

Immersive Design Fiction: Using VR to Prototype Speculative Interfaces and Interaction Rituals within a Virtual Storyworld

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ABSTRACT

Immersive design fiction is a novel approach that embeds speculative interactions within a rich virtual reality (VR) storyworld. Immersive design fictions use VR to translate new design opportunities into story-driven, embodied experiences by positioning the participant as a character in a narrative world. This paper presents a case study of an immersive design fiction that depicts a fictionalized reimagining of an industry partner’s work practices. This VR experience explores speculative interfaces for creative work and collaboration in the context of a fictional workplace environment. By placing design fictions within rich immersive contexts such as room-scale VR, researchers and practitioners can go beyond prototyping imagined interfaces to also speculate about the interaction rituals and surrounding social context within an experiential storyworld. This approach makes methodological and theoretical contributions to design fiction research by demonstrating a toolkit for exploring and reflecting upon the intersections between speculation, embodiment, and narrative context.

Author Keywords

Design fiction, speculative design, virtual reality, immersive design fiction, embodiment, experience design.

ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation]: User Interfaces—prototyping; J.5 [Art and Humanities]—design

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INTRODUCTION

Human Computer Interaction (HCI) is a field oriented to the future through both discursive and experiential methods. Techniques of ‘envisioning’ draw upon the rhetorical frame of fiction to illustrate technological opportunities of the future [12,34,70,87,88]. And techniques of experiential prototyping enable practitioners to explore aspects of technological experience that don’t exist yet but could [1,19,21,49,65,74]. Broadly speaking, such techniques have tended to relate to the future in fairly uncritical terms. However, more recently, reflexive critiques have also problematized the utopian framing that research on technological innovation tends to invoke when relating to the future [12,34]. Addressing these sorts of tensions, HCI’s orientation to the future has become inflected by approaches that are reflective [35,43,72], speculative [3,15,30,37,64], critical [29,36,41,68], and reflexive [18,28,55].

Much of the work in speculative design and design fiction tends to emphasize the discursive role played by designed objects as vehicles for provoking conversation. Design fiction accomplishes this discursive work through diegetic props (artifacts of a storyworld) [15,16,78,79] that blur the boundary between fact and fiction and through narrative forms such as films or other media [3,20,37,44,48,79] that transport us to imagined universes. Such discursive approaches [84] or defamiliarizing moves [11] are typically oriented to: surface critical questions, destabilize assumptions about technology, and expand our sense of the possible [17,28,37,39,67,82].

While this characterization of design fiction emphasizes discursivity over embodied action, HCI and its adjacent fields have increasingly found opportunities to bridge speculative and experiential approaches to design [23,26,38,59,86]. Some have characterized this shift as an attempt to overcome the “experiential gulf” between our ability to imagine the future and our ability to experience it [23,24]. Work that bridges this gulf in a range of ways includes research on speculative enactments [38] experiential futures [22,23,24], speculative game design

[26], design fiction and sustainable practices [86], tangible possibilities [76], speculative civics [9,30], and speculative ritual design [58,59,63,64].

In this paper, we integrate aspects of speculative and experiential design through a novel methodology and conceptual framework we call ‘immersive design fiction.’ We present a case study of an immersive design fiction that explores speculative interfaces for creative work and collaboration as part of a fictionalized reimagining of an industry partner’s work practices. Our paper deploys this case study to argue that immersive design fictions are particularly well suited for prototyping embodied, social, and contextually rich aspects of speculative experiences.

Speculative Ritual

Prefiguring a turn to the experiential, Bleecker’s foundational essay grounds design fiction in embodied experience by foregrounding the concept of the ‘interaction ritual’ [15]. Borrowing this concept somewhat obliquely from Irving Goffman [45], Bleecker adapts the interaction ritual to address the ways that humans engage with machines and to underscore how interfaces invite, constrain, or otherwise afford particular patterns of action. For Bleecker, the interaction ritual is a reminder that any story we tell about a new technology is also a story about the broader behavior patterns and social practices that we imagine growing up around it. Building on this concept, research in HCI has drawn attention to the ritual as a subject of speculative design [58,59,63,64]. Likewise, design research, more broadly, has expanded the notion of ‘ritual’ beyond its ceremonial connotations to also accommodate ritual aspects of: everyday encounters with technology [63,64], workplace practices [66], family rituals [25], encounters with animistic technologies [59], rituals of romantic communication [59], and rituals of civic participation [58]. While such activities might just as easily be framed as ‘routines’ or ‘practices,’ the frame of ‘ritual’ offers the designer an etic lens, through which familiar actions can be seen with fresh eyes [57]. This broad ranging applicability of ritual as a topic of design builds on the work of ritual studies scholars who have long drawn attention to the human capacity to craft and adapt rituals [10,46,47,80].

Immersive Design Fiction

Virtual Reality (VR) is a well documented medium of experience design [42,50] as well as a site of accelerated user experience innovation [2]. Immersive design fictions (IDFs) extend methods of VR prototyping by placing speculative interfaces and interaction rituals within virtual narrative contexts. In particular, IDFs position a participant as a character in a narrative world with both pre-scripted and interactive elements. With this approach, researchers and practitioners can explore embodied aspects of design fiction by situating speculative prototypes within an experiential storyworld in VR.

