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# Speculative Design as Thought Experiment

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## Abstract

Speculative design is a subsidiary field of critical design practice. It generally involves developing scenarios based on a central object, often a prototype. Because it is concerned with alternative present and future states, many acknowledge the potential of speculative design for raising critical discussion and public engagement on science, technology, and society. In this article, we ask how the analogy of speculative design to thought experiments highlights or problematizes certain aspects of speculative design. Building on the work of Anthony Dunne and Fiona Raby, we answer this question through a comparative conceptual analysis of speculative design and thought experimentation as they are understood in their original contexts. We go on to create a theoretical framework applied to four cases: *Metamorphosis*; *Walden, a game*; *The Substitute*; and *GoatMan*. We argue that understanding speculative design by analogy to thought experiments could help design practitioners better achieve the aim of public engagement, enabling a more inclusive and nuanced discussion about the form and style of speculative design.

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- 1 James Auger, "Speculative Design: Crafting the Speculation," *Digital Creativity* 24, no. 1 (2013): 12, DOI: <https://doi.org/10.1080/14626268.2013.767276>; Anthony Dunne and Fiona Raby, *Speculative Everything: Design, Fiction, and Social Dreaming* (Cambridge, MA: MIT Press, 2013), 1–9; Matt Malpass, "Between Wit and Reason: Defining Associative, Speculative, and Critical Design in Practice," *Design and Culture* 5, no. 3 (2013): 340, DOI: <https://doi.org/10.2752/175470813x13705953612200>.
- 2 Dunne and Raby, *Speculative Everything*, 2.
- 3 James R. Brown and Yiftach Fehige, s.v. "Thought Experiments," in *Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta, last modified September 26, 2019, <https://plato.stanford.edu/entries/thought-experiment/>.
- 4 James W. McAllister, "The Evidential Significance of Thought Experiment in Science," *Studies in History and Philosophy of Science* 27, no. 2 (1996): 233–50, DOI: [https://doi.org/10.1016/0039-3681\(95\)00044-5](https://doi.org/10.1016/0039-3681(95)00044-5).
- 5 Dunne and Raby, *Speculative Everything*, 80.
- 6 Cameron Tonkinwise, "Design Fictions About Critical Design," *Modes of Criticism* 1 (2015): online, available at <https://modesofcriticism.org/design-fictions-about-critical-design/>.
- 7 Kayla Anderson, "Ethics, Ecology, and the Future: Art and Design Face the Anthropocene," *Leonardo* 48, no. 4 (2015): 338–39, DOI: [https://doi.org/10.1162/leon\\_a\\_01087](https://doi.org/10.1162/leon_a_01087).
- 8 Wikipedia, s.v. "Thought Experiment," last modified July 6, 2021, [https://en.wikipedia.org/wiki/Thought\\_experiment](https://en.wikipedia.org/wiki/Thought_experiment). It should be noted that the Wikipedia page today is not the same as it was when Dunne and Raby wrote *Speculative Everything*. For that version, please visit [https://en.wikipedia.org/w/index.php?title=Thought\\_experiment&oldid=583768144](https://en.wikipedia.org/w/index.php?title=Thought_experiment&oldid=583768144).
- 9 Julian Baggini, *The Pig That Wants to Be Eaten: and Ninety-Nine Other Thought Experiments* (London: Granta Books, 2005). This book, written by a philosopher and journalist, provides the reader with 100 short thought experiments, mostly drawn from philosophy and in some cases from fiction, and contains some exciting ruminations about the quandaries these thought experiments explore, particularly focused on moral choices. However, it does not discuss the nature of thought experiments, certainly not at the conceptual level from which Dunne and Raby's analogy spins.
- 10 Matt Malpass, "Criticism and Function in Critical Design Practice," *Design Issues* 31, no. 2 (2015): 69–70, DOI: [https://doi.org/10.1162/desi\\_a\\_00322](https://doi.org/10.1162/desi_a_00322).

## Introduction

Speculative design is an approach to design in which designers create a product or object connected to an imagined scenario. While the scene is often set in the future, it may involve an alternative past or present situation. Within the domain of critical design practice, speculative design is used to encourage people to engage in critical reflection. In addition to new thoughts on present realities, this can lead people to imagine the reality they desire. These imaginative acts can contribute to public debate on such contemporary issues as new and emerging technologies, climate change, capitalism, etc.<sup>1</sup>

Speculative design methods were popularized by designers Anthony Dunne and Fiona Raby in the book *Speculative Everything: Design, Fiction, and Social Dreaming*, now a central citation for practitioners and theorists discussing speculative design. The book has attained the status of founding document in the field. Dunne and Raby describe speculative design as "a means of speculating how things could be"<sup>2</sup> and explain it by way of an analogy to thought experiments.

In academia, thought experiments are broadly understood as "devices of the imagination used to investigate the nature of things."<sup>3</sup> They derive their authority from following the principles used in physical experimentation.<sup>4</sup> Dunne and Raby argue that the strength of the analogy between thought experiments and speculative design stems from a property shared by both concepts: they allow us to imaginatively investigate possibilities, which permits us "to step outside reality for a moment to try something."<sup>5</sup> The analogy has since persisted in the field<sup>6</sup> and is also present in art.<sup>7</sup>

Several conceptual crossover points between speculative design and thought experiments make this a potentially useful analogy. Nevertheless, Dunne and Raby's explanation does not engage with the rich conceptualization of thought experiments in science, philosophy, or the other fields from which the concept stems. The only citations in their definitions of thought experiments are the Wikipedia page "Thought experiment"<sup>8</sup> and the popular science book *The Big Pig that Wants to be Eaten and Ninety-Nine Other Thought Experiments*.<sup>9</sup> While the notion of thought experiments in design is not explicitly used across the field, it implicitly informs the work of those who build on Dunne and Raby. In this article, therefore, we examine the analogy to thought experiments, their conceptual history, and their potential as a means of conceptualizing speculative design. We ask how the concept of thought experiments can highlight or problematize certain aspects of speculative design. We answer these questions by identifying and discussing how various aspects of speculative design are affected when we conceptualize them as thought experiments.

This article has several goals. First, we seek to strengthen the analogy by closing the gap between Dunne and Raby's conceptualization of thought experiments and the way that scientists and scholars from traditional academic fields understand the term. We undertook the conceptual work for this article in line with the overarching aims of critically inclined speculative design, so that it can serve those working with this approach. As Matt Malpass points out, designers who engage in critical design establish a new set of competencies in users who can then understand such work as design.<sup>10</sup> We argue

- 11 Dunne and Raby, *Speculative Everything*, 80.
- 12 *Ibid.*, 80.
- 13 *Ibid.*, 80.
- 14 Edward A. Davenport, "Literature as Thought Experiments (on Aiding and Abetting the Muse)," *Philosophy of the Social Sciences Pacific Philosophical Quarterly* 13, no. 3 (1983): 279–306, DOI: <https://doi.org/10.1177/004839318301300302>; Catherine Z. Elgin, "Understanding: Art and Science," *Synthese* 95, no. 1 (1993): 13–28, DOI: <https://doi.org/10.1007/bf01064665>; Peter Swirski, *Of Literature and Knowledge: Explorations in Narrative Thought Experiments, Evolution, and Game Theory* (London: Routledge, 2007), 6–10.
- 15 Herbert A. Simon, *The Sciences of the Artificial*, 3rd ed. (Cambridge, MA: MIT Press, 1996), 4.

that this work should be taken seriously in the rhetorical “package”—the collective elements that contextualize, frame, and endow a piece with specific meanings and functions—with which a speculative design piece is delivered. Secondly, as we will demonstrate, a considered analogy to thought experiments creates a set of conceptual and material expectations that can aid designers in the process of creating and sharing their speculative designs. Thirdly, we also see this work as being relevant to curators and theorists for two reasons: 1) a design piece’s rhetorical package is not solely curated by the designer—as a piece moves through different spaces and contexts, curators and theorists at times share curatorial responsibility; and 2) both are generally concerned with matters of reception, critique, and theory. Finally, we aim with this article to contribute to an interdisciplinary dialogue between designers and design theorists and social science and humanities scholars like ourselves. We acknowledge that our language and argumentation may differ from that of designers, and we hope that ongoing exchange with the field will lead to a shared vocabulary and a space of common understanding.

### Speculative Design as Thought Experiment in Dunne and Raby

Dunne and Raby’s conceptualization of speculative design as thought experiments in *Speculative Everything* is the most extensive consideration of this analogy to date. Initially, they define thought experiments as “constructions, crafted from ideas expressed through design—that help us think about difficult issues” and provide the freedom to “make full use of the imagination.”<sup>11</sup> This imaginative aspect of thought experiments is essential to their vision of speculative design. Dunne and Raby briefly discuss thought experiments in mathematics, science, and philosophy, and dwell on their use in ethics, an area of frequent concern to speculative designers. They perceive the primary purpose of thought experiments as being “to test ideas, refute theories, challenge limits, or explore possible implications.”<sup>12</sup> They also connect thought experiments to storytelling through examples from literature and cinema, arguing that writers fuse “narrative and concept to produce functional fictions.”<sup>13</sup> The term “functional fictions” mirrors a move in academic circles to understand literary fiction as thought experiments to explain how fiction can provide insight into the real world.<sup>14</sup>

Dunne and Raby position their imaginative, open speculative design in stark opposition to the supposed problem-solving, here-and-now focus of mainstream and commercial design (see [Figure 1](#)). While this dichotomy is replicated in speculative design discourse, the framing is problematic, as it downplays the tendency of design to be concerned not just with how things are but “how things ought to be,”<sup>15</sup> and so is always engaging with and constructing a hypothetical (future) scenario in a conventional design process.

Dunne and Raby’s understanding of thought experiments partially aligns with that of the traditional disciplines. While the authors’ ideas seem occasionally to connect with scholarly debates, their discussion does not seem to be informed by this literature. It is striking that they do not use or cite the extensive literature on thought experiments to build their argument. This is

Figure 1

A/B, a work in progress since 2009. This image was taken from Dunne and Raby's book *Speculative Everything*, designed by Kellenberger-White, published by MIT Press 2013. While communicating through this comparative list format helps Dunne and Raby distinguish how their approach differs from how design is understood more broadly, it could also be argued that it simplifies "mainstream" design and draws a hardline between it and "critical" approaches. Image © 2013 Kellenberger-White.

A	B
Affirmative	Critical
Problem solving	Problem finding
Provides answers	Asks questions
Design for production	Design for debate
Design as solution	Design as medium
In the service of industry	In the service of society
Fictional functions	Functional fictions
For how the world is	For how the world could be
Change the world to suit us	Change us to suit the world
Science fiction	Social fiction
Futures	Parallel worlds
The "Real" Real	The "Unreal" Real
Narratives of production	Narratives of consumption
Applications	Implications
Fun	Humor
Innovation	Provocation
Concept design	Conceptual design
Consumer	Citizen
Makes us buy	Makes us think
Ergonomics	Rhetoric
User-friendliness	Ethics
Process	Authorship

A/B, Dunne & Raby.

16 Sjaak Koenis and Karin Bijsterveld, *Conceptual Analysis: An Introduction* (Maastricht: Colofon, 2018), 5.

17 *Ibid.*, 9.

18 Mieke Bal, *Travelling Concepts in the Humanities: A Rough Guide* (Toronto: University of Toronto Press, 2002), 20.

especially odd because they ask readers to consider their work in the same category as that of scientists and philosophers.

Rigorous engagement with the existing scholarly literature is standard practice in academic communities. The absence of an engagement with the literature on thought experiments opens a space for criticism from scholars, which can get in the way of the main idea of speculative design as a tool for social, cultural, and ethical critique. The thought experiment analogy can potentially be useful for speculative design, but to be effective requires a comparative analysis of the terms as they are understood in their original contexts.

