UNLOOP 2026

Book of Abstracts
of the Symposium on Interaction
and Computational Media Design

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EDITED BY

Miguel Carvalhais
Pedro Cardoso
Eliana Santiago
Fabrício Fava

DESIGN

Henrique Miguel

COVER

Lara Portelinha

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KEYNOTE SPEAKER

Laura Beloff
Aalto University – School of Art, Design and Architecture

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Foreword:
An Invitation to Break the Loop

With the increasing pervasiveness of computational media, the influence of interaction design in our lives also grows. Today, at the foundation of its educational and professional practices lies Human-Centred Design (HCD), a philosophy that prioritizes users' characteristics, needs, workflows, and usage contexts, and that adopts a set of design methodologies and testing metrics intrinsically tied to them. This approach has been successfully fostering user-friendliness, streamlined tasks, and states of flow by creating products that minimize cognitive stress, that remain "ready-to-hand", and that help everyone to maximise the potential of computational media in their lives. Because of this, HCD has undeniably shaped the modern media landscape, but this positive impact is not without some downsides.

An uncritical application of HCD can result in the optimization for the familiar, trapping users in hedonistic loops that prioritize comfort over substance and meaning. This focus on effortlessness manifests as dark patterns, aggressive gamification, the enshitification of platforms, or in several other exploitations of the persuasive nature of digital media, contributing to eroding the potential for critical thinking and metacognition in users. If ease of use is unfettered and not conflated with a lack of meaningful friction, it may lead to a reduction of diversity, radicalization, and a dilution of the ergodic potential of computational media. Ultimately, it may lead to alienation—the very opposite of the original goals of flow theory—and encourage shallow and unreflective interactions that facilitate convergent thinking and the formation of echo chambers.

Given its influence on all human activity, the design of computational media—from games, to generative AI, creative software, social networks and most other aspects of our post-digital lives—shapes our creativity and impacts societal fronts, from politics to ecology and culture. The UNLOOP symposium emerges from this, taking place in the context of Break the Loop, a research project that seeks to address these short-

comings by expanding HCD methods and developing tools to counteract their negative effects. Break the Loop questions the dominant paradigms of HCD and explores friction, inconvenience, and playfulness in computational media as inducers of meaning, reflectiveness and higher-order thinking.

UNLOOP took place on June 26, 2026, at the Faculty of Fine Arts of the University of Porto, and was co-organised with i2ADS the Research Institute in Art, Design and Society, and the Masters in Interaction and Computational Media Design. The symposium welcomed Laura Beloff, from Aalto University, School of Art, Design and Architecture, as its keynote speaker, with a talk titled *Chickens and Bones: From Fossils to Algorithms*, and twenty other presentations, compiled here as extended abstracts.

UNLOOP is not only the conclusion of a research project as it is a first step towards its further development and its scaling to a larger community of research and practice. We look forward to the continuation of these conversations.

The Organizing Committee.

Extended Abstracts

Deception by Design: Anti-Piracy Deception in Video Games

KEYWORDS

Deception;
Anti-piracy;
Game design;
Digital rights management;
Ludic unreliability.

RITA MALAQUIAS
European University of Lisbon,
Lisbon, Portugal
rita.malaquias@ext.universidadeeuropeia.pt

PEDRO CARDOSO
i2ADS, Faculty of Fine Arts,
University of Porto,
Porto, Portugal
pcardoso@fba.up.pt

PAMELA TEUBIG
European University of Lisbon,
Lisbon, Portugal
pamela.teubig@universidadeeuropeia.pt

EVA OLIVEIRA
INESC-TEC / Polytechnic
Institute of Cávado and Ave,
Barcelos, Portugal
eoliveira@ipca.pt

SUMMARY

Anti-piracy in video games often relies on DRM systems that block access to the game for unauthorised users, but some games take a different approach: they alter how the game works, either by making progression harder, presenting unfair outcomes, or simply behaving strangely. This turns anti-piracy design mechanisms as part of the game experience itself, usually subverting players' expectations. This extended abstract explores how these alternative anti-piracy mechanisms work as designed experiences.

CONTEXT

Anti-piracy measures in digital media are typically understood as technical systems designed to prevent unauthorised access and distribution. In video games, these measures often take the form of Digital Rights Management (DRM), including licence verification, encryption, and online authentication. These approaches operate outside gameplay, restricting access before or during execution. While widely used, such systems have been criticised for their limited effectiveness and for introducing friction in the user experience of legitimate users (Haber et al. 2003; McDonald et al. 2015).

However, not all anti-piracy mechanisms operate as such. Some allow unauthorised copies of video games to run while altering the gameplay experience itself. Players can play, but game systems disrupt progression, introduce instability, or produce unexpected outcomes. In these cases, anti-piracy enforcement occurs through user interaction rather than access restriction.

This paper argues that certain anti-piracy mechanisms function as designed play experiences rather than purely technical protections. Instead of blocking access, they deceive the player and manipulate their expectations. Anti-piracy becomes then part of the player's experience rather than a condition imposed before it.

Drawing on theoretical work on deception and game design, and supported by case studies, this paper reframes anti-piracy as an experiential process. It examines how gameplay alterations can challenge assumptions about consistency, fairness, and system transparency

DECEPTION IN GAME DESIGN, DRM, AND LUDIC UNRELIABILITY

Deception plays a role in game design, particularly in relation to player expectations and how players understand and interpret the rules and systems in a game. Games often provide incomplete or misleading information as part of their design, influencing how players understand rules and outcomes. Rather than being incidental, these forms of misdirection can be used deliberately to design player experience (Malaquias and Cardoso 2025).