Immersive design fiction also points to new opportunities for research through design (RtD). In particular, we hope to demonstrate: (1) new intersections between speculative design, narrative context, and embodied interaction, and (2) new aspects of reflective practice that arise when these disparate parameters are addressed in parallel.

Embodiment and Presence in Immersive Design Fiction

By situating a sense of presence in a speculative storyworld, immersive design fictions are particularly well suited for speculating about new kinds of experiential and embodied knowledge. For over two decades, research in VR has demonstrated opportunities for complex social coordination in virtual contexts, for example through explorations of Collaborative Virtual Environments (CVEs) [13,14]. Such environments address the opportunities posed by Klemmer et al. [51] in that they support: fully embodied affordances, tacit knowledge, and social coordination.

VR experiences also support a rich sense of embodied presence. ‘Presence’ here refers to a phenomenon in which the body’s perceptual systems have been sufficiently stimulated such that one feels they exist in a place different from where they are physically located [60,75].

While presence is the perceptual cue, immersion includes a wider range of meanings. However, researchers point to specific aspects of immersion in VR, such as spatial immersion and immersion through participant agency [75]. To these criteria we also add social immersion among simulated non-player characters (NPCs).

The Design Context & Target Audience

Our target audience for this experience comprised industrial designers and engineers in the furniture design sector. In particular, this project involved a partnership between the Steelcase Workspace Futures group and the Mobile & Environmental Media Lab (USC). We proposed an immersive design fiction aimed at helping Steelcase industrial design teams speculate about—and surface new questions related to—the potential impact that VR design tools could have on their own internal work practices. In particular we addressed opportunities, interfaces, and workflows for creative collaboration. We designed a series of immersive experiences involving fictional characters and interfaces situated within a coherent story world. Taken together we referred to this collection of experiences as the *Virtual Design Workspace*.

In the *Virtual Design Workspace*, we position the VR participant as a designer working at Steelcase in the near future, at a time when mixed reality work environments have been integrated into the Steelcase product design cycle. The participant experiences three episodes set at the early, middle, and final stages of Steelcase’s product design cycle. These episodes reimagine familiar practices of ideation, sketching, modeling, annotation, and review. In each episode, the user participates as an industrial designer on a team working towards a seating product solution for

new furniture needs precipitated by the ecology of mixed reality work environments.

While the context for this design may appear to be more prosaic than would be typical of a ‘design fiction,’ we believe that this work qualifies as design fiction insofar as: (1) we explicitly sought to defamiliarize the assumptions of our fieldsite; (2) we engaged reflexively with the narrative aspects of our approach (in line with Bleecker’s initial framing [15]); (3) we designed a fictional storyworld along with imagined interfaces and rituals; (4) our ultimate goal was not to create a working prototype to be deployed but rather to surface new questions and encourage our industry partners to see their existing work practices with fresh eyes.

Anticipated Contributions to the Field

The approach to speculative design championed by Dunne and Raby centers “the preferable” as a design goal within the nested “cones” of possibility and plausibility [22,83]. Others within HCI have challenged this framing along with speculative design’s claims to criticality [7,68,85]. Given the contested nature of the role of criticality in speculative design, it is important that we clarify our goals and anticipated impact.

We share an interest in the broad value of design fiction for critical engagement [57,58,59], however, this particular project has focused more narrowly on the kinds of speculative strategies available within the context of a client-facing relationship with an industry partner. How will audiences within an enterprise context internalize and make use of the provocative and destabilizing role that design fiction can play? What unanticipated questions can an immersive design fiction open up? And how might we reimagine their interaction rituals in ways that defamiliarize their assumptions about their everyday practices? Driven by these sorts questions, we hope to demonstrate that strategies of provocation, defamiliarization, and fictional worldbuilding demonstrate value in these industry contexts.

This work also makes significant contributions to research in design fiction and speculative design. By enabling participants to experience the subject-position of a character within a narrative context, we anticipate that immersive design fiction could have broad applicability, including implications for new avenues of critical engagement. Representational works in VR have proven to be well positioned for this kind of critical engagement. For example, *NeuroSpeculative AfroFeminism* positions the experienter as a young black girl in a hair salon that doubles as an afrofuturist rite of passage [4]. VR work has also demonstrated the ways that immersive experiences can help viewers take on the perspective of, and empathize with, unfamiliar, underprivileged, or marginalized subjects [54]. Pointing to these examples, we suggest that the theoretical and methodological contributions we propose here may extend beyond the narrower scope of industry client-focused immersive design fiction.

METHODS

Our approach involved a mixed methods integration of fieldwork, experience prototyping, design fiction, virtual reality design, along with aspects of game design. We spent a month observing and interviewing industrial designers and engineers at Steelcase to understand their work practices, so that we could craft a narrative VR experience that productively intervened into our partners’ real world contexts. We developed various imaginary storyworlds with fictional characters and interfaces and explored these narrative contexts through improvisation in physical space using cardboard and loose story “scripts” for the actions of both primary participants and NPCs. Subsequently, primitive prototypes of VR experiences were developed and iterated upon. We also prototyped speculative forms of embodied action by recording our movements and controller input and then using this data to drive the animations of NPC avatars.