## Methodology

To address Dunne and Raby's lack of explicit connections to other understandings of thought experiments, our research began with a comparative conceptual analysis of speculative design and thought experiments. Conceptual analysis is understood as the "systematic investigation of what authors or speakers try to achieve by their use of concepts in particular texts and contexts."<sup>16</sup> The method involves conducting close readings of individual texts, comparing the use of concepts between texts, and examining how a "text intervenes in a specific context."<sup>17</sup> When conducting our conceptual analysis, we drew on transdisciplinary scholar Mieke Bal's focus on meaningful rather than correct uses of concepts.<sup>18</sup> Reflecting on how concepts travel and change between disciplines, Bal explains "while groping to define, provisionally and partly, what a particular concept may *mean*, we gain insight into what it can *do*. It is in the groping that the valuable work

- 19 Bal, *Travelling Concepts*, 17, original emphasis.
- 20 Diana Ridley, *The Literature Review: A Step-by-Step Guide for Students*, 2nd ed. (Los Angeles: SAGE, 2012), 56. The snowball technique involves starting from one or more core pieces of literature, expanding to the references listed by that text, and continuing from those texts to the references listed in each case.
- 21 Brown and Fehige, "Thought Experiments."
- 22 Auger, "Speculative Design," 11.
- 23 *Nature — Cooper Hewitt Design Triennial* (exhibition, May 10, 2019–Jan 20, 2020, Cooper Hewitt, Smithsonian Design Museum New York and Cube design museum, the Netherlands), accessed July 19, 2021, <https://collection.cooperhewitt.org/exhibitions/2318794480/>.
- 24 The Cube design museum closed at the end of 2020; the municipal government retracted its funding in light of the COVID-19 pandemic. It has since been absorbed into the Discovery Museum, which occupies the same location. "Cube Designmuseum Moet Sluiten — Provincie Limburg Stopt Subsidie (Cube Design Museum Must Close — Province of Limburg Stops Funding)," *Design Digger*, September 9, 2020, accessed July 14, 2021, <https://www.designdigger.nl/2020/09/09/cube-designmuseum-moet-sluiten-provincie-limburg-stopt-subsidie/>.
- 25 The *Nature* exhibition at the Cube was chosen for a number of reasons, including that it offered a range of design pieces to consider, preliminary analysis of press material indicated the exhibition would be amenable to a thought experiment reading, and it was both geographically and institutionally accessible. For more information, please visit <https://www.vevdl.com/en/projects/cube-nature>.
- 26 See Shahar Livne, "Metamorphism," *Shaharlivnedesign.com* (personal website), accessed July 14, 2021, <https://www.shaharlivnedesign.com/metamorphism>.
- 27 See Tracy Fullerton and USC Game Innovation Lab, "About," *Walden, a game* (official website), accessed July 14, 2021, <https://www.waldengame.com/>.
- 28 See Alexandra Daisy Ginsberg, "The Substitute," *Work*, *daisyginsberg.com* (personal website), accessed July 14, 2021, <https://www.daisyginsberg.com/work/the-substitute>.
- 29 Thomas Thwaites, "A Holiday from Being Human (GoatMan)," *Thomasthwaites.com* (personal website), accessed July 14, 2021, <http://www.thomasthwaites.com/a-holiday-from-being-human-goatman/>.

lies."<sup>19</sup> Through analyzing a cross-section of scholarly literature on thought experiments, we grope at what the concept means to gain insight into what it can do when applied to speculative design.

The literature on thought experiments spans the fields of philosophy, mathematics, science, and literature, and reaches into numerous other fields. Author Laura Barendregt used the snowball technique,<sup>20</sup> beginning with an article in the Stanford Encyclopedia of Philosophy.<sup>21</sup> Our analysis focused on identifying key debates and positions on thought experiments, which allowed us to reconsider our original skepticism toward using the term to describe speculative design. We found that the idea of the thought experiment has been defined more broadly than we first thought.

Our review of speculative design also employed the snowball technique, starting with suggestions from informants and colleagues. It is our view that all design is concerned to some degree with hypothetical scenarios. As a result, these may conceivably be understood in connection with thought experimentation. In this case, our research focused on speculative design. We also decided to include literature on critical design, since the differences among its community members' tangential practices and terms are "subtle and based primarily on geographical or contextual usage."<sup>22</sup>

We focused on literature written by practitioners and educators with academic credentials. Most of this involved articles published in design journals or magazines. We concentrated on texts that were frequently cited, seeming to offer a key contribution to the conceptualization of speculative design. We supplemented the literature with recorded, semi-structured interviews conducted by Barendregt with professionals and designers associated with the *Nature* exhibition<sup>23</sup> at the Cube design museum in the Netherlands.<sup>24</sup> This was the primary site of the research project that this article draws on.<sup>25</sup> Interviews lasted approximately one hour. We obtained interviewee consent orally at the start of each interview. Finally, we compared the concepts, teasing out parallels and points of divergence between speculative design and thought experiments, concerning ourselves primarily with how applying the term to speculative design would affect the conceptualization of speculative design and not thought experiments. Author Nora S. Vaage contributed to the analysis of the material and the argument of the article.

To give these rather abstract terms a concrete testing point, we considered four cases covering a spectrum of approaches and media: *Metamorphism*;<sup>26</sup> *Walden, a game*;<sup>27</sup> *The Substitute*;<sup>28</sup> and *GoatMan*.<sup>29</sup> We obtained information on these pieces through analysis of the works within the *Nature* exhibition. In addition, we used texts by project creators, news coverage, and research interviews via Skype or in person with the creator of each piece. Interviews followed the same procedure: one hour sessions by oral consent.

One consideration prior to conducting each of these interviews was whether to inform the participants of our view of speculative design and thought experiments. We did not want to introduce bias into the responses. Since these professionals have their own ideas about their work, and because they are aware of various perspectives, we concluded that presenting our viewpoint would not stop them from explaining their own positions. They each have a considerable stake in these conceptualizations, and our research

- 30 Auger, "Speculative Design," 12.  
 31 Dunne and Raby, *Speculative Everything*, 2.  
 32 Ibid., 4.  
 33 Alexandra Daisy Ginsberg, "Better: Navigating Imaginaries in Design and Synthetic Biology to Question 'Better'" (PhD dissertation, Royal College of Art, 2018), <https://researchonline.rca.ac.uk/3231/>.

Figure 2

With *Transfigurations*, Haines presents a range of hyperrealistic human "babies" (life size models) that have been surgically modified to cope with a high stress environment, for example a hotter or wetter climate. With this, the audience might be encouraged to ask: what are the benefits and hazards if we modify our children to adapt to a harsh reality, as opposed to seeking to limit the changes occurring in our natural environment? Please visit <https://www.agihaines.com/transfigurations> for more information. Images from the exhibition Human+ at Centre de Cultura Contemporània de Barcelona. © 2015 Nora S. Vaage.

aims to feed back into their fields, so for us to withhold this perspective — leaving our interests open to interpretation — would be unethical. However, we kept this concern in mind when developing our topic guide, so interviewees' current understandings of speculative design, their practice, and design piece were discussed before asking them to consider the thought experiment analogy.

Rather than reviewing each concept independently, we structured our analysis according to four interconnected categories that emerged from the literature: purpose, form, means of engagement, and context of consideration. These themes allow us to demonstrate the specific areas of speculative design that are affected by a consideration as thought experiments. While we discuss them in the order stated here, we do not consider these categories as a hierarchy. Each has potential to inform the others.

## Purpose

Within the literature, the primary purpose of speculative design is identified as facilitating public discussion.<sup>30</sup> As Dunne and Raby explain, speculative design

"aims to open up new perspectives on what are sometimes called wicked problems, to create spaces for discussion and debate about alternative ways of being, and to inspire and encourage people's imaginations to flow freely. Design speculations can act as a catalyst for collectively redefining our relationship to reality."<sup>31</sup>

The emphasis on public discussion and critical reflection has a political dimension. Speculative designers advocate for consumer involvement, as they believe that decisions affecting our future should be made more democratically. They hold that even our conception of what it means for a future to be preferable<sup>32</sup> or better<sup>33</sup> is currently determined by those in positions of power within Western, capitalist societies. Agi Haines' work *Transfigurations* is an example that does this well (Figure 2).



- 34 See John D. Norton, "Why Thought Experiments Do Not Transcend Empiricism," in *Contemporary Debates in Philosophy of Science*, ed. Christopher Hitchcock (Malden: Blackwell Publishing Ltd, 2004), 44–66.
- 35 While all counterfactual propositions are hypothetical by definition, the reverse does not hold. The distinction here is that counterfactual situations run against what we know to be real (a common example used is the scenario of Hitler remaining in power after 1945, or the Nazis winning WWII), whereas other hypothetical situations might be or become real under given circumstances. Sophie Roux, "Introduction: The Emergence of the Notion of Thought Experiments," in *Thought Experiments in Methodological and Historical Contexts*, ed. Katerina Ierodiakonou and Sophie Roux (Leiden: Brill, 2011), 1–33.
- 36 Peg Tittle, *What If ... Collected Thought Experiments in Philosophy* (New York: Pearson Longman, 2005), x. This view is more prominent in philosophy than in the sciences.
- 37 Brown and Fehige, "Thought Experiments," online; Sören Häggqvist, "A Model for Thought Experiments," *Canadian Journal of Philosophy* 39, no. 1 (2009): 57, DOI: <https://doi.org/10.1353/cjp.0.0040>. The experimentalist position, held by McAllister in "Evidential Significance" for example, asserts that like physical experiments, thought experiments provide evidence that supports or refutes a certain hypothesis.

### Figure 3

*The Incredible Shrinking Man* is an ongoing speculative project, initiated by Arne Hendriks but involving researchers and designers from various backgrounds to explore the idea of shrinking humans to 50cm for the purpose of conservation. While the team of researchers use their expertise to explore this scenario in relation to topics like food, ecology, dwarfism and entertainment, the project also consists of workshops that aim to bring together publics and experts to consider and construct the scenario in new and creative ways. <https://www.the-incredible-shrinking-man.net/>. 3a, 3b © 2018 Arne Hendriks. 3c © 2015 Nora S. Vaage.

