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This is not a speculation, this is the reality: **Reflection on Speculative Design Workshop in HCI & Design Research**

Samuel Huron
Samuel.Huron@telecom-paris.fr
Institut Polytechnique de Paris,
Telecom Paris, CNRS i3
Palaiseau, France

Wei Wei
weiwei@uvic.ca
University of Victoria
Victoria, Canada

Wen-Jie Tseng
wen-jie.tseng@sorbonne-
universite.fr
Sorbonne Université, ISIR
Paris, France

Elise Bonnail
elise.bonnail@telecom-paris.fr
Institut Polytechnique de Paris,
Telecom Paris, LTCI
Palaiseau, France

Eleonore Genest
Eleonore.Genest@telecom-paris.fr
Institut Polytechnique de Paris,
Telecom Paris, CNRS i3
Palaiseau, France

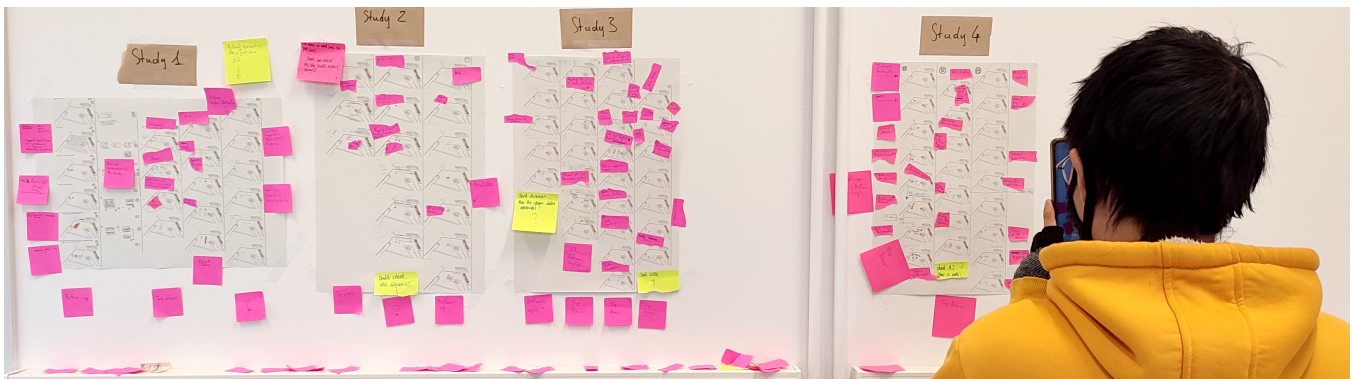


Figure 1: Mosaic of minified sketches fo speculative design produced by the participants during the workshop in subsection 2.1

Abstract

In this paper, we reflect on the qualities of our methods across three speculative design workshops that we designed, ran, and analyzed as part of distinct Human-Computer Interaction research projects. These workshops were conducted over the past four years and each yielded to a research publication on a different topics: visualization, virtual reality, and extended reality. Each workshop employed a different speculative framing that we define in the paper: functional, critical, and exploratory. We summarize the motivations, the process of applying speculative methods, and the outcomes of the speculation. Finally, we reflect on five qualities for speculative design research: speculative plausibility, grounding of speculation, common framing of speculation, synthesis within a framework, and the quality of reflection.

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1 Introduction

Every day, we witness the growing negative impact of digital technology on society, and the Human-Computer Interaction (HCI) community has become increasingly aware of these concerns. These issues include dark patterns and deceptive design [8], the creation of sexualized child imagery with AI on worldwide social networks [15], digital labour exploitation for training AI [5], mass surveillance [17], and even cases of users dying while using VR [1].

Such problems were not part of the visions held by the founders of the HCI community. Many pioneers and industry leaders initially expected to “*make the world a better place*” by augmenting human intelligence [7], making computation accessible to children [11], and fostering democratic access to information. However, as ideas emerging from HCI labs have been deployed into commercial products and integrated into society, unexpected negative consequences

have surfaced. As a research community, it is urgent to become more critical and conscious of the potential harms associated with the technologies we develop. Speculative and critical design [2, 6] appears to be a group of approaches that can provide a reflective and critical assessment of the potential negative consequences of interaction techniques before they are fully deployed and impact society. Despite this promise, it remains unclear how to best run such investigations.