Research and fact-finding phase

The first phase of our research involved observation and interviews of designers, engineers, researchers, and project managers from Steelcase. We visited their business headquarters in Grand Rapids, MI to familiarize ourselves with the working habits and rituals of those working on the design of seating products. We conducted interviews of key members in a seating product design team in order to identify common practices, processes, and pain points. We also documented the Steelcase product design lifecycle from research insights to fully operationalized fabrication.

Throughout this research process we attended in particular to contexts that seemed ripe for speculative intervention. We aimed to go beyond pain points and surface level desires and instead sought out opportunities to reimagine the broader problem space by exploring alternative interaction rituals for collaboration and creativity in VR.

Our partners were initially interested in VR telepresence to support communication with a remote office in Munich. While acknowledging this goal, we treated our partners’ initial desires as a jumping off point for a broader speculative exploration. Indeed, our partners invited this approach and welcomed the opportunity to surface new questions and challenge assumptions about interactions in VR. Using insights from our observations and interviews, we designed speculative interaction rituals for ideation, collaboration, and prototype delivery.

Narrative Design

Based on this initial research phase, we began to develop a rich storyworld for our *Virtual Design Workspace* to inhabit. Taking inspiration from our research of Steelcase work practices, we began to develop a loose narrative framework that allowed us to explore features like character and conflict through experiential techniques (including bodystorming and embodied improvisation methods [21,56,74]).

Initial narrative experiments included story scenarios involving tentacle-covered aliens who demanded creative output from hapless human workers. The context of alien elites with non-anthropomorphic bodies enabled us to consider entirely new kinds of environments and furniture object-forms, but we eventually abandoned this approach.

In the design fiction story we ultimately constructed, we sought out a balance between familiarity and strangeness. The user assumes the role of a designer on a near-future seating product design team tasked with rethinking the purpose of furniture in a world where all objects and environments operate as anchors for virtual interfaces. In the first scene, the participant is guided by a narrator's voice-over. The narrator character is a fictional project-leader who directs both the participant and the NPCs as they respond to a design prompt for a mixed reality seating product. In subsequent scenes, the participant encounters NPCs (inspired by real life counterparts at Steelcase).

This storyworld provided a space for us to position fictional characters loosely inspired by counterparts at Steelcase. We devised a series of “Narrative Episodes” based on different phases of the Steelcase product lifecycle, including aspects of: product research, concepting, ideation, prototyping, iteration, and review. Each Narrative Episode positions the participant as a member of a Steelcase design team. The episodes involve tightly scripted elements as well as opportunities to interact. Participants use the speculative tools they have seen operationalized during scripted story sequences. The participant cannot affect the outcome of the story with their actions, but can create original product designs with the speculative tools. Despite this limited agency, the narrative framing of these experiences dramatizes participation by situating interactive goals within the context of a dramatic deadline.

EPISODE 1: SPECULATIVE IDEATION



Figure 1. Speculative Ideation:
(a) Insight space and (b) Playground (ideation environment)

Video documentation for Insight Spaces: <https://vimeo.com/210096850>
Video documentation for Playground: <https://vimeo.com/210096550>

This first narrative episode of the *Virtual Design Workspace* combines an immersive design prompt with an ideation environment we called *Playground* [Fig. 1(b)]. The episode begins by directly addressing the user as a character within the storyworld. The user is placed within an “insight space”—a geodesic dome populated with media assets depicting seating contexts and body postures associated with mixed reality. A fictional project leader guides them through a 360-degree panoramic summary of a fictionalized design prompt. This opening sequence serves to establish

the fictional storyworld, the core design problem, and the narrative goal.

At the completion of the design prompt, the dome rises to reveal *Playground*, an in-world environment for industrial designers and engineers to ideate during the initial phases of concept development. The narrator tells the design team to create as many chair models as possible during a brief ideation sprint. For the rest of the episode, the participant creates concept sketches for seating products alongside remote participants from Munich and Los Angeles offices in the same shared virtual space. These remote participants are played by NPC's (non-player characters). During the ideation process, the narrator continues to address the participants, at times chiding them for not concentrating on seating products.

Sketching

The Steelcase designers and engineers we spoke to emphasized how, during early concepting and ideation phases, they rely on lo-fi drawing tools such as black Sharpie pens and small Post-Its. Adapting this sensibility for VR, we wanted the tools in this episode to maintain a simple, sketchy, aesthetic form in order to reinforce creative fluidity and discourage participants from being too precious about any one particular idea. We avoided complex nested interfaces and brush options common among existing VR drawing tools such as TiltBrush. Instead, we emphasized a sketching tool that would enable users to sketch and manipulate a high quantity of lo-fi drawings [Fig. 2]. Also unlike TiltBrush, we enabled users to expand and contract their drawings independently from the surrounding world itself so that they could treat their sketches as multiples in a sequence rather than as a unified object in a single world-space.



Figure 2. Lo-fi sketching tool for concepting and ideation. (Allows user to manipulate multiple drawings independently.)

Baking

We also used the geography of the space itself as a way of structuring interface features and leveraging tacit knowledge. For example, we developed an interface feature we refer to as an “oven” which “bakes” each drawing – transforming its shape in various ways according to different ovens available [Fig. 3.]. We used this interface model in order to take advantage of the unidirectional transformation metaphor inherent in baking. Baking enables a user to begin a new drawing and manipulate each subsequent drawing independently.