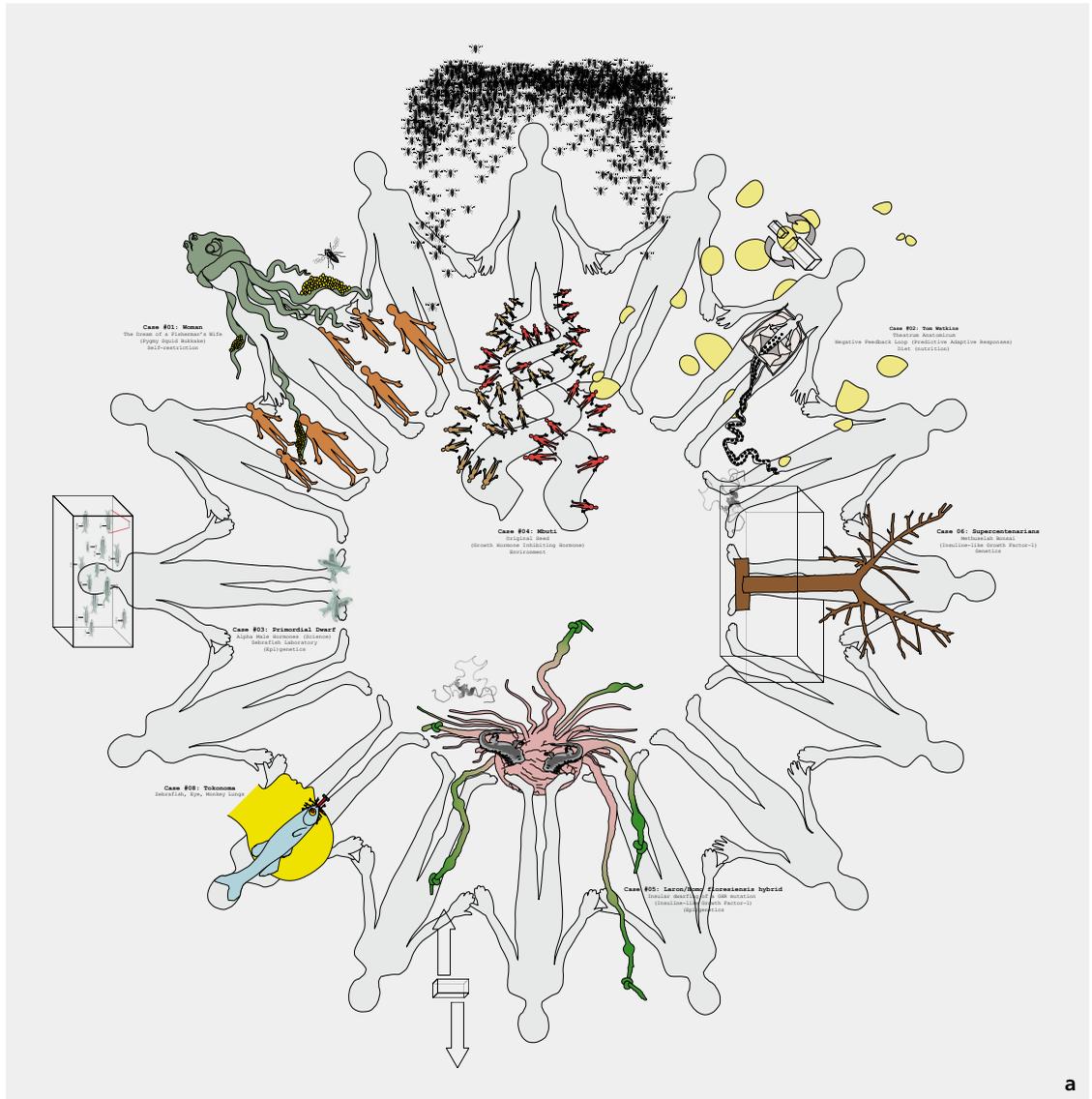
Perhaps because they are used within a range of different fields, scholars have used thought experiments for a number of different purposes. A much-referenced definition is John Norton's conception of thought experiments as arguments that use hypothetical or counterfactual situations to make their point.<sup>34</sup> However, as pointed out by several key scholars, this definition is not just limited by its focus on thought experiments as arguments, but also by the use of overlapping terms: counterfactual situations are also hypothetical, they also present us with a "what if."<sup>35</sup> Some argue that precisely this property of thinking "What if?" is at the core of every thought experiment.<sup>36</sup> Within physics and the other natural sciences, a primary purpose is testing theories and hypotheses.<sup>37</sup> Some scholars recognize the additional potential of thought experiments to be explanatory or heuristic tools.<sup>38</sup> Others argue that this is not a separate function—the claims made by a theory or hypothesis are made clear and evident<sup>39</sup> by way of illustration, and weaknesses revealed. In constructivist philosophy of science, thought experiments can also reveal inconsistencies in scientific theory and practice. This can potentially lead to a paradigm change or reform the existing system.<sup>40</sup> In all these various versions, the value of thought experimentation is the opportunity to consider something that is not readily accessible in our physical realm. That something may be a physical phenomenon, a scientific discovery, a societal structure, an ethical intuition, or a conception of the divine.

From the perspective of this article, it is most interesting to look to scholars who define the purpose of thought experiments in broader terms. They assert that thought experiments can provide novel insight into real-world phenomena<sup>41</sup> or generate ideas and multiple conclusions, rather than only illustrate a theory or hypothesis.<sup>42</sup> In her universal account of thought experiments in science and philosophy, Rachel Cooper states,

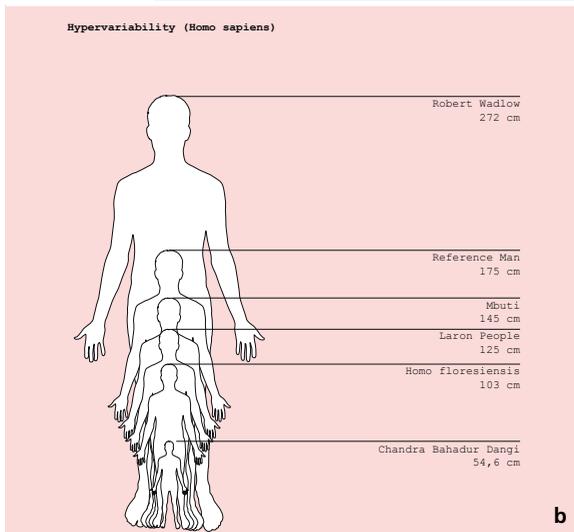
"Thought experiments can show us whether or not a situation is possible. In doing this they can indirectly teach us about the actual world. Discovering that a situation is impossible shows us how the world cannot be. Similarly, discovering that a situation is necessary shows us how the world must be."<sup>43</sup>

In replacing theory with situation, Cooper broadens the scope of how thought experiments can function, and what they can describe. Exactly what a situation comprises she leaves open to definition.

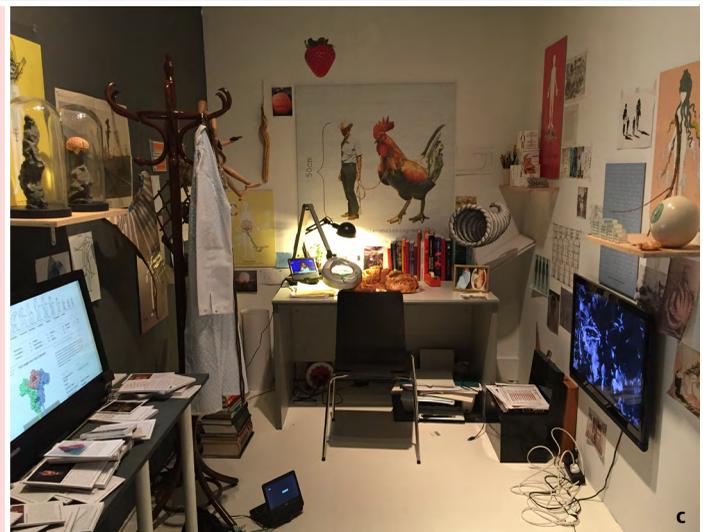
The argumentative understanding of the purpose of thought experiments could cause the audience of speculative design to focus on whether a future scenario will or will not occur, whether it is good or bad, and whether the designer endorses it. The assumption that speculative design amounts to an argument for or against any specific scenario could prove destructive to the purpose of provoking open discussion on contemporary issues. If this understanding of purpose is carried over to speculative design, the nuanced reflection designers say they strive for may be lost. Instead, by adopting broader definitions that consider thought experiments as heuristic tools that allow multiple conclusions, designers can present speculative design thought experiments as open ended structures in a process of cocreation with an audience. Audiences can draw different conclusions from a scenario without necessarily supporting or rejecting it. An example of this in practice is *The Incredible Shrinking Man* (Figure 3).



a



b



c

- 38 Karl Popper, "On the Use and Misuse of Imaginary Experiments, Especially in Quantum Theory," in *The Logic of Scientific Discovery* (1959; London: Taylor & Francis Group, 2005), 465; Georg Brun, "Thought Experiments in Ethics," in *The Routledge Companion to Thought Experiments*, ed. Michael T. Stuart, Yiftach Fehige, and James R. Brown (Abingdon: Routledge, 2018), 200–201, DOI: <https://doi.org/10.4324/9781315175027-12>.
- 39 Brown and Fehige, "Thought Experiments."
- 40 Tamar Szabó Gendler, "Galileo and the Indispensability of Scientific Thought Experiment," *The British Journal for the Philosophy of Science* 49, no. 3 (1998): 397–424, DOI: <https://doi.org/10.1093/bjps/49.3.397>; Thomas S. Kuhn, "A Function for Thought Experiments," in *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago: University of Chicago Press, 1977), 240–65.
- 41 Nancy J. Nersessian, "Cognitive Science, Mental Modeling, and Thought Experiments," in *The Routledge Companion to Thought Experiments*, ed. Michael T. Stuart, Yiftach Fehige, and James R. Brown (Abingdon: Routledge, 2018), 309, DOI: <https://doi.org/10.4324/9781315175027>.
- 42 Brun, "Thought Experiments in Ethics," 196–98.
- 43 Rachel Cooper, "Thought Experiments," *Metaphilosophy* 36, no. 3 (2005): 339, DOI: <https://doi.org/10.1111/j.1467-9973.2005.00372.x>. Cooper's assertion is in line with the spirit of Dunne and Raby's argument, as they emphasize that speculative design is not interested in the impossible (the realm of fantasy). But rather than focusing on the probable, which in their view is where most design exists, it operates between the plausible and the possible, and often with a strong interest in what is preferable. Dunne and Raby, *Speculative Everything*, 3–6.
- 44 Like many scholars, Kuhn acknowledges the "category of 'thought experiment' is ... too broad and vague for epitome," noting that his analysis focuses on the class of thought experiments that proved effective in the twentieth century reformulation of physics. Kuhn, "A Function," 241.
- 45 Malpass, "Between Wit and Reason," 341.
- 46 Alisa Bokulich, "Rethinking Thought Experiments," *Perspectives on Science* 9, no. 3 (2001): 285, DOI: <https://doi.org/10.1162/10636140160176152>; Brun, "Thought Experiments in Ethics," 195–210; McAllister, "Evidential Significance," 240.
- 47 Swirski, *Of Literature and Knowledge*, 96–123.
- 48 Letitia Meynell, "Images and Imagination in Thought Experiments," in

Thomas Kuhn notes that not all thought experiments highlight contradictions in our present understandings.<sup>44</sup> Despite this, the revisionary potential of the thought experiment is integral to speculative designs intended to provoke critical reflection of the status quo. When applied to speculative design, this purpose of thought experiments is central—the analogy serves as a reminder to practitioners working with speculative design to ensure that open and critical reflection is part of an audience's engagement and experience with the piece.

## Form

Speculative design is generally understood to take the form of an artifact situated within a scenario communicated to an audience through a framing device such as image, film, or narrative text. As Malpass explains, the objects function as props, but they "are often subsumed within larger narratives or contexts, constituting but one part of a larger design device."<sup>45</sup> This interplay of various forms and materials can be seen in the iterations of Ai Hasegawa's *I Wanna Deliver a Dolphin* (Figure 4).