In this position paper, we summarize and review three case studies in which speculative design has been used as a research method for HCI. Each case study corresponds to a published paper and employs speculative design through a different framing:

- **Functionally oriented:** This frame allows us to explore how specific interaction techniques and strategies might be designed for future technologies that are not yet available.
- **Critically oriented:** This frame aims to foreground risks before certain technologies become widely deployed and potentially used in harmful ways.
- **Exploratory oriented:** This frame identifies plausible risks and benefits arising from future combinations of specific technologies, techniques, and use cases that may prove problematic.

These case studies motivate a reflection on the qualities essential for conducting research using a speculative design approach in HCI. In Section 3 we define and exemplify five qualities: C1 - speculative plausibility, C2 - grounding of speculation, C3 - a common frame for speculation, C4 - synthesis within a framework, C5 - and quality of reflection. We contribute to the workshop by proposing these three frames, and these five qualities of speculation.

2 Case study

To introduce my reflection on speculative design we summarize three published papers as case study in which we have been using speculative design as a method. The first one (Autocomplete) is an exploration of how we might design an interaction technique for authoring a visualization, the second one (DarkSide of VR perceptual manipulation) is exploring the risks and potential harms that could be inflicted to user through a set of interaction techniques, the last one (XP Memory manipulation) is exploring a domain of research that was underexplored from both an utilitarian perspective and a risk assessment perspective: the manipulation of memory with VR. In each case study we summarize the motivation, the process and the outcome.

2.1 Auto-complete Strategies in tangible visualization authoring

Wei et al. [16] (Figure 2) explore how autocomplete mechanisms might support visualization construction, particularly in constructive [9] authoring environments. The motivation is forward-looking: the authors interrogate how future visualization systems could anticipate users' next steps while preserving agency and expressivity during the authoring process. In this sense, the work operates within a **functionally-oriented speculative** frame.

Methodologically, the authors organized a speculative design workshop structured in three phases. First, to ground participants' speculation in a concrete design activity, they asked 15 participants



Figure 2: Picture of one of the Autocomplete speculative design workshop.

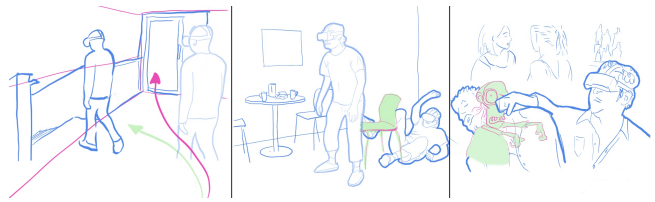


Figure 3: Illustration of three speculative design scenarios of attacks with VR perceptual manipulations.

to construct a visualization using physical tokens. Secondly, they invited them to sketch how they might want to interact with a tangible constructive visualization autocomplete system in a near future scenario. To constrain the speculative space and ensure comparability, the authors provided a graphical templates in which they had to sketch and a step-by-step description of an autocomplete interaction process. Third, participants presented and discussed their sketches with one another. The workshop generated 93 pages of sketches, which the authors analyzed through multiple rounds of thematic analysis conducted by the three authors until consensus was reached. This process enabled the author to identify and compare three strategies of potential interaction technique that differ in granularity, system initiative, and representational commitment.

From a quality perspective in speculative design, the study demonstrates rigor through (1) grounding speculative activity in a lived design situation experienced prior to speculation, (2) providing a shared frame of reference—both in the sequence of actions and the design context—to make participants' scenarios comparable, and (3) conducting a systematic comparative analysis of the proposed scenarios. The plausibility of the envisioned futures is supported by technical feasibility and domain relevance.

2.2 Dark sides of VR perceptual manipulation

Tseng et al. [14] (Figure 3) investigate the potentially harmful uses of perceptual manipulation techniques in Virtual Reality, such as redirected walking and haptic redirection. The motivation is explicitly anticipatory and critical: rather than extending the capabilities of these techniques, the authors seek to surface how they might be misused in future contexts to cause physical, psychological harm. The work is grounded in the observation that HCI research often emphasizes beneficial applications while underexploring negative



Figure 4: Illustration of the scenario “buy a frame” that allows you to insert your picture into the memory photo of fiend’s album.

or malicious futures. As such, the paper adopts a **critically oriented speculative** frame, aiming to foreground risks before these technologies become widely deployed.