Interaction Rituals Associated with Baking

We connected the baking interface to speculative interaction rituals we dubbed “on to the next one” in which

participants and NPCs alike are encouraged by a narrator to sketch an idea quickly and then move onto next sketch (emphasizing quantity over quality). We also suggested rituals of “interdimensional printing” through a virtual 3D printer that displays a message (“sent to 3D printer”) when it is used to bake a sketch.

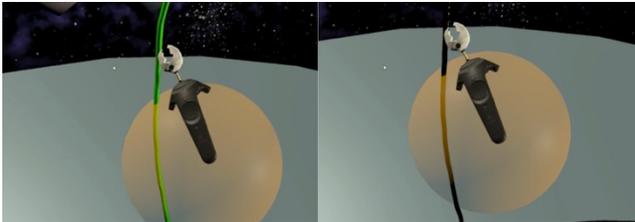


Figure 3. Baking interface. User places their drawing so that it intersects with a sphere “oven.” Once this collision occurs the drawing is “baked” and the user can begin a new drawing. This “oven” interface feature was inspired by the thesis project of collaborator, Julian Ceipek.

World-pops

Designers and engineers at Steelcase frequently engaged with media resources that might jostle their assumptions and help them to think creatively. Responding to this user context, we wanted to create a speculative prototype in VR that would help us to explore new opportunities for serendipitous inspiration and out-of-the-box thinking. In order to support this kind of creativity, we developed an interface feature we refer to as ‘world-pops.’ These objects look like large lollipops which roll around on the ground [Fig. 4].

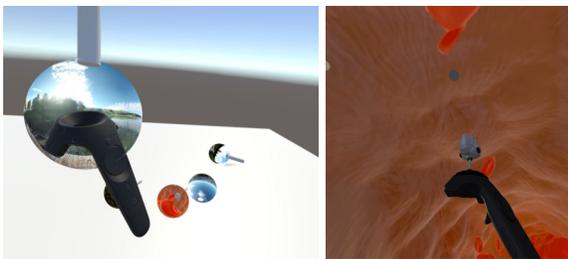


Figure 4. World-pops: lollipop shaped objects (left) which blossom into immersive worlds-within-worlds. On the right, a user is inside a

When a user holds a world-pop above their head like an umbrella, it expands to become a 360 video in a nodal sphere, which surrounds the user [Fig. 4]. These 360 videos can transport a user to a novel environment such as a forest, a human cell, or a snowstorm. We also included word-pops with more familiar environments such as a classroom or an office space. All the drawing features described above are also enveloped by this new environment so that ideation sketches can be generated in a novel environment and then brought back into a primary space.

An interaction ritual that figured strongly in driving the world-pop idea involved blooming a world-pop around oneself to “go into your own world” and be inspired by oblique and unexpected forms of source material. World-

pops were also inspired by thinking about rituals of brainstorming that alternate between solo and group work.

Non-player characters as co-participants

We also wanted to explore rituals that blended solo and collaborative creativity. In our fieldwork, we learned about the value of situating solo creativity within social contexts (for example, brainstorming rituals that alternate between periods of solo and group work). This observation inspired the world-pop concept and encouraged us to explore ways that multiple users might productively observe each other’s sketches while working independently. Accordingly, we structured the *Playground* experience as a series of islands floating in outer space [Fig. 5] with individuals on each island visible to one another yet responding independently to a shared design prompt.

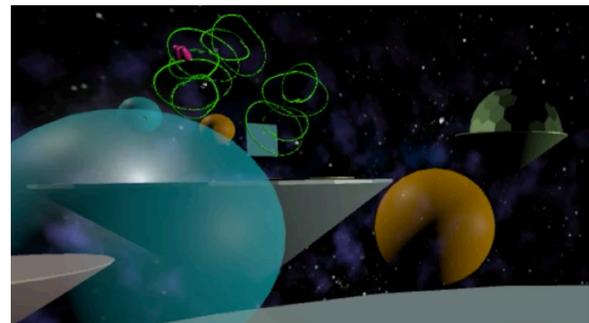


Figure 5. Playground Islands: outer space scene with an NPC (in pink) drawing on an adjacent island.

EPISODE 2: SPECULATIVE COLLABORATION

The second episode of the *Virtual Design Workspace (Model Manipulation)* depicts a fictional design meeting, which takes place several months after the initial ideation phase. This episode enabled us to explore speculative interfaces for manipulation, annotation, and social collaboration. We needed the tools in this episode to be more nuanced and powerful, since the episode depicts a later stage in the Steelcase seating product design cycle and involves a rich array of collaboration contexts.



Figure 6. Model Manipulation:
 (a) Rafael invites participant to join him “in-world” to collaborate with Ada in Munich.
 (b) Ada and Rafael are represented by NPC avatars (with simple binocular heads and controller tool-tips for hands)

Video documentation of Model Manipulation:
<https://vimeo.com/210096616>

The Story

The first portion of this scene involves a tightly scripted narrative in which the participant—cast as a member of the design team in Grand Rapids—is greeted by an engineer named “Rafael,” who invites the participant to follow him into a telepresence environment to meet a lead designer in Munich named “Ada” [Fig. 6(a)]. Once in-world, Ada and Rafael are both represented by NPC avatars [Fig. 6(b)]. During this initial pre-scripted story sequence, the participant watches as Ada and Rafael conduct a design review and discuss the merits of a current chair prototype.