Among the many terms that scholars use to describe or explain thought experiments, "scenario" appears so frequently<sup>46</sup> that it is understood to be the core of a thought experiment. Traditionally, these scenarios take the form of a narrative (written or spoken), and thereby rely on some of the tools of literary fiction.<sup>47</sup> The narrative can be accompanied by visual illustrations—diagrams, images, animations—that depict aspects of the experiment. This is a common practice in thought experiments for the physical sciences.<sup>48</sup> The perception of the potential forms through which thought experiments can be represented has broadened with application of the term to film<sup>49</sup> and video games.<sup>50</sup>

A mutual concern with scenarios is one of the strongest parallels between speculative design and thought experiments, as some of our interviewees observed.<sup>51</sup> When conceptualized as thought experiments, the scenario aspect of speculative design takes center stage, instead of merely providing background information for a designed object. Designers may replicate the strategies of thought experimentation while adjusting the concepts to fit their specific purposes. This is apparent in *Speculative Everything* when Dunne and Raby divide thought experiments into three categories: reductio ad absurdum, counterfactual, and what-if scenarios.<sup>52</sup> While all three categories are found in the larger literature on thought experiments, Dunne and Raby disregard the fact that both the reductio ad absurdum and counterfactual scenarios are also ways of asking, "What if...?"<sup>53</sup> The difference in Dunne and Raby's conceptualization of the what-if category is that they connect it to scenarios describing the future, rather than (alternative or possible) present day or past situations.<sup>54</sup>

When conceptualized as thought experiments, we expect designers to continue using text, images, and film to contextualize speculative design objects. This contextualizing material may become more prominent to ensure that the scenario is adequately communicated to the audience.<sup>55</sup> In practice, this can serve as a reminder that the prop or prototype is not in itself the

Figure 4

Ai Hasegawa's *I Wanna Deliver a Dolphin* presents its audiences with a scenario where humans gestate and birth animals as a response to issues of overpopulation and endangered species. This scenario is presented through a range of materials including a yes/no flowchart to help potential mothers decide what species to carry, and a physical prop of a dolphin inside a womb, similar to those found in an obstetric clinic. She also makes use of video "documenting" a live water birth, available at <https://aihasegawa.info/i-wanna-deliver-a-dolphin>. This more graphic yet tranquil account has the potential to stimulate a more visceral response from audiences. © 2013 Ai Hasegawa.



**Dolph-human Placenta**  
The placenta originates from the baby's side, which in this case is a dolphin, and not from the human side. This avoids the ethical and legal difficulties associated with reproductive research involving human eggs.

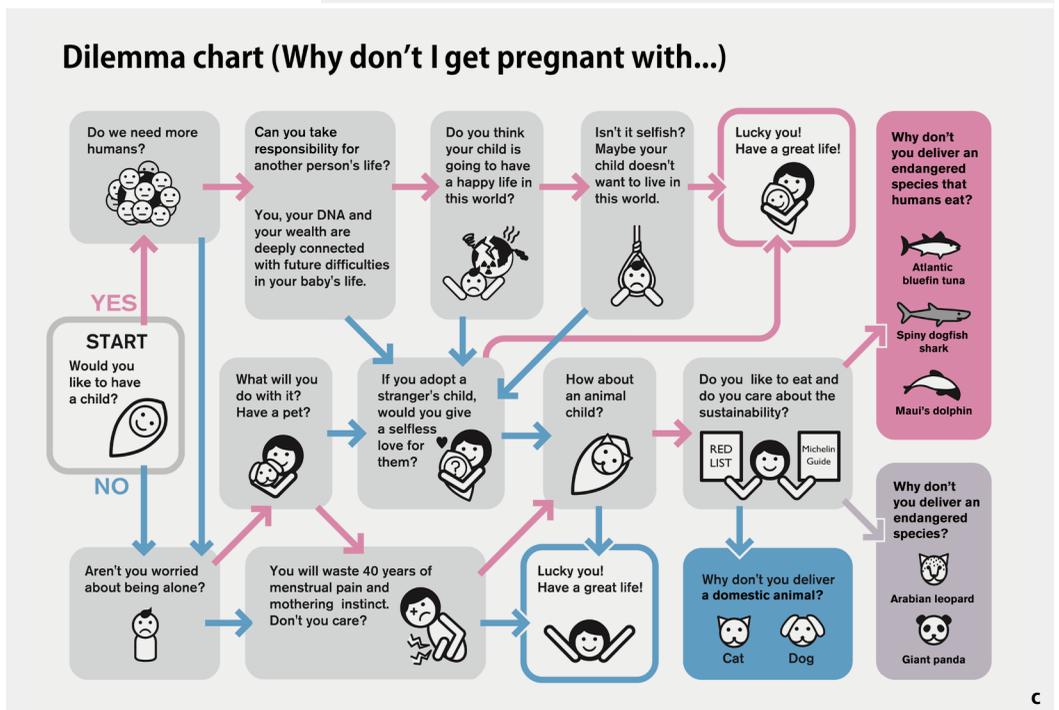
The decidua is formed by implantation of the egg. Usually, foreign cells in the body (for example from other individuals) are attacked by the immune system, but inside the decidua, they are tolerated. However, even though the decidua accepts cells from other individuals, non-human cells would still be attacked. In the dol-human placenta's case, it has been modified to distinguish mammals from non-mammals, making it even more tolerant.

**Normal human placenta:** Oxygen, nutrients, hormones and antibodies (immunoglobulin Gamma, IgG) delivered to the baby. Dol-human placenta blocks delivery of IgG to the baby.

**Wastes and carbon dioxide delivered from the baby**

**Māui's dolphin (Critically Endangered)**  
The world's rarest and smallest known subspecies of dolphin. As of 2016, it is estimated that 63 adults (95% confidence there are between 57 and 75) Maui's dolphins exist in the world. The main reason for the unatural Maui deaths are caused by entanglement and drowning in gillnet or trawl fishing. Adults measure between 1.2 - 1.4 m and weigh up to 30 kg. The newborn baby is almost the same size as a human baby (50 - 60 cm). Lifespan 20 years. New Zealand, West coast of North Island.

**First milk**  
Dol-human placenta blocks delivery of human IgG to the dolphin baby. Usually Dolphin placenta does not pass the immune system from the mother, instead it is passed by the first milk, which contains with high levels of several antibodies. Also, dolphin milk contains high levels of fat. The human mother needs to feed the synthesised first milk to the baby just after the delivery.



- The Routledge Companion to Thought Experiments*, ed. Michael T. Stuart, Yiftach Fehige and James R. Brown (Abingdon: Routledge, 2018), 509, DOI: <https://doi.org/10.4324/9781315175027-29>.
- 49 David Davies, "Can Philosophical Thought Experiments Be 'Screened'?", in *Thought Experiments in Philosophy, Science, and the Arts*, ed. Mélanie Frappier, Letitia Meynell and James R. Brown (New York: Routledge, 2013), 223–38, DOI: <https://doi.org/10.4324/9780203113271-21>.
- 50 Marcus Schulzke, "Simulating Philosophy: Interpreting Video Games as Executable Thought Experiments," *Philosophy & Technology* 27, no. 2 (2014): 251–65, DOI: <https://doi.org/10.1007/s13347-013-0102-2>.
- 51 Gene Bertrand, research interview, April 26, 2019; Alexandra Daisy Ginsberg, research interview, May 2, 2019; Shahar Livne, research interview, May 3, 2019.
- 52 Dunne and Raby, *Speculative Everything*, 80–87.
- 53 See Cooper, "Thought Experiments," 328–47; Roux, "Introduction"; Tittle, *What If...;* and Bokulich, "Rethinking Thought Experiments," 287.
- 54 In making this distinction, Dunne and Raby present *The Golden Institute* by Sascha Pohflepp as an example of a counterfactual thought experiment. It imagines an alternative energy history for the USA. They contrast this to the forward facing what-if scenario *SlaveCity—Cradle to Cradle* by Atelier Van Lieshout, which considers a scenario where humans become slaves in the production of energy. Dunne and Raby, *Speculative Everything*, 84, 87; see also Atelier Van Lieshout, "Cradle to Cradle," Works, *Ateliervanlieshout.com* (professional website), accessed July 14, 2021, <https://www.ateliervanlieshout.com/work/cradle-to-cradle/>.
- 55 At present, the extent to which the scenario is communicated depends on curatorial decisions within a given exhibition context.
- 56 Schulzke, "Simulating Philosophy," 252.
- 57 *Ibid.*, 263.
- 58 *Ibid.*, 252.
- 59 Sanjay Chandrasekharan, Nancy J. Nersessian, and Vrishali Subramanian, "Computational Modeling: Is This the End of Thought Experiments in Science?" in *Thought Experiments in Philosophy, Science, and the Arts*, ed. Mélanie Frappier, Letitia Meynell and James R. Brown (New York: Routledge, 2013), 256, DOI: <https://doi.org/10.4324/9780203113271-22>.
- 60 Elgin, "Understanding," 24.
- 61 Meynell, "Images and Imagination," 509.

speculative design piece, but one aspect within the overall aim of eliciting the imagination of a speculative scenario.

Additionally, the necessity of a central object may be relaxed as designers might embrace forms of virtual simulation as ways of creating engaging thought experiments. Marcus Schulzke made the first step in this direction, suggesting that video games can be understood as "virtual thought experiments" that "function heuristically ... when they are interpreted as modelling philosophical problems."<sup>56</sup> He considers them in comparison to narrative thought experiments in philosophy, arguing that constructing a thought experiment through the medium of video games has the benefit of allowing experiments to be performed within the simulation of the game. Another benefit Schulzke gives is that the medium can "raise problems ... without giving answers," allowing players to use the game to explore different philosophical possibilities,<sup>57</sup> which resonates strongly with the goals of speculative design.

This discussion of form raises a question of how material or virtual a thought experiment can be. Schulzke acknowledges that a primary difference between thought experiments and video games is an element of performance. This element allows people to perform the actual experiment within the experiential world of the game.<sup>58</sup> This is perceivably a challenge to the criterion that thought experiments are executed exclusively within the mind and displays how the properties of an experiment change when it is moved from the mental to virtual realm. Some scholars classify computer simulations as distinct from thought experiments on a "spectrum of simulative model-based reasoning."<sup>59</sup> Catherine Elgin opposes this position arguing that thought experiments "instantiate phenomena they concern not literally, but metaphorically." Since what occurs in computer simulations "can be metaphorically described as at a temperature of absolute zero," they cannot be considered literally instantiated and so can still be regarded as thought experiments.<sup>60</sup> This argument creates space for designers using virtual reality or computer simulation in their speculative design thought experiments, but it may also raise problems for those producing (working) prototypes and positioning their work in this way. However, we argue that these physical objects, similar to virtual enactments and conventional contextualizing media, only give a focal point from which the scenario unfolds. Thus, it is better not to understand these as a form of literal instantiation. Rather, they promote different types of imaginings<sup>61</sup> in the speculative design thought experiment. Theoretically, this opening up of form changes the category of "speculative design" and may encourage design practitioners and theorists alike to make different comparisons, including other design practices that might not be considered if the category were defined in connection to product design.