Methodologically, the authors conducted a speculative design focus group with eight domain experts in VR, HCI, and design. Participants were invited to go through a three-step process: first, to brainstorm scenarios in which perceptual manipulation could be leveraged to induce physical harm; secondly, to identify dimensions that would help categorize and structure the space of these scenarios (e.g., types of harm); and third, to assess the relevance of each dimension. Participants generated 19 scenarios and 12 dimensions, along with several hours of session transcripts. These materials were analyzed using qualitative thematic analysis to identify recurring patterns of harm, forms of misuse, and ethical tensions. This analytic process resulted in a structured characterization of risks associated with perceptual manipulation technologies. In addition to empirically demonstrating the possibility of inducing harm through perceptual manipulation, the authors implemented two proof-of-concept prototypes capable of causing a user to fall or collide with physical obstacles. These prototypes were tested only by the authors, as ethical constraints prevented evaluation with external participants.

From a quality perspective in speculative design, the study demonstrates rigor through (1) strong anchoring of speculative scenarios in participants’ domain expertise, ensuring plausibility; (2) systematic qualitative analysis that moves beyond anecdotal speculation toward structured insights; and (4) the development of prototypes that function as material proofs of concept of the main issue. The value of the work lies not in proposing design solutions, but in producing a shared vocabulary for discussing harm, responsibility, and safeguards in immersive systems.

2.3 XR memory manipulation

Bonnail et al. [3] (Figure 4) examine how Extended Reality (XR) systems could intentionally or unintentionally manipulate human

memory processes. The motivation is anticipatory and ethically driven: rather than optimizing XR interfaces, the authors interrogate how immersive technologies might exploit well-documented cognitive mechanisms—such as encoding biases, retrieval distortions, or false memory formation—to influence users’ beliefs, recollections, and decisions. The work responds to a broader concern in HCI that emerging immersive systems increasingly mediate lived experience, yet their long-term cognitive implications remain underexplored. The paper thus adopts an **exploratory oriented speculative** frame, aiming to identify plausible cognitive and societal risks and benefits before such manipulative capabilities become normalized in commercial XR ecosystems.

Methodologically, the authors organized three speculative design workshops involving researchers with expertise in XR (6) and cognitive science (6). Each speculative design workshop was involving four experts and one moderator for approximately three hours. Participants collaboratively generated speculative scenarios describing how XR technologies might intervene at different stages of memory processing (e.g., encoding, pre-retrieval cues, retrieval reconstruction). Each workshop was composed of three rounds; each round would follow these three steps, first a presentation of a set of memory limitations, second an individual brainstorming session in which participants have to fill post-it with constrained fields, and third a discussion between the participants. All workshop happens on a mirror board. Throughout the workshops, participants produced 74 speculative scenarios (25 discussed during the workshop) which were documented and subsequently analyzed through systematic qualitative thematic analysis. Through iterative coding and synthesis, the authors derived a structured conceptualization of XR Memory Manipulations, identifying core components and categorizing them according to the stage of memory they affect. The speculative scenarios function as analytic probes: they externalize assumptions about technological affordances and cognitive vulnerabilities, enabling structured examination rather than purely fictional exploration.

From a quality perspective in speculative design, the study demonstrates rigor through (1) interdisciplinary grounding in established cognitive psychology research on memory mechanisms, ensuring theoretical plausibility; (2) structured workshop design and documentation across multiple sessions, enhancing breadth and reliability; and (3) systematic thematic synthesis that transforms speculative material into a transferable conceptual framework.

3 Reflection on quality criterias

These papers tend to apply several widely acknowledged criteria of research rigor [10, 13], including: *rationale clarity* regarding why speculation is mobilized; *method transparency*, with detailed descriptions of data collection and analysis protocols; *participant validity*, through the engagement of appropriate stakeholders aligned with the research question; *analytic depth*, achieved by systematically structuring outputs into frameworks, strategies, or threat models; and *reflective critique*, through explicit discussion of implications and limitations.

Beyond these general criteria, we identify five main common dimensions of quality of speculation. The **(C1) speculative plausibility**: anchoring scenarios in existing or plausible technologies

and usage, **(C2) grounding of speculation**: providing the minimum common element to structure the speculation, **(C3) common frame of speculation**: a system of concept, dimensions or categories that make the scenarios comparable, and **(C4) synthesis in a framework**: providing a formal operational structure of the knowledge gain from the speculation, and the quality of the **qualities of the reflection (C5)**.