Ada and Rafael are at a crucial juncture in the design process when engineering and design collaborators must agree on final form factors. Ada explains that the design process is currently behind schedule but may need to “go red” if they are not satisfied with the final design choices. (Within Steelcase, “go red” refers to a ritualized practice of putting out an “SOS” to colleagues and halting the advancement of a prototype to operations stages. It is used sparingly, as it involves institutional and financial costs. We adapted this ritual within VR, and explored how the environment itself might reflect “going red.”)

Frustrated by a creative block, Ada brings the two inside a nature-inspired world-pop in order to inspire them to come up with new parametric shapes modeled on the formal aesthetics of leaves. Inspired by placing the chair prototype against a forest background, Ada draws a new shape for a chair arm. Then returning to an office environment, she uses a voice annotation tool to record her insight and embed it to the chair design.

Despite Ada and Rafael’s progress on the design problem, they are still not satisfied and turn to the participant for assistance, asking: “Well, what you do *you* think?” At this point, the participant is given an opportunity to use all the tools demonstrated by Rafael and Ada. By mimicking the actions they have just witnessed the NPC’s perform, participants are able to not only experiment with the interactive affordances of a new set of tools, but also have an opportunity to understand their function within a narrative context.

NPCs as Social Actors

In order to demonstrate novel interaction rituals to the user, it was crucial for us to be able to represent Ada and Rafael [Fig. 7] as social actors within our immersive design fiction. As a way of prototyping speculative forms of embodied action, we implemented a system that allowed us to act out movements and controller actions, record these inputs, and play them back on cue. We needed NPCs to make full use of the design tools we had created for the participants to use, including the tools for grabbing and manipulating objects and making 3D sketches in the air. This step was required for the NPCs to convincingly demonstrate and take part in the social rituals of creative collaboration we intended to highlight.

We made the strategic choice to fashion NPCs as simple hands (represented by tool tips) and eyes (represented by a colored binocular shape). The rationale for this choice was so that our NPC-action recording tool could drive NPC actions without us also having to resort to a full Mo-cap solution. This decision enabled us to be nimble and continue to adapt the immersive design fiction as the NPC narrative scenarios evolved.



Figure 7. NPCs represented by “binocular” avatars

Speculative Interfaces and Interaction Rituals

In designing the interfaces for the *Model Manipulation* episode, we wanted to support richly collaborative interaction rituals enmeshed within the affordances of the space. Our goal then was to enable participants and NPCs alike to leverage the situated geographies of their bodies in space.

Exploding

For example, NPCs and users alike can explode a chair model [Fig. 8] and then isolate a particular facet of the model to channel attention during a design meeting.



Figure 8. Chair exploding into component parts

Annotating Through Sketching

Users and NPCs can also annotate chair models by sketching on top of them [Fig. 9 (a)] or in the environment around them [Fig. 9(b)]. This form of annotation could support both synchronous and asynchronous modes of communication.



Figure 9. Annotation

- (a) Sketched annotations attached to a model (in purple);
- (b) environmental annotations independent from the model (in green);
- (c) recorded voice annotations using a microphone tool.

We also prototyped interfaces for recording voice annotations [Fig. 9(c)] and attaching these annotations to a model.

Defamiliarization

Drawing from existing practices we encountered in our fieldwork, we sought to defamiliarize rituals of brainstorming, critique, and documentation. For example, riffing on our informants’ practices of project logging, we created an in-world camera character (represented by a flying eye ball) that broadcasts to an in-world “television” [Fig. 11]. We framed this character as both a “pet” and a project-log tool. Since both the camera and television could be repositioned or resized in any way, participants could call attention to particular features in the environment by orienting the camera character accordingly.

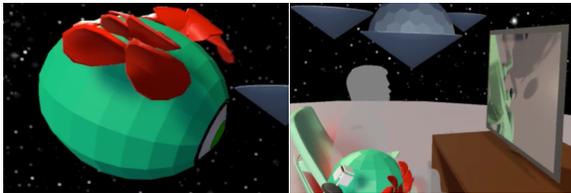


Figure 11. Camera Project Logger
A camera (eye-ball) records the design process and helps collaborators coordinate attention.

Ending the Scene in a “Mess”

In the second half of the *Model Manipulation* episode, the VR participant takes control of various interfaces that they have seen Ada and Rafael operate. We intended this hand-off of agency (from NPC to VR participant) to spark an open sandbox-like experience. We appreciated the contrast between Ada and Rafael’s deliberate and practiced actions vs. the more exploratory “mucking around” that participants tended to engage in. This difference helped us to reflect on a possible future of “seamful” messiness in immersive contexts [33]. But it also underscored the everydayness of Ada and Rafael’s casual virtuosity with the tools. Insofar as an “alien” interface could seem familiar and unremarkable when operated by the “natives” of our storyworld, the IDF sets up a “future mundane” [62] and supports a “suspension of disbelief about change” [77].

EPISODE 3: CHAIR REVEAL

The concluding episode of the *Virtual Design Workspace* depicts a ritual in which a final chair prototype is dramatically revealed.