## Means of Engagement

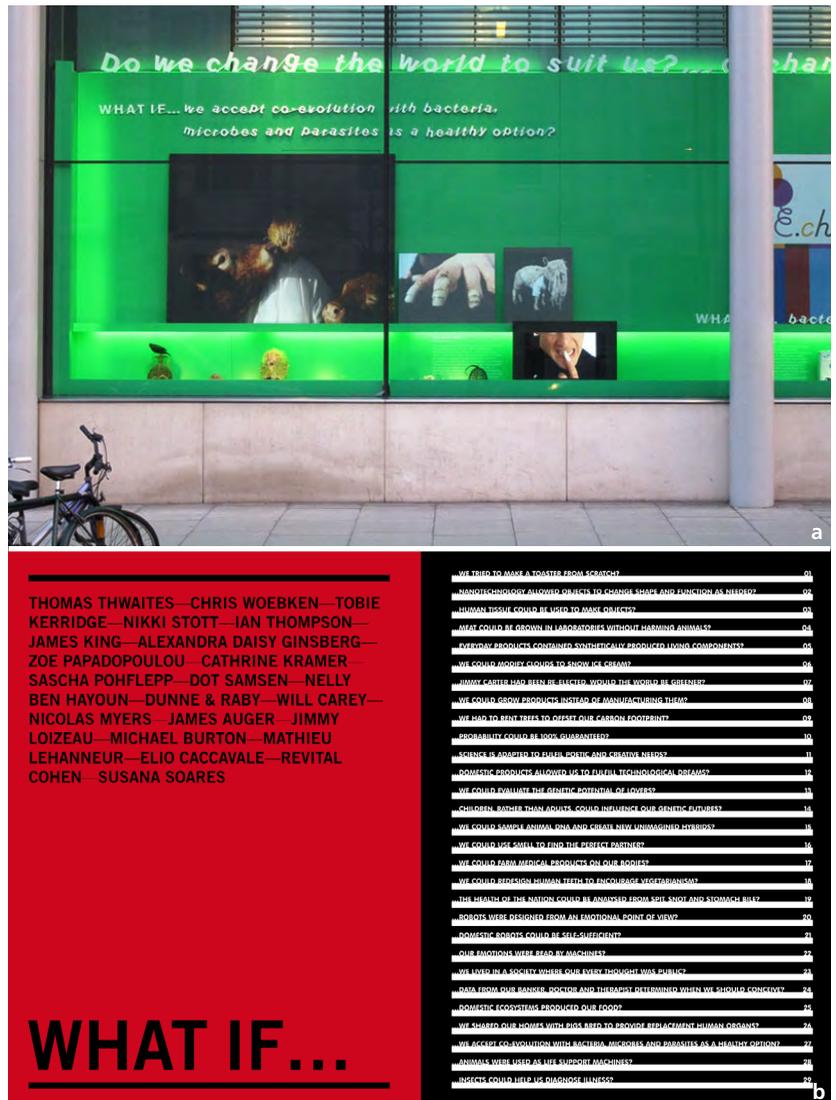
Designers claim that speculative designs achieve their purpose of sparking discussion and reflection through the audience's engagement with the speculative artifact and contextualizing material. They argue that the artifact materializes the scenario via tangible form, acting as an access point

- 62 Auger, "Speculative Design," 20; Dunne and Raby, *Speculative Everything*, 6; Malpass, "Between Wit and Reason," 333–56.
- 63 This emphasis on access points can be a fruitful contribution by the design field to the theocratization of thought experiments. The potential for mutual enrichment is part of the reason we encourage further exchanges between designers and social science and humanities scholars.
- 64 Auger, "Speculative Design," 12.
- 65 Dunne and Raby, *Speculative Everything*, 3, 86–87.

to the imagined scenario and catalyst for discussion and reflection.<sup>62</sup> By imagining future or alternative scenarios, audiences are able to critically reevaluate the status quo and reimagine their current society in terms of their newfound insight.<sup>63</sup>

One concern in the literature is how to ensure meaningful engagement, since authors generally agree that the speculative design or its presentation should not alienate its audience. James Auger suggests that one way designers can ensure their work remains accessible is to provide audiences with a perceptual bridge that allows them to move from their own context to the realm of the design concept.<sup>64</sup> Dunne and Raby build on Auger asserting that a what-if proposition can be used both to create a scenario and as a perceptual bridge, inviting the audience to suspend disbelief and entertain an alternative reality (Figure 5).<sup>65</sup>

Figure 5  
Dunne and Raby experimented with this tactic in a series of *WHAT IF ...* exhibitions between 2009–2011. 5a is of the iteration at the Wellcome Trust Windows 2010–11, and 5b is an excerpt from the catalogue of the iteration at the Science Gallery at Trinity College Dublin 2009. 5a © 2011 Anthony Dunne & Fiona Raby. 5b © 2009 Science Gallery at Trinity College Dublin.



- 66 Cooper, "Thought Experiments," 328–47; see examples in Häggqvist, "A Model," 60.
- 67 Ross P. Cameron, "Improve Your Thought Experiments Overnight with Speculative Fiction!," *Midwest Studies In Philosophy* 39, no. 1 (2015): 29–45, DOI: <https://doi.org/10.1111/misp.12033>; Davenport, "Literature as Thought Experiments," 281, 301–02; Elgin, "Understanding," 24.
- 68 Meynell, "Images and Imagination," 498.
- 69 Albert Einstein and Leopold Infeld, *The Evolution of Physics* (Cambridge, UK: Cambridge University Press, 1938), 8.
- 70 Cameron, "Improve Your Thought Experiments," 43.

Imagination is an integral component of thought experimentation. The invitation to imagine (and related acts) features heavily in the literature, it often signals the start of a thought experiment.<sup>66</sup> Scholars applying the term to the arts also use the terms "imagine" and "imaginative" when defining thought experiments.<sup>67</sup> This widespread use of imagine and its derivatives places the act of imagination at the core of thought experimentation and stipulates the non-material or "otherwise" character of the experiment.<sup>68</sup>

Interestingly, the thought experiment literature sometimes characterizes this imaginative mechanism as "speculative thinking." When considering the connection between the work of Galileo and Newton, Albert Einstein and Leopold Infeld stated, "We have seen that this law of inertia cannot be derived directly from experiment, but only by speculative thinking consistent with observation" (see Figure 6).<sup>69</sup> More recently, Ross P. Cameron posited speculative fictions as extreme moral and metaphysical thought experiments. He argues that unlike realist fiction, writers of speculative fiction can focus on specific issues through abstracted scenarios, without dilution by the restrictions of reality, thus testing our comfort zone.<sup>70</sup> Within this interpretation, speculative thinking becomes key for creating useful and engaging thought experiments.

These arguments about the importance of speculative thinking in thought experiments reinforce its connection to speculative design. The systematic and rigorous approach to imagining that constitutes a defining feature of thought experimentation could be an asset for speculative design. By upholding this requirement, we believe designers and curators will have to seriously consider how best to present a speculative design to maximize imaginative engagement. We can see designers and curators utilizing existing concepts and practices in speculative design (like Auger's perceptual bridges) and thought experimentation, as well as inventing new ways to enable a deeper consideration of the scenario on the part of the audience and thus more reflection.

Thought experiments follow a basic structure where the experimenter or participants first imagine a scenario and allow it to play out according to

Figure 6

Galileo's thought experiment on inertia. Galileo argued that in the complete absence of friction, a ball rolling down a hill would have enough momentum to reach the same height on an opposite hill, regardless of the inclination of the uphill slope. Using this logic, on a level surface, the ball would roll indefinitely, in the absence of any returning forces. The conclusion, that an object will continue moving with constant velocity unless acted upon by a force, was adopted by Newton as his first law of motion. Image by MikeRun at Wikimedia Commons, 2018; licensed under CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0/>).

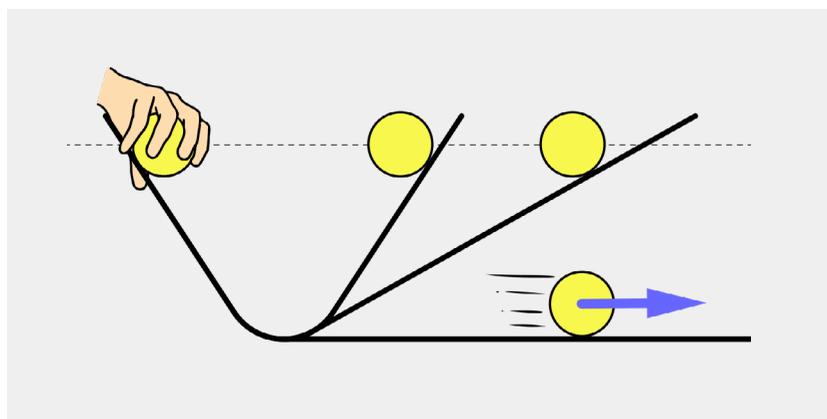
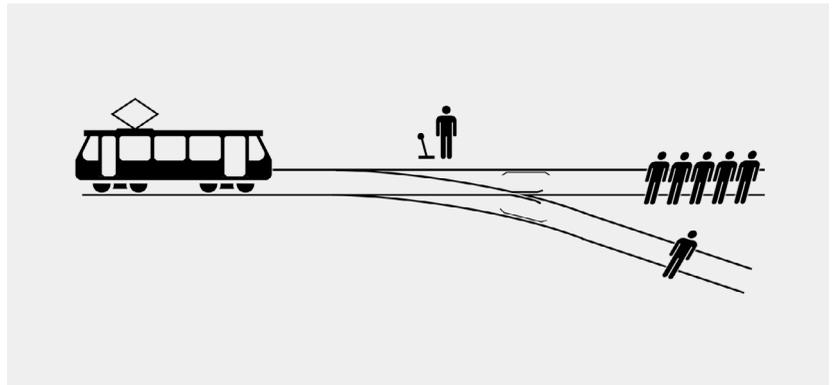


Figure 7

The Trolley Problem has several interesting variations that radically impact its ethical responses. What if the only way to save the five workers is to push one large man onto the tracks, stopping the trolley before it reaches the others? Very few people would condone this active killing, whereas in the original scenario, pulling the lever saves five people, and changing the track has the unfortunate side effect that one person still has to die. Image by McGeddon at Wikimedia Commons, 2016; licensed under CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0/>).



- 71 Cooper, "Thought Experiments," 336.  
 72 Brown and Fehige, "Thought Experiments"; Brun, "Thought Experiments in Ethics," 196.  
 73 Philippa Foot, "The Problem of Abortion and the Doctrine of the Double Effect," in *Virtues and Vices and Other Essays in Moral Philosophy* (1967; Oxford: Clarendon Press, 2002), 19–32.  
 74 Cooper, "Thought Experiments," 337.  
 75 Brown and Fehige, "Thought Experiments," online.  
 76 Christopher W. Bauman et al., "Revisiting External Validity: Concerns About Trolley Problems and Other Sacrificial Dilemmas in Moral Psychology," abstract, *Social and Personality Psychology Compass* 8, no. 9 (2014): 536, DOI: <https://doi.org/10.1111/spc3.12131>.

certain rules. These may either be the rules of our given natural and social world, or variations on these rules specified by the experimenter.<sup>71</sup> We can then consider the results of the course of events and reactions to the course of events, drawing conclusions from this.<sup>72</sup> While thought experiments in science work through an imaginative yet reasoned cause-and-effect logic to gain credibility and refute potential criticism, thought experiments in ethics explore philosophical theories and the often mysterious human moral compass. As a result, they allow us to seek both rational and instinctive reactions within the same thought experiment. A good example of an ethics thought experiment is Philippa Foot's *Trolley Problem* (Figure 7).<sup>73</sup> In her scenario, audiences are asked to imagine they are on a trolley car speeding down the track towards five workers. All they can do to avoid killing the workers is switch the trolley to an adjacent track with just one worker on it, killing one person instead of five. By imagining what they would do in this situation, audiences can test various ethical theories or explore their own instinctive moral reaction.

