirror exercise served a role similar to the prototyping by assisting in creating a mental model of the idea. The participants critically assessed the idea by speculating on the user experience and substituting the user persona with unintended stakeholders that arose from the exercise. While simulating the user experience, participants thought of the potential challenges of implementing the product and envisioned the unintended consequences of the idea. The process allowed the participants to mentally test and simulate their idea on possible user personas. Through speculation and reflection, some participants completely detoured away from their original idea or scaled down the product. To mitigate the negative consequences and encourage the positive consequences of adopting their ideas, the participants reconstructed their idea through an iterative process, adding more details along the way and expanding the original purpose of the product to initially unintended, but possible usages. This entire process allowed them to create new user personas as they iteratively considered the stakeholders at different levels and redefined the intended purposes and problems that the idea should focus on.

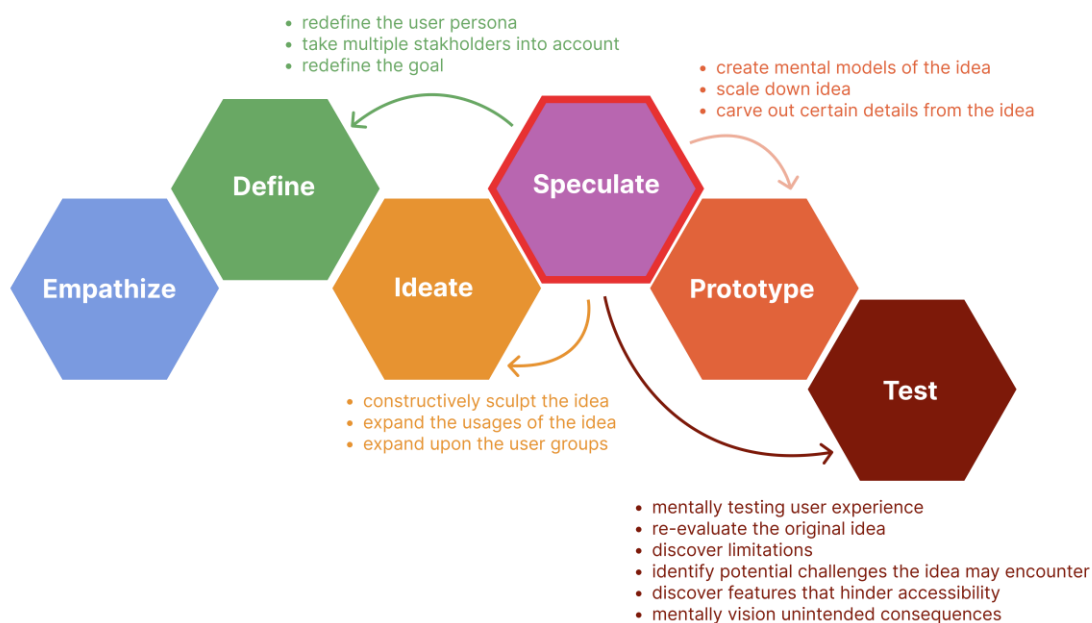


Figure 1. Visual mapping of critical speculation's effect on the design thinking process (Stanford d.school, 2018)

4 DISCUSSION

4.1 Possible usability of speculation in design thinking

To review, we identified three potential roles of speculative design in the design thinking process. Critically-oriented speculation helped the participants to 1) think about various stakeholders'—including users'—perspectives, 2) shape the idea through removing and adding elements, and 3) discover unexpected values and potential challenges that they could face during the implementation of the ideas. In the current section, we discuss how such shifts were made possible and suggest possible explanations.

Regarding the first shift, speculative inquiries create and bring into account various personas of potential users and stakeholders, without focusing on immediate user needs (Wakkary et al., 2015; Wong and Khovanskaya, 2018). Bjögvinsson et al. have pointed out that all stakeholders, expanding from the immediate users that are considered in the prototyping process, might appropriate designs in unexpected ways and that all stakeholders must be engaged as designers (Bjögvinsson et al., 2012). Such unforeseen appropriation of designs can be prevented beforehand by speculation (Hanna, 2019), as it allows designers to reposition their designs in the context of humans, institutions, technologies, values, and politics in the system (Wong and Khovanskaya, 2018).