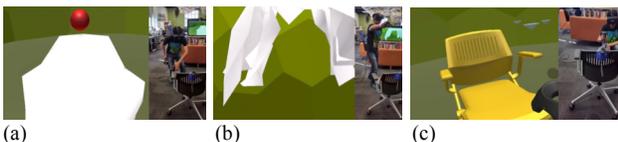


Figure 12. Chair Reveal:
Silver sheet covering chair prototype (a); silver sheet flies flying up to reveal chair (b), as hybrid-object in both virtual and physical space (c).

Video Documentation for Chair Reveal: <https://vimeo.com/210096730>

This final episode resolves the overarching dramatic tension of the immersive design fiction and introduces speculative interfaces for mixed reality. At the outset, a silver sheet blows in front of the participant [Fig. 12(a)] while the

narrator congratulates the team on the successful completion of the chair design. The participant can then lift the sheet [Fig. 12(b)], revealing a final chair prototype [Fig. 12(c)]. (Note: this ritual of dramatic reveal was inspired by similar rituals practiced at Steelcase.) At this point the narrator encourages the participant to sit in the chair, revealing it to be a hybrid-object that exists in both virtual and physical space. The chair presented [Fig. 14(c)] mapped onto a trackable chair in physical space, so that when a user in VR touches the virtual chair they also feel the physical analogue. One can sit in the physical chair and roll or rotate while simultaneously seeing the virtual model respond accordingly.

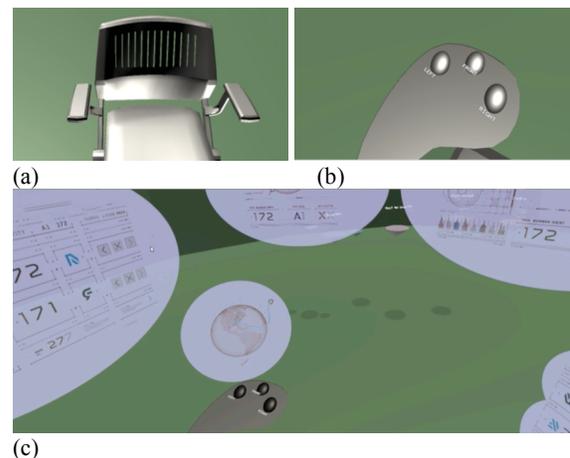


Figure 12. Chair as interface.
(a) Virtual model of chair that tracks as physical chair moves in Vive space; (b) speculative interface attached to chair arm; (c) AR panels that move with physical chair.

This mixed reality chair prototype presents a speculative interface for an augmented reality display system with tactile inputs [Fig. 12(b)]. The AR interface forms a loose cocoon around the user and moves with them as they rotate or move their chair in space [Fig. 12(c)]. While designing this interface, we speculated about rituals of “cocooning” – going into an AR cocoon to be free of distractions while focusing on solo work. Examples like this final one demonstrate the value that immersive design fictions may have going forward as tools for prototyping interfaces that will later be deployed in augmented reality and mixed reality contexts.

DEPLOYMENT FOR TARGET AUDIENCE

Throughout our process we maintained close contact with our partners at Steelcase, and as new experiential prototypes were created, they were able to quickly try them out onsite and share them with others within the organization. While we did not have direct control over these deployments and sharing practices, their format and outcome are nevertheless valuable resources for understanding how an industry partner can make use of an IDF. Involving the target audience in the interaction design process—through early demos and various iterations of the

Virtual Design Workspace—helped to refine and tighten the experiences and sparked speculative conversation about broader changes in work practice on the horizon. Contrasting this process with more traditional techniques of corporate envisioning, we draw attention to the ways that our partners saw these prototype demos as opportunities for speculative provocation with an eye towards destabilizing assumptions and surfacing new questions.

Sharing the Virtual Design Workspace with Participants

Our partners ran demos for twenty-five people at Steelcase Business Headquarters in Grand Rapids. Most demos involved two participants at a time, taking turns in VR with the other observing on a 2D screen. These participants included principal industrial designers, principal engineers, product development managers, user experience designers, and principal researchers. Initial meetings were scheduled for 60 minutes and were eventually expanded to 90 minutes. This expansion of time is reflective of the amount of productive conversation that resulted from the demos.

Outcome of Demos with Target Audience

Given our target audience and the context-specificity of this immersive design fiction, a traditional user research approach made less sense conceptually as well as logistically. However, our Steelcase partners documented the process of sharing the *Virtual Design Workspace* with key stakeholders in the organization, and we report a summary of those findings here. The goals behind sharing the *Virtual Design Workspace* with Steelcase participants was two-fold: (1) to give back to the internal participants (seating design/engineering team members) and to demonstrate how their practices were understood and reimagined in an immersive design fiction; (2) to expose the wider Steelcase community to the ways that VR might impact various aspects the business.

Participants found the experience deeply provocative and had comments to connect what they experienced or observed one another experiencing. During the demos, they described their sensations, raised design questions, and offered suggestions for design tweaks or ways to deepen the possible interaction in VR.

Our partners conveyed to us that the narrative aspects of the immersive design fiction experiences successfully supported participants in reimagining familiar work processes that had become routine. The potential for communicating and collaborating in new ways, generating and archiving in-world activities, and reshaping the iterative process were all called out as opportunity areas for reimagining their current work practices.