Cooper adds that this imaginative process must be conducted in a rigorous fashion, and that this is what "differentiates thought experiments from daydreams and much fiction."<sup>74</sup> Attention to detail and rigor should be critical factors when evaluating thought experiments. As James R. Brown and Yiftach Fehige observe, "The more detailed the imaginary scenario in the relevant aspects, the better the thought experiment."<sup>75</sup>

Some scholars have argued against the use of sacrificial dilemma models of thought experiments (like the Trolley Problem), because they are "unrealistic and unrepresentative of the moral situations people encounter in the real world."<sup>76</sup> While in this instance rigor and credibility are equated with realism, we argue against this correlation in the case of speculative design as it undermines the inherent purpose of considering alternatives and questioning the status quo. Instead, rigor can imply that a scenario's premises render it accessible and credible to the experimenter, and that its presentation encourages the experimenter to commit to engaging with the scenario and considering its potential. This emphasis on rigorous imagination and speculative thinking could generate a critique that speculative design conceptualized as thought experiments will privilege intellectual engagement. We

- 77 Auger, "Speculative Design," 20; Dunne and Raby, *Speculative Everything*, 6–9.
- 78 Malpass, "Criticism and Function," 59–64.
- 79 Dunne and Raby, *Speculative Everything*, 43.
- 80 Auger, "Speculative Design," 9.
- 81 Oron Catts and Ionat Zurr, "Artists Working with Life (Sciences) in Contestable Settings," *Interdisciplinary Science Reviews* 43, no. 1 (2018): 40–53, DOI: <https://doi.org/10.1080/03080188.2018.1418122>; Suzanne Lee and Nadine Bongaerts, "Collaborating with...," in *Nature: Collaborations with Design*, ed. Andrea Lipps et al. (New York: Cooper Hewitt, Smithsonian Design Museum, 2019), 197–203.
- 82 Anderson, "Ethics, Ecology, and the Future," 340.
- 83 Thomas Thwaites, personal correspondence, March 24, 2021.
- 84 Dunne and Raby, *Speculative Everything*, 102; Norman Potter, "Is a Designer an Artist?," in *Design and Art: Documents of Contemporary Art*, ed. Alex Coles (London: Whitechapel Gallery & MIT Press, 2007), 31, available at <https://advdesign2017.files.wordpress.com/2017/07/is-designer-an-artist-potter.pdf>.
- 85 Cameron, "Improve Your Thought Experiments"; Davenport, "Literature as Thought Experiments"; Elgin, "Understanding"; Swirski, *Of Literature and Knowledge*.
- 86 Davies, "Philosophical Thought Experiments."
- 87 Schulzke, "Simulating Philosophy."

argue that speculative designs can function in a similar way as ethics thought experiments, with the added potential to engender embodied and emotional engagement with the possibilities inherent in a thought experiment, because designers use the materiality of the form to enhance instinctive, emotional, and visceral responses to certain scenarios. Ai Hasegawa's *I Wanna Deliver a Dolphin* is a prime example of a piece that does this (see Figure 4). Similarly, the analogy can encourage designers and audiences to consider how the thoughts triggered by the specific scenario can potentially be translated into broader insights, like ethics thought experiments such as the Trolley Problem.

### Context of Consideration

While there is consensus in the literature that speculative design has been informed by both art and design movements of the 1960s and 1970s,<sup>77</sup> and that, historically, artistic discourses have informed interpretations of critical design,<sup>78</sup> there is disagreement over where to position these types of critically inclined and imaginatively informed works. Some hold the work should be interpreted exclusively as design, arguing that interpreting speculative design within an artistic context will lead the audience to dismiss the provocation as mere fiction, reducing its capacity to evoke meaningful discussion and reflection.<sup>79</sup> They believe that presenting the artifacts and scenarios as design anchors them more within reality, stating, "It is preferable for the concept to pass as *real*."<sup>80</sup> Critics of this position assert that enabling a design to pass as real takes speculative design in a direction that risks misinforming the public and skewing their understanding of contemporary design, science, and technology. These critics are often practitioners within the arts and sciences who work materially with the technology they comment on, rather than imaginatively.<sup>81</sup> Paradoxically, one group worries the design will look too real, and the other that it is not real enough. The anxiety behind both concerns is that when placed in a certain context, the critical and reflective potential of the work will be impinged. Kayla Anderson occupies a third position, arguing it is the "decisive liminality" of these practices and their ability to be interpreted through various lenses that "lends them power," giving the example of Jae Rhim Lee and the *Infinity Burial Suit* (Figure 8).<sup>82</sup>

The strong association of thought experiments with science and philosophy means using the term to conceptualize another entity will cause it to be compared to (or even included in) its original context of use. This is potentially helpful to designers wanting to position themselves within and collaborate with those in academic contexts. (Interdisciplinary) collaboration is an important part of critical and speculative design work; the "thought experiment" frame could be a way to create a shared space of understanding with potential collaborators unfamiliar with speculative design.<sup>83</sup> While the connection between science, philosophy, and design is not a new move,<sup>84</sup> making an explicit comparison with the thought experiment concept provides designers with a new tool to engage these domains.

A recent wave of scholarship on thought experiments has considered the applicability of the concept to a number of artistic fields such as literature,<sup>85</sup> film and cinema,<sup>86</sup> and video games.<sup>87</sup> These applications stem from a desire

Figure 8

*The Infinity Burial Suit* began as a speculative project, becoming more material and “real” over time — today Lee’s company Coeio manufactures and sells a range of Infinity Burial products at <https://coeio.com/>. While the project can, at this point, easily be classified as product design, at the beginning (2011 onward) Lee often positioned herself as an artist to put her audiences at ease when presenting her provocation. This image of the suit was taken at the *Nature* exhibition at the Cube design museum in 2019. © 2019 Laura Barendregt.



to explain the cognitive power and function of the arts, and they substantiate the claim that engaging with artistic mediums can generate knowledge. Through our ethnographic research, we have both observed practitioners drawing on the concept of thought experiments when discussing speculative design or being amenable to the comparison if they have not been confronted with it before. As professionals they are often aware of the connection between speculative design and thought experiments, and they are also aware of the existing literature on thought experiments in the arts. As a result, they feel that the comparison strengthens the connection of speculative design to the arts. However, we should not assume that this connection is common knowledge to a general public. In a case study of a design exhibition, Barendregt found that when visitors encountered the designation of thought experiment, many became confused and rejected the designation. However, more specific research across more cases is required to substantiate this observation beyond a tentative claim.

### Crafting a Set of Criteria

So far, we have identified aspects of speculative design that would be highlighted or problematized by a conceptualization as thought experiments. We have offered a series of assertions on how a speculative design project acting as a thought experiment would be expected to appear, function, and be considered. These expectations are that the project [1] invites an audience to test, consider, and explore a scenario in a [2] rigorous and imaginative fashion. The scenario should be rigorously constructed and [3] be presented in a way whereby it is not literally instantiated. The conclusions drawn from the scenario should ultimately [4] foster critical reflection in the audience, either

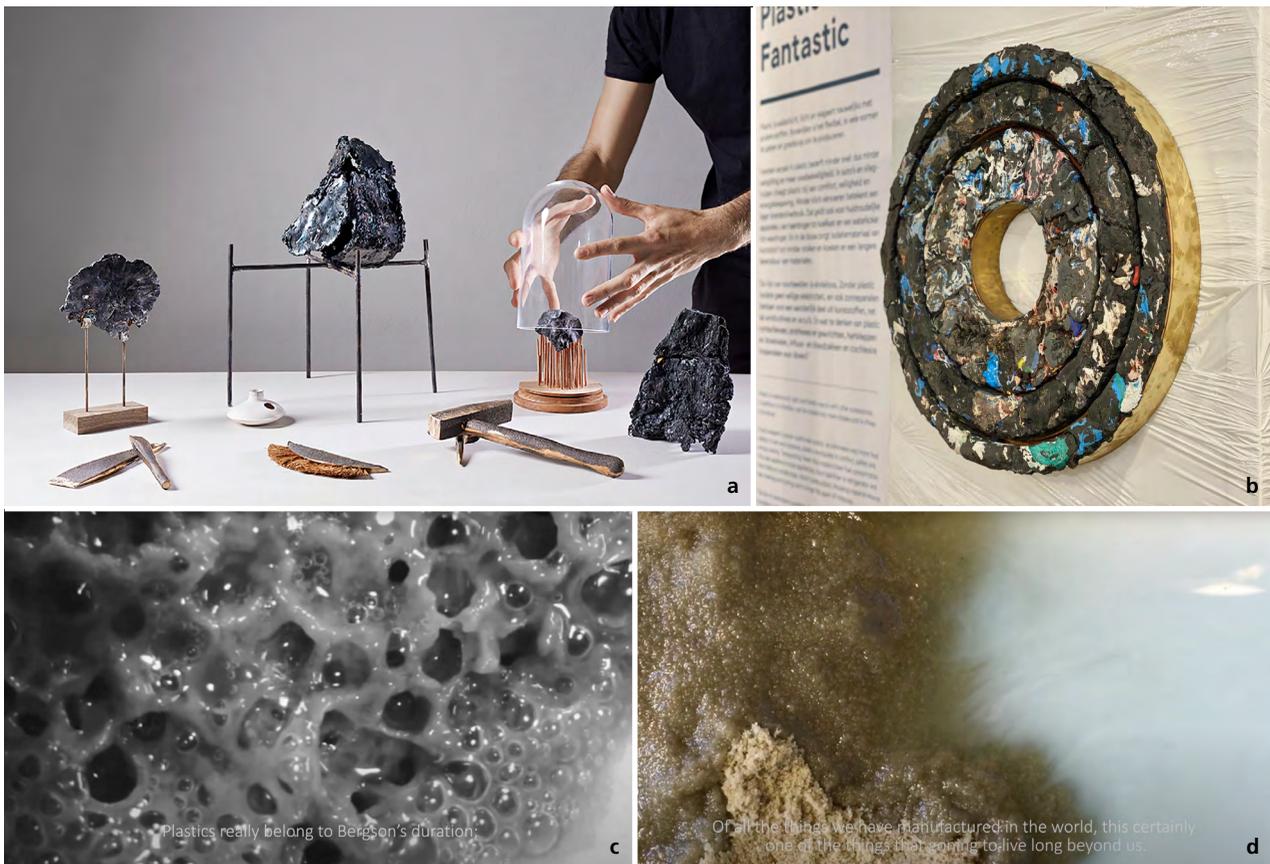


Figure 9

*Metamorphism's* speculative scenario is represented and elicited through a number of artifacts and contextualizing material. 9a presents material and designed objects. These can be displayed in exhibitions alongside more designed pieces like *Metamorphism—Deep Time* and didactic panels as in 9b, or accompanied by video material like 9c and 9d, full video can be accessed at <https://www.youtube.com/watch?v=3tacBVPyix-A&t=7s>. 9a © 2020 Shahar Livne, Design Academy Eindhoven, and Ronald Smits. 9b, 9c, 9d © 2020 Shahar Livne.

by highlighting contradictions in the status quo or by encouraging them to transfer insight gained from the specific scenario to other contexts.

### Testing the Criteria

We will now test these four criteria against four cases that can be conceptualized as speculative design.

*Metamorphism* by Shahar Livne drafts a distant, yet possible, future scenario where plastic waste that once polluted the Earth has been absorbed by nature and is mined as a raw material. Livne uses “Lithoplast,” the speculative material outcome of this metamorphic process, to engage people in this scenario. Lithoplast is presented in exhibitions in various forms, often alongside the tools she uses to work it and video material (Figure 9). She sees the material as a prop to provoke imaginative engagement with the scenario and its material consequences, and reframe our planet’s plastic “problem.” *Metamorphism* aligns with all the criteria that (tentatively) establish a speculative design as a thought experiment. It is therefore a model example of this conception. Livne also uses the term to frame her work, explaining *Metamorphism* should be



Figure 10  
Stills from *Walden, a game*. © 2014–2020  
Tracy Fullerton and the Walden Team.

considered “beyond its embodiment in plastic; it is a ‘thought-experiment’ on materials production and culture, in both historical and futuristic contexts.”<sup>88</sup>

*Walden, a game*, is an open world simulation by Tracy Fullerton and the Game Innovation Lab at the University of Southern California (USC). It is based on *Walden*,<sup>89</sup> Henry David Thoreau’s account of his two-year philosophical experiment in deliberate and self-reliant living by Walden Pond in Concord, Massachusetts. The video game constitutes a “virtual version of Walden” that allows the player to “live Thoreau’s experiment”<sup>90</sup> (Figure 10). The creators took *Walden* as their starting point and further enhanced their perspective by studying 1800s paintings of the landscape and visiting Walden Pond State Reservation in Massachusetts. Their rigorous reconstruction aims to create an authentic virtual experience of the environment that Thoreau interacted with over 150 years ago. *Walden, a game* is an interesting case because it enables players to conduct an experiment locked to a specific time and place that is impossible to access physically in the present.