Speculation further acted as an idea sculptor perhaps because speculative and critical approaches facilitate participants to narrate descriptions of design details (Wakkary et al., 2015) and allow more concrete mental imagery of the ideas. Mental imagery, which works as effectively as depiction such as sketching (Athavankar, 1997), serves a role similar to Prototyping (Stanford d.school, 2018), an effective way of visualizing and elaborating on ideas (Tschimmel, 2012). Also, with critical inquiries on the future of the idea, the participants put creativity constraints (Onarheim and Biskjær, 2013) to themselves to diverge their ideas wider on a condition of what the ideas should and should not contribute to.

Furthermore, as speculative design's nature is to speculate about how things could be, Dunne and Raby make an analogy of the act of speculating to thought experiments (Dunne and Raby, 2013). As thought experiments, speculations on the possible uses and appropriation of the idea can serve a similar role as mental testing, analogous to the Testing step (Stanford d.school, 2018) in design thinking. Speculative design allows us to critique current practices and challenge the assumptions, preconceptions, and givens about the product (Auger, 2013; Dunne and Raby, 2013). An act of challenging assumptions and making a critique on current practice has a similar role to the Testing step in design thinking, which challenges designers and allows the designers to redefine the problems and create new ideas (Plattner et al., 2010).

Such effects of critically-oriented speculation can have numerous potential benefits if applied to design thinking. As the Prototyping and Testing modules' purpose is to fail early and often, mentally prototyping and testing the ideas before the prototyping allows participants to experience “micro-failures” at a low cost (Coughlan et al., 2007). The micro-failures did not discourage the participants but rather expedited the participants to constructively re-sculpt the idea in an alternative context for a preferable future (Wong and Khovanskaya, 2018), as manifested in the notably low counts of reductive idea sculpting codes compared to those of the constructive.

With the micro-failures and critical envision of their ideas, critical and speculative inquiries can also reinforce the iterative nature of design thinking (Plattner et al., 2010). The participants went back to the prior steps of design thinking iteratively and came up with new ideas. In each cycle of iteration, the participants embodied the socio-cultural values and challenged current social, cultural, economic, and political agendas related to the product, as speculative design aims (Galloway and Caudell, 2018). Moreover, the stakeholders other than the user persona that arose from the interviews can be applied to the design thinking module to facilitate the participants to not only think about the probable users but also plausible and possible users to help guide the designers for preferable futures (Dunne and Raby, 2013).

To recap, speculative inquiry expedited the participants to discover potential stakeholders and be more context-aware. With a speculative approach, they imagined unintended negative consequences of the ideas and creatively deviated away from them with new ideas that take values such as environmental awareness, privacy, culture, and tradition into account. These in all helped bridge the gap between design thinking in practice and in ideal by stimulating participants to imagine on not only the best-case scenarios but also possible negative outcomes that the idea may bring in the real world.

As the speculative design is criticized for its “gallery problem,” (Hanna, 2019), the act of critically depicting futures can engage a broader audience and also gain practicality and dynamicity by acting as a tool in design thinking, a methodology that deals with real-world problems, collaborating with various practical fields and organizations (Brown and Wyatt, 2010). For instance, as the interview progressed, participants came up with new ideas that are more embedded in the real-world context, ideas that addressed environmental, privacy, cultural and traditional issues.

5 CONCLUSION AND FUTURE WORK

This qualitative research presents a novel approach to applying speculative design to the conventional design thinking model. Through an exploratory study of 12 in-depth interviews, we identified seven potential perks of such an application. Our Black Mirror module served more roles beyond awakening the creators about the ethical, socio-cultural, and environmental impact that the product may bring. It served as an idea sculptor and worked as a tool for mental prototyping and mental testing. Among many effects of critical speculations on design thinking, constructive idea sculpting played the most impactful role with the most quote examples (see Table 2). The study faces several limitations. Because the study was primarily exploratory, we did not look at the effect of speculative design on the quality of the design outcomes. In future studies, we hope to conduct more intentional experiments in which we look at the relationship between speculative design and the characteristics of final ideas. Furthermore, we hope to investigate the role of critical and speculative inquiries through workshops in a group setting, as design thinking is a collaborative approach. Our future research will seek to incorporate various elements of speculative design and continue developing the Black Mirror module by encompassing more in-depth features of speculative design and design thinking.

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