Reimagining Existing Practices

We were particularly interested in such instances where participants used the experience to reimagine their existing practices with fresh eyes. For example, the “exploding chair” interaction ritual in the model manipulation episode prompted discussion about how to integrate this kind of

virtual tool into their existing analogue practice of model annotation (using colored masking tape to indicate additive or subtractive changes). Likewise, the camera and voice recording features led to conversation about retooling the ritual of prototype critique through embodied project logs that could be reviewed and edited asynchronously by team members. Finally, the world-pop experience led to provocative questions such as: How do you share work? Can you make a world-pop between two people? How do you tell stories to others within a world-pop? Could we drop a chair into an office environment (world-pop) in order to understand the lived context of a design we’re working on? Can this environment shrink down to become a “notebook” that travels with me?

As an example of an IDF, the Virtual Design Workspace largely succeeded in bridging the experiential gulf described in the introduction. Placing a user as a character in the story can help them to connect their own embodied actions within VR to particular goals and obstacles within a narrative context. This positioning opens up a new embodied vocabulary for participants to explore and experience their own familiar practices with fresh eyes.

DISCUSSION

At this point, we would like to return to some basic questions: what is an immersive design fiction (IDF), and how does this technique relate to other approaches which combine the experiential and the speculative?

To highlight the takeaways we gleaned from our experience, our approach to IDFs includes a toolkit that comprises the following constellation of techniques.

- (a) User as Character: The user of an IDF is a participant in an unfolding storyworld.
- (b) Non-player-characters (NPCs) as Social Actors: NPCs help to position the user within a lived social context and demonstrate possible interaction rituals.
- (c) Reflective Narrative Design: The storyworld serves as a testing ground for ideas about fictional characters, goals, interfaces, practices, and interaction rituals.
- (d) Environmental Defamiliarization: The environment of the IDF should strike a balance between a familiar and unfamiliar relationship to the known world.
- (e) Ritual (Re)design: By appropriating familiar rituals from the fieldsite and then redesigning them for a new fictional context of use, designers can probe new embodied interactions and rethink existing practices.

Experiential + Narrative Design as Reflective Practice

Some researchers characterize design fiction as a jumping off point for the process of *imagining* a diegetic storyworld [27]. Others advocate for design fictions that demonstrate more explicit narrative form, in order to situate speculative ideas in relation to narrative mechanics (including characters, goals, conflicts, objectives, obstacles, and

resolutions) [81]. Designers who also play the role of storyteller can iterate on their prototype designs in parallel to iterating on the story itself. Design fictions also offer designers an opportunity to test out their ideas against the logic of a storyworld. Like interactive systems, storyworlds carry their own structures of constraints and affordances (even supernatural features must have consistent rules). Narrative structures also offer a testing ground for tinkering with, and reflecting upon, the implications of a design idea in relation to a particular character with a particular point of view occupying a particular position in an unfolding story.

Interaction Ritual as Embodied Metaphor to Think With

In Bleeker's original framing, designing fiction casts the diegetic artifact as a jumping off point for imagining alternative interaction rituals. But for IDFs the imagined experience is no longer merely the epiphenomenon of the designed object. By situating the design of virtual artifacts and interfaces within a storyworld, designers can prototype the interaction rituals that envelop a particular artifact or interface. With IDFs the jumping off point for imagination is not the object but the embodied experience, made-sense of within a vivid story world with its own internal logic, objectives, and obstacles. In this way the interaction ritual itself can serve as an experiential launch pad for imagination, not merely something to be provoked in the mind through conversation, but rather an embodied metaphor to think with.

Reflective Practice & Experiential Design

Donald Schön famously describes the process of design as a reflective conversation in which the designer begins to understand the “grain” of a medium [71]. In HCI, this “conversation” increasingly occurs between a designer and an experiential medium. Addressing the needs of this challenge, HCI has increasingly focused attention on aspects of embodiment in interaction [21,31,51,53,65]. In accordance with this turn towards the experiential, research in HCI has called for the extension of interactions beyond the screen in order to: support a richer sense of embodiment, utilize the body's affordances, leverage tacit knowledge, and support complex forms of social coordination [52]. When designers prototype such embodied experiences, they often rely on experiential proxies in the form of bodystorming [65,73], “Wizard of Ozting” [1], social interaction prototyping [8,53] or other performative techniques in the experience design toolkit.

Schön's notion of a reflective practitioner gradually coming to understand the “grain” of a medium—through iterative “conversation” with its structure—has also been applied to the design of information systems [32] and to the embodied mechanics of rituals [57]. Designers of interactive systems learn about the capacities and contingencies of an evolving system through tinkering [5,6]. This process involves holding one variable static, while shifting others around, to see what happens, and then releasing that variable to explore another. Despite the similarity to hypothesis testing,

this process is less systematic, in that its object of inquiry is itself an evolving phenomena. Reflective practice is a more intuitive [40], embodied, and often collaborative form [61] of sense-making and inquiry.

Reflective Practice & Narrative Design

Likewise the evolving system of a storyworld with its concomitant logic and constraints affords a similar kind of reflective tinkering. A story's narrative world as well as its constitutive narrative structure—comprising characters, goals, conflicts, objectives, and obstacles, etc.—can serve as a testing ground for speculating about interfaces and object-forms.