Each case exhibits specific methodological qualities and adresses these criterias differently. In AutoComplete subsection 2.1, one distinctive contribution is the **grounding of speculation (C2)** in a reference activity that mimics key properties of the anticipated speculative context. By first engaging participants (that are potential end-user) in a constructive visualization task, we exposed them to the practical constraints and cognitive demands of the activity before inviting speculative projection. This grounding allowed participants to situate their speculation within both low- and high-level challenges encountered during the performed task, thereby reducing the **risk of producing implausible (C1)** or “above-ground” scenarios detached from practice. Similarly to prospective use methods [12]. Another criterion was **the triangulation of sources** [4], as scenarios were documented both through sketches and oral explanations, providing complementary representations of the same speculative propositions across different media. This paper output was a list of strategy of interaction technique fulfilling **(C4)**, and a reflective discussion **(C5)** on trade off about visualization authoring automation.

In Dark Side of Perceptual Manipulations subsection 2.2, rigor is reinforced through the deliberate **recruitment of expert participants (C2)** with deep familiarity in VR technologies and interaction design, ensuring the generation of credible and technically grounded scenarios. The study further demonstrates systematic analysis through iterative thematic examination of transcripts and scenarios, resulting in a **structured categorization of risks (C4)**. Importantly, the work foregrounds critical reflection **(C5)**, explicitly examining ethical and safety implications beyond surface-level speculation.

In Memory Manipulations in XR subsection 2.3, plausibility is strengthened through the breadth of scenario generation **(C1)**, conducted across multiple workshops. The study also relies on interdisciplinary expert participants **(C2)**, bringing complementary perspectives from XR research and cognitive science. Speculative scenarios are explicitly tied to concrete XR affordances and established cognitive science insights, reinforcing **speculative plausibility (C1)**. As in DarkSide, the result are structured in a framework here a **threat model, (C4)** which lead to an explicit discussion of societal impacts extends the speculative material into a domain of ethical and political reflection **(C5)**.

Another cross-cutting methodological strategy concerns the provision of a **common frame of reference in speculation to structure and compare speculative scenarios (C3)**. Such a frame can either be imposed as a constraint or emerge from participant activity. In AutoComplete (subsection 2.1), a common frame of reference was imposed through visual and sequential templates that structured the speculative interaction process. Similarly, in Memory, participants used preformatted post-it templates containing predefined fields to document scenarios. In contrast, in DarkSide, the frame of reference emerged inductively through participants’

identification of dimensions and categories to structure and compare speculative scenarios. Across all three studies, methodological choices were deliberately tailored to optimize the plausibility and comparability of speculative scenario collections while maintaining analytic rigor.

4 Limitations

In this work, we explored three speculative design frames in HCI, functionalist, critical, and exploratory, through three case studies. The reflections presented here constitute an attempt to formalize a frame and quality criteria for speculative design workshops in HCI. We acknowledge that other speculative frames not addressed in this paper could be used, and might be equally powerful and valuable. For instance, a dystopian frame foregrounds negative or hazardous futures in order to intensify ethical awareness, while a counterfactual frame may explore alternative historical trajectories to interrogate technological determinism and contingency.

We argue that each speculative design frame carries its own quality criteria, limitations, and strengths, as they are oriented toward different epistemic and pragmatic goals. Consequently, evaluating rigor in speculative design should account for the intended function of the frame mobilized, rather than applying a single, uniform standard across heterogeneous speculative approaches.

5 Conclusion

In this position paper, we presented three case studies of speculative design workshops in HCI. Through these cases, we formalized the notion of a speculative design frame and identified three distinct orientations: functionalist, critical, and exploratory. Building on this comparative analysis, we reflect on both general and frame-specific criteria for conducting research using speculative design methodologies. From these case study we also identify, define and exemplify five qualities for speculative design: speculative plausibility, grounding of speculation, common frame of speculation, synthesis in a framework, and the quality of reflection. To go further, we believe that rigorous speculative design research in HCI could inform digital technology governance and regulation for protecting a more free and safer future for humans and society.

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