*The Substitute* by Alexandra Daisy Ginsberg features a digital rendering of a male northern white rhinoceros, an African subspecies on the brink of extinction. Set in a white room, devoid of context, the piece consists of a soundtrack of rhino noises and a series of pixels slowly assembling to form the rhino, which disappears in an instant before the process starts again (Figure 11). Similar to *Walden, a game*, it parallels the real world. Several groups of scientists are currently working to restore the species through

88 Livne quoted in Jim Biddulph, “Jim Biddulph in Conversation with Shahar Livne,” *Design Insider*, June 29, 2018, accessed July 12, 2021, <https://www.designinsiderlive.com/jim-biddulph-in-conversation-with-shahar-livne/>.

89 Henry D. Thoreau, *Walden; or, Life in the Woods* (Boston: Ticknor and Fields, 1854), available at <https://www.gutenberg.org/files/205/205-h/205-h.htm>.

90 USC Game Innovation Lab, “Behind the Scenes of Walden, a Game,” YouTube video, 10:28, posted by USC Game Innovation Lab, Jan 22, 2018, <https://www.youtube.com/watch?v=eOQPgA5aAUM>.

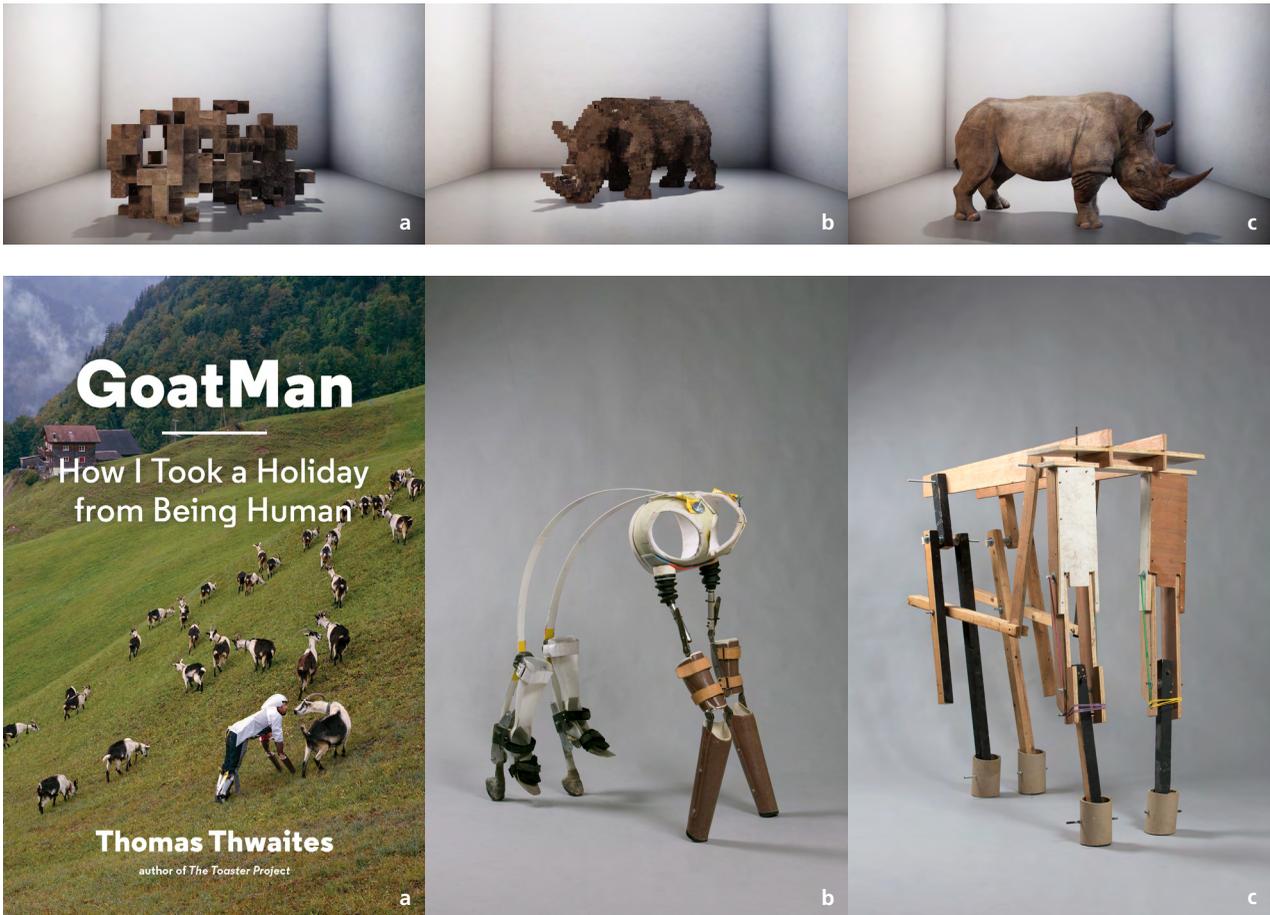


Figure 11 (top)  
Stills from *The Substitute*. © 2019 Alexandra  
Daisy Ginsberg.

Figure 12 (bottom)  
12a depicts the book cover of *GoatMan*, in  
which Thwaites documents and reflects on his  
design research process and experience in the  
Alps. 12b shows the final prosthesis used in the  
Alps and 12c an early prototype in the research  
process that has since been used in exhibition.  
12a © 2016 Thomas Thwaites. 12b, 12c © 2016  
Thomas Thwaites and Tim Bowditch.

91 Daniel Fernandez, "Can the Northern  
White Rhino Be Brought Back from  
the Brink of Extinction?" *Smithsonian  
Magazine*, June 2018, accessed July 14,  
2021, <https://www.smithsonianmag.com/science-nature/northern-white-rhino-brought-back-brink-extinction-180969000/>.

genetic manipulation.<sup>91</sup> The project explores the philosophical ramifications of those real-life experiments and confronts the audience with a paradox: humans are preoccupied "with creating new life forms, while neglecting existing ones."<sup>92</sup>

In *GoatMan*, Thomas Thwaites "tried to become a goat to escape the angst inherent in being a human."<sup>93</sup> The project involved a year-long research process in which Thwaites studied goats and constructed a series of prostheses that would allow him to move and live as a goat, including eating grass. It culminated in Thwaites' spending three days living with a goat herd in the Swiss alps and writing a book, *GoatMan: How I Took a Holiday from Being Human*.<sup>94</sup> In exhibition, it has been represented by the book, a video, and/or prototype prostheses (Figure 12). The work can be read at multiple levels, from a "badly done science project" about how to physically transform oneself into a goat using modern technology and design to a more philosophical reflection on dichotomies in western knowledge traditions that divide humans from the natural world, the body from mind.<sup>95</sup> As will become evident, *GoatMan* becomes an arguably problematic case for our criteria due to Thwaites' self-conception of his work as speculative design.

In the following sections we will discuss the cases against each of the four criteria in turn.

- 92 Ginsberg, research interview.
- 93 Thwaites, "Holiday from Being Human (GoatMan)," online.
- 94 Thomas Thwaites, *Goatman: How I Took a Holiday from Being Human* (New York: Princeton Architectural Press, 2016).
- 95 Thomas Thwaites, research interview, May 10, 2019.
- 96 Bertrand, research interview, April 26, 2019; Hans Gubbels, research interview, May 15, 2019. Barendregt attended a panel event and exhibition of recorded interviews at MU Artspace in Eindhoven on March 21, 2019 that Ginsberg participated in. Underneath the television showing her interviews was the text #syntheticbiology #architecture #speculativdesign.
- 97 Auger, "Speculative Design," 12; Dunne and Raby, *Speculative Everything*, 3, 86–87.
- 98 Kelly Streekstra, "Interview: Designer Shahar Livne Is Geomimicing the Future of Plastics," *Next Nature Network*, April 18, 2018, <https://www.nextnature.net/2018/04/interview-shahar-livne/>.

### *Centrality of the Scenario*

Three of the four cases invite their audiences to explore a clearly defined scenario. *Metamorphism* involves a future in which plastic is considered a raw material. *Walden*, a game explores the 150-year-old experiment of Henry David Thoreau. *GoatMan* examines the situation of a man living with a goat herd. *The Substitute*, however, not only resists this aspect of the criteria, it gains its critical power from the absence of a clearly constructed scenario. Rather than placing the rhino in a realistic potential future habitat, Ginsberg virtually resurrects it in an empty white room to communicate that any rhinoceros that is brought back will exist outside of its natural environment. Without other rhinoceroses as teachers, it is deprived of the habitus it needs to be a "real" rhinoceros. Through this abstracted presentation Ginsberg aims to elicit a visceral emotional response that leads to critical reflection.

While *The Substitute* and Ginsberg's approach has been labelled as speculative design by others,<sup>96</sup> in our interview she resisted both this conceptualization and the comparison to thought experiments. This parallel rejection is grounded in Ginsberg's understanding of speculative design and thought experiments as both being based in scenario construction. People may currently refer to her work as speculative design due to her connection to Dunne, Raby, and their Design Interactions environment at the Royal College of Art. However, when speculative design is defined through the concept of thought experimentation, the scenario aspect becomes central. Although a scenario is implicit in the virtual resurrection which asks us to consider the ramifications of returning this rhinoceros species from extinction, we agree that its abstract representation in *The Substitute* does not constitute careful scenario construction. For these reasons we hesitate to apply the label of thought experiment to *The Substitute*, and feel that withholding it on these grounds helps to justify speculative design as thought experiments.

### *Rigorous and Imaginative Engagement*

Whether an audience is able to recognize and engage critically and reflexively with a scenario very much depends on whether its presentation enables its members to explore it both rigorously and imaginatively. To achieve this, designers should ensure that the scenario is accessible to the audience. This often involves building perceptual bridges to the work.<sup>97</sup> In *Metamorphism*, both the material and topic of plastic act as a perceptual bridge to ground the thought experiment scenario in our reality. Physical engagement with Lithoplast provides opportunities to consider its different dimensions. As the designer of the piece, physically experiencing Lithoplast's malleability enabled Livne to assert that in the scenario the material will likely be worked by hand. This allows others to imagine the introduction of a "plasticsmith" who works the material similarly to the black- and goldsmiths of the past.<sup>98</sup> Audiences also benefit from firsthand physical engagement with the material. Livne reported that audiences who are allowed to pick up Lithoplast objects are amazed by how light they are, which enables them to better engage with the speculative future scenario (see Figure 13).

Like Livne, Thwaites recognizes the value of physical engagement to enhance imagination. He pushes this further in *GoatMan*. Translating the rigor



Figure 13 (top left)

Livne described that expecting the piece to be heavy, people's arms tend to jolt or drop as they are surprised by how light the object is. © 2020 Shahar Livne & Alan Boom.

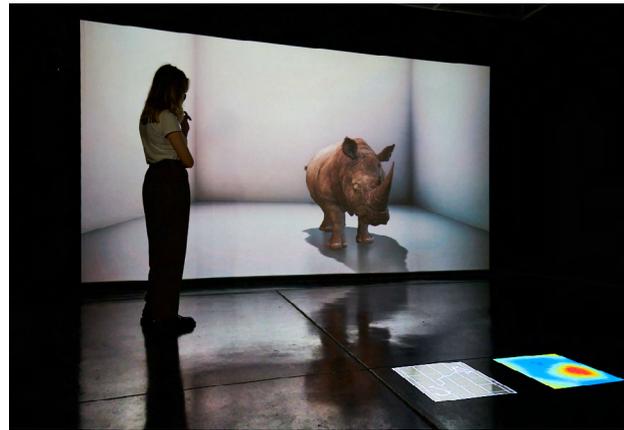


Figure 14 (top right)

A woman encounters *The Substitute* at *And Say The Animal Responded?*, an exhibition that took place at FACT Liverpool, 2020. © 2020 Rob Battersby.

and intensive physical engagement on the part of the designer to the audience can be challenging. In an exhibition context, audiences could be given the opportunity to interact with Thwaites's prostheses, mimicking his embodied exploration to a degree, and be encouraged to think critically about the work through questions in didactic material while doing so. Of course, this is not without risk. Given the potential for damage to the objects, injury to members of the public, and questions of liability that spring from this, curators and administrators may be less likely to offer such experiences unless specifically motivated to do so. Also, the presentation of *GoatMan* in book form allows the project to travel outside of the gallery and invites audiences to take their time in following Thwaites's design research process and considering his provocations.