For immersive design fiction, both narrative context *and* experiential design co-evolve in parallel such that any tinkering with one inevitably impacts the other. For example, the order of narrative beats and social interactions between Ada and Rafael shaped the way that we utilized space and sequentialized actions (for example, their scene begins with problem articulation, pivots to divergent inspiration in a world-pop, translates this inspiration through model-manipulation and model-annotation, and finally concludes with a solicitation for help from the user).

Embodiment in Immersive Design Fiction

IDFs are richly embodied experiences, in that they offer participants an opportunity to experience a design fiction scenario first hand. This distinguishes IDFs from other forms of simulated experiences such as filmic representations of speculative rituals [44,63]. By situating design fiction explorations in VR, we understand not only how a design *idea* operates within this narrative context but also how an *embodied experience* might be situated within a lived storyworld.

IDFs also give participants agency over interactive features within a storyworld. In this way, we echo Coulton's approach to speculative game design where enacted mimesis is grounded within narrative diegesis. Speculative game design enables players to have first hand experiences within a diegetic world [26], but unlike screen-based ludic experiences, IDFs offer participants a rich sense of embodied presence. (There is of course a potential overlapping area of speculative games set in VR.)

IDFs not only offer embodied presence in a storyworld but also provide opportunities for simulating social interaction and modeling how multiple people might communicate with and through speculative technology. Enacting and recording behaviors of NPCs offers a reflective opportunity for designers to inhabit the story context and practice the gestural and social behaviors that an immersive interface makes possible. From the user's perspective, NPC actions can also model agency and interactive use-cases, so that the same actions can be understood within a larger social and narrative context. Prototyping in this way, designers can use NPCs and diegetic elements of a world to tell story about

how imagined interfaces relate to particular embodied experiences and social practices.

IDFs also offer an opportunity to rethink the body's affordances in terms of alternative models of physics. Manipulated objects demonstrate a heterodoxical relationship to the physical world (for example: expanding, contracting, falling, floating, flying, transforming, etc.). Each new prototype then is a new opportunity to model agency and causality in a virtual world. Similarly, the world surrounding a user can: contract, expand, ascend, descend, or otherwise transform around them. Manipulating the environment in this way, immersive design fictions can represent worlds within worlds. Physical and virtual elements of the world can also be integrated, for example, through hybrid objects that exist isomorphically in both physical and virtual spaces.

Comparisons to Related Approaches:

Our approach to IDFs involves a pre-scripted narrative with interactive elements. In this sense, an IDF is more open than a linear story, but also more constrained than the kinds of open contextual facilitations associated with experiential futures [23,24,69] or speculative enactments [38].

That said, our approach does share some ground with Elsdén et al.'s notion of speculative enactments, characterized as “prioritizing participant experience” and anchoring speculation in “a familiar structure for participation” [38]. For our intended audience of Steelcase industrial designers, speculative interaction rituals explored in VR served as a similar kind of familiar participatory structure, modeled on an existing “future mundane.”

However, unlike speculative enactments, our approach places less emphasis on participant investment in the perceived “real-life stakes” of the speculative scenario. Rather than creating a wholly improvisational or participant-driven “set of circumstances,” our prototypes instead led participants through a series of fixed narrative milestones, with opportunities for interaction occurring only between these fixed story points. At several points in the story, our participants were invited to play freely with the tools they had been given, but their actions could not alter the (carefully scripted) course of the story overall. As a crucial difference, then, IDFs can incorporate aspects of pre-scripted narrative, while still allowing the participant to interact within the storyworld.

FINAL REFLECTIONS

Immersive design fiction (IDF) is a novel approach that bridges experiential and speculative approaches to design. IDFs invite us to leap beyond speculation about object-forms or interface systems to also model the embodied use cases, narrative context, and surrounding social worlds that might envelope particular experiences or artifacts. Framed broadly, IDFs offer: new ways of probing and prototyping embodied interaction and new methods of reflective practice, combining experiential and narrative context.

We designed an IDF to explore how immersive technologies might impact the future of industrial design and creative collaboration. In particular this project speculated about new interfaces and workflows for creative collaboration situated within practices of ideation, sketching, modeling, annotation, and review. Framing this speculative intervention as an IDF, enabled us to foreground the intersection between speculative interfaces and speculative practices. This approach had a considerable impact on our target audience of industrial designers at Steelcase by provoking speculative conversations about the future of their own workplace practices and rituals.

While this project is situated within the narrower context of furniture design, the approach and insights generated can apply to a much broader range of creative applications. IDFs that support both pre-scripted and interactive elements are well suited for prototyping embodied interaction rituals, and we envision broad applicability for this approach. We also find that new frameworks of reflective practice are possible when processes of story telling, worldbuilding, embodied performance, and experiential design all happen in parallel. For example, storyworlds and narrative structures offer a valuable testing ground for tinkering with and thinking through the mechanics of embodied interaction.

We do concede that our story context was narrowly focused on VR as a diegetic feature of the storyworld. However, similar approaches could surely use the medium of VR to prototype experiences outside of VR as a narrative topic. Along these lines, we suggest avenues for further research include opportunities to orient IDFs as critical vehicles in a range of contexts including topics of gender, race, politics, power, etc. And we consider this trajectory—towards more critically engaged IDFs—as an obvious next step that can be informed by the methodological approach we have introduced here.

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