As a video work, *The Substitute* uses different means of eliciting a reaction and engaging its audiences. When the sounds of the emerging rhinoceros are amplified in the space surrounding the video material, audiences hear the creature before they see it. This triggers curiosity and intrigue so that they go and seek out the project, feeling a sense of reward when they find it. When the video material is projected across a wall space they are confronted with a "life size" version of the rhino (Figure 14). This helps to elicit a stronger response than if they had viewed the work at the size the images are printed in a journal article such as this. As people in the audience engage with the didactic material, they learn the almost extinct status of the rhino and feel a sense of loss. This stands in marked opposition to the surprise and joy of finding the rhino moments before. Through this structured experience, Ginsberg takes viewers on an emotional journey to enhance their critical engagement with the issues she raises.

In contrast, *Walden, a game* invites rigorous and imaginative engagement by immersing the audience within the scenario rather than asking them to construct it mentally. Importantly, the scenario remains somewhat open, so that game participants retain some autonomy to explore and shape the events of the game themselves. Following in Thoreau's footsteps, players may develop an attitude towards him, an awareness of how they

99 Tracy Fullerton, research interview, April 23, 2019.

100 Ibid.

are spending their time, and an appreciation for the environment—but they are not forced to. Fullerton explains that as an open world simulator, “There is no right or wrong way to play the game,” adding that “*Walden* is not trying to teach you anything in a didactic fashion,” it seeks to provide a space that fosters reflection by allowing a virtual experience of Thoreau’s experiment.<sup>99</sup> As a video game, *Walden, a game* has the potential to invite prolonged engagement from audiences outside of an exhibition space. Much like Thwaites’s book, it can find a space for itself in homes and classrooms. Although Fullerton acknowledges that “people play less in public,” and so the exhibition context can be limiting, she also recounted one staging of *Walden* that included bean bags scattered in front of large screens, leading to audiences engaging as spectators as well as players for prolonged periods in the exhibition setting (Figure 15).<sup>100</sup>

Our analysis reveals that issues of presentation, framing, and curation apply to all four cases, and raise the question of how best to present speculative design pieces so they foster the type of engagement required to enable critical reflection and discussion on the part of the audience. Such considerations can be sidelined in an exhibition space, because existing dominant framings and practices of presenting design override those required of speculative design, and the general stress and pressure of an installation process can set in. As we have argued, adopting the framework of thought experiments can keep the concerns of engagement and presentation central to the agenda, ensuring that the critical capacity of these works is undiminished.

### *Non-literal Instantiation*

These four cases sketch a picture of what non-literal instantiation could entail for speculative design thought experiments. As a typical speculative

Figure 15  
*Walden, a game* installed at SFMOMA in 2018. © 2018 Tracy Fullerton.



101 Thwaites, research interview.

102 Thwaites, "About," online.

103 Dunne and Raby, *Speculative Everything*, 80–82.

104 Thwaites, research interview.

105 Fullerton, research interview.

106 Ginsberg, research interview.

design, *Metamorphism* uses Lithoplast as a prop to engage the audience in the scenario, similar to the way that a physics thought experiment may use an image to illustrate spatial aspects of a given scenario. Livne does create the Lithoplast physically through a lab process called geomimicry—she accelerates the metamorphosis of unrecyclable plastic waste with marble dust and minestone, but she does not consider the project as a physical experiment to create a raw material. One possible point of resistance is Livne's fashioning of Lithoplast into specific forms rather than simply presenting it as a lump. This risks shifting the project from thought experiment towards material application. However, the objects are intended to function imaginatively, inviting audiences into the speculative scenario, fitting nicely with our criteria.

Conversely, *GoatMan* challenges this aspect of the framework as Thwaites performed the experiment and explored the scenario physically, arguably constituting literal instantiation. Like *The Substitute*, *GoatMan's* defiance of this criterion contributes to the piece's power. As Thwaites explains, "If I hadn't actually gone and slept in goat poo for however long, then I think the project would have lost something. Trying something impossible adds another element" (Figure 16).<sup>101</sup> However, Thwaites self-identifies as "a designer (of a more speculative sort), interested in technology, science, and futures research."<sup>102</sup> Dunne and Raby also cite *The Toaster Project* (where Thwaites attempted to make a toaster from scratch in his London backyard) as an example of a *reductio ad absurdum* thought experiment, since Thwaites's going through the process reveals the absurdity of being able to burn a piece of toast in the morning.<sup>103</sup> While both *The Toaster Project* and *GoatMan* contain elements of absurdity, this neglects the fact that Thwaites did not conduct the experiments in thought, but carried them out in the physical realm.

Although *GoatMan* seemingly does not adhere to this criterion, Thwaites has connected *GoatMan* to speculative design discourse by framing it as an "alternative version of the future ... [when] we will look for exotic experiences ... have a holiday as different animals in order to get people thinking about the ideas of using prostheses to transcend our human forms."<sup>104</sup> Thwaites thus frames the project as provoking the imaginative consideration of a scenario that is not literally instantiated. Engaging with Thwaites's book and seeing the prostheses could allow the reader to conduct the experiment in thought, just as audiences have engaged in Thoreau's experiment through *Walden, a game* or the original text. The scenario thus reaches beyond the physical experiment, which is subsumed within a narrative that asks, "What if we could take a holiday from being human?" One could perceive Thwaites's reporting on his physical experiments as perceptual bridges to bring the audiences into the scenario. His *GoatMan* and *The Toaster Project* thereby become interesting cases for testing both the nuances of conceptualizing speculative design as thought experiments, and how physical a thought experiment can be.

*Walden, a game* and *The Substitute* provide opportunities to consider the place of simulation within our criterion. Fullerton was quick to accept the proposal that video games, and *Walden* in particular, are thought experiments, despite not having considered the comparison before.<sup>105</sup> However, Ginsberg rejected the premise that simulations could be included, as she felt they breached the degree of instantiation permitted.<sup>106</sup> We have chosen to

Figure 16  
Thwaites living with the goats. © 2016  
Thomas Thwaites and Tim Bowditch.



107 Fullerton, research interview.

108 Fullerton, research interview.

109 Dunne and Raby, *Speculative Everything*, 71.

110 Livne, research interview.

align our definition of thought experiments within design as broad enough to include simulation with the part of the literature that argues for this. We believe the dialogue between game developers and speculative designers this encourages can have exciting outcomes.

Unlike the other examples we discuss, *Walden, a game* comes from outside the bubble of critical and speculative design and has not been labelled as speculative design to date. The video game is generally considered within the discipline of game design, which did not understand itself as design until recently.<sup>107</sup> Yet a similar critical movement has taken place within game design as in critical design. Fullerton labels her practice “experimental game design” and positions herself in opposition to commercial game design traditions that start from specific game play genres. Instead, she begins by asking “a question about an emotional or intellectual or social, cultural situation or outcome of the game”, and then considers “what kind of game activities and mechanics might lead to that outcome.”<sup>108</sup>

Fullerton’s understanding of experimental game design thus resonates strongly with the ethos of critical and speculative design. Dunne and Raby mention game design as an inspiration for speculative design because of its “fictional world building” abilities,<sup>109</sup> but do not suggest that game design could be a form used for speculative design proposals. Their justification seems to be that forms like game design and cinema manifest a world, whereas object props allow the audience to imagine the world for themselves. We agree that game design may limit the imaginative agency of the audience in this respect, but it also endows them with agency through allowing interaction with the speculative world inside the scenario. Within our proposed framework the field would focus less on the forms through which speculative scenarios are manifested, and more on the elements of rigorous scenario construction, imagination, and critical reflection. Opening up the definition would facilitate communication between these previously disparate forms of design, encourage speculative design practitioners to look beyond the typical forms of product design, and allow them to reach different audiences in contexts yet to be explored by speculative design, like the classroom and home.

### ***Fostering Critical Reflection***

All four cases provide their audiences with opportunities for scenario specific and broader critical reflection. Even if *Metamorphism* is rooted in the plastic “problem,” it also offers the opportunity for audiences to reconsider wider cultural, social, and material paradigms. As Livne<sup>110</sup> explains, “The bottom line of this project is how are we treating our nature, how we treat our resources.” She stresses that the creation of materials is a responsibility that needs to be considered reflexively. In *The Substitute*, the questions Ginsberg raises about the white rhino can be applied to other species and contexts, and *GoatMan* can encourage reflection about our relationships with other species and nature more broadly, as well as our modern lifestyle. For audiences to seize these layers of meaning an imaginative leap is often required, invited by the ways a scenario is framed. With *Walden, a game*, Fullerton’s

111 Ginsberg, research interview.

team hopes that through exploring the virtual, open world they have created, players may translate reflections from the game into their real lives. Like Ginsberg, they use the realm of the virtual to talk about the physical world.<sup>111</sup>

Fostering critical reflection is discussed at length in the existing literature on speculative and critical design. As a result, it needs less elaboration than the first three criteria. Through discussion of our cases, we have sought to highlight how the core purpose of critical reflection is inextricably linked to the first three criteria. Is there a scenario to be considered and explored? Are there measures in place to enable rigorous and imaginative engagement with the scenario? Is form being considered and used in a purposeful and inviting way? Reflecting on such questions can help designers and curators ensure that in encountering a singular speculative design audiences are able to consider more fully and critically the world around them and their place within it.

## Conclusion

In this article we examine how a speculative design can act as a thought experiment. We consider the strengths and limitations of our conceptualization and test it against four cases. By identifying four criteria for classifying a design piece as a speculative design thought experiment, we provide a framework to categorize an artifact as speculative design in its own right, rather than on the basis of the designer's previous work or academic credentials. We argue that this will open up the category of speculative design at a theoretical level, since centralizing the scenario relaxes the criterion of a design artifact. This leaves open the possibility that game design and other virtual simulations can be considered within speculative design. Practically, this means the frame of thought experimentation can encourage and aid interdisciplinary collaboration, as it provides a shared concept for different parties to work with.

Additionally, we have argued that adopting the thought experimentation framework can provide a set of tools to create and disseminate effective speculative design pieces, ensuring that rigorous, imaginative, and critical audience engagement are at the heart of this experience. We believe that when carried out with an awareness of how a piece can be read by the audience and a real commitment to facilitating engagement with the piece, speculative design can provide a broader public with profound grounds for critical reflection.

While we have sought to illustrate some best practices through our cases, we recommend further research on how such engagement can be facilitated by particular design and curatorial strategies. We also recommend research on how the explicit labelling of a design piece as a speculative design thought experiment may shape the way it is read and the context in which it is considered. Finally, while we have been concerned mainly with the impact the thought experiment analogy would have on speculative design, our analysis has raised the question of how material or physical a thought experiment can be. This is relevant to theorists beyond the field of speculative and critical design. How the comparison affects the conceptualization of thought

experiments is another interesting question for further work, as is a consideration of thought experimentation within the broader field of design.

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There are no conflicts of interest involved in this article.

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