Our past work examined how deception can be designed through recurring design patterns, showing how games can mislead players through mechanics, feedback, and representation (2025). Such approaches demonstrate that deception can be a structural property of gameplay, influencing how players perceive and respond to the game's systems.

Simultaneously, the design of deception raises ethical concerns. Research on dark patterns in games identifies mechanisms that influence player behaviour in ways that are not transparent, particularly in monetised contexts (Zagal et al. 2013). Similarly, studies on transitions from premium to free-to-play monetisation models show how design decisions can move from encouraging players to keep playing to adding limits and reduce their freedom while interacting with the game (Hadan et al. 2024). Work on player perception further suggests that trust in a game depends on expectations of consistency and fairness (Yin et al. 2024).

Traditional DRM operates differently from the gameplay based anti-piracy mechanisms. It relies on preventive controls, restricting access through technical means (Haber et al. 2003). While intended to protect intellectual property, these systems often affect legitimate users, introducing inconvenience and reducing trust (McDonald et al. 2015). In this sense, traditional DRM treats piracy as a condition to be blocked rather than addressed through interaction.

Alternative approaches emphasise deterrence rather than prevention, allowing unauthorised access while introducing consequences that discourage it (Gopal and Sanders 1997). Some anti-piracy mechanisms extend this idea by altering gameplay itself, using changes in systems and outcomes to communicate consequences to the player.

The concept of *ludic unreliability* (Gualeni and Van de Mosselaer 2021) provides a useful way to understand these interventions. It describes situations in which a game undermines the player's assumptions about how its systems function, requiring reinterpretation. In the context of anti-piracy, such unreliability is not only aesthetic but functional, influencing how players experience and respond to the game.

RELATED WORK: CASES AND TECHNIQUES

Several video games illustrate how anti-piracy mechanisms can function through gameplay rather than access restriction. *Game Dev Tycoon* (2012) presents a clear example of this approach. The developers distributed a modified version of the game through torrent platforms. This version allowed normal progression at first, but later introduced increasing levels of piracy within the game world, which eventually led to financial failure (Klug 2013). This change was not presented as a restriction but as part of the simulation itself. Players attempted to respond to the in-game piracy without realising that their experience had been altered. As a result, many players publicly complained about the game's difficulty, revealing that they were playing the modified version.

In *FIFA Manager 09* (2009), players reported that unauthorised copies of the game resulted in the manager being dismissed at the end of each season, regardless of performance. A developer explanation reproduced in community forums confirms that this behaviour was linked to pirated versions (GameFAQs 2009). Because this outcome occurs within the simulation, players often interpreted it as a bug or an issue with game balance rather than as a deliberate intervention.

Regarding the case of *Mirror's Edge* (2008), unauthorised copies were reported to affect the protagonist's movement speed, preventing players from successfully completing jumps required to progress in the game. The game relies heavily on momentum, and reducing movement speed disrupts its core mechanics. This change does not prevent access to the game itself, but alters how it functions, making progression difficult without clearly indicating the cause.

Earthbound (1994) employs deception in its anti-piracy mechanism. Instead of stopping the game from running, the game detects pirated copies and changes how it behaves during gameplay. In pirated versions, enemies can appear in unusual places, making the game harder than initially intended when compared with the legitimate copy. In some instances, the game may also corrupt the saved data or crash deliberately near the end, which prevents players from finishing the game. In this case, anti-piracy is designed into the gameplay experience itself rather than being handled externally. This is an example of the crash and burn deception pattern as documented by Malaquias and Cardoso (2025).

DISCUSSION

These cases show that anti-piracy can function through design rather than technical restriction. By altering gameplay systems, developers can introduce consequences that are experienced directly by players.

This approach relies on the assumption that players expect consistency in how games operate. When this consistency is disrupted, players must reconsider how the system works.

Research on player perception suggests that trust depends on the reliability of mechanics and feedback (Yin et al. 2024). When this reliability is compromised, the experience becomes uncertain.

In these situations, players may initially interpret disruptions as errors or design flaws. Only later, if at all, do they recognise them as intentional. This changes how the experience is understood, turning what appears to be a problem into an intentional feature.

These ideas aren't just relevant to games, but are also important to consider for interaction design. Some software companies rely on invasive kernel-level restrictions that frustrate users, driving them towards unauthorised versions of the software. Instead, designers could use subtle and experienced based design to make the legitimate version more appealing (for example, reduced functionality in unauthorised copies). This way, users would choose the legal product because it offers a better and more reliable experience, rather than being forced into compliance through technical restrictions.

As stated, these methods also bring out ethical issues: as Zagal, Björk, and Lewis's work on dark patterns shows, design can influence behaviour in ways that are not always transparent (2013). Some players might see anti-piracy mechanisms that rely on deception as justified, while others see them as unfair. There is also the question of these mechanisms' effectiveness. While they may discourage some forms of piracy, they are often shared and discussed in online communities. This visibility can reduce their impact while contributing to a game's cultural presence.

Despite these limitations, such approaches demonstrate that enforcement can be achieved through the game experience itself rather than through external restrictions. They show how design decisions can influence how players act and understand the game without needing outside systems to control them.

CONCLUSIONS

Anti-piracy mechanisms in video games are often treated as technical solutions to unauthorised access. This extended abstract has argued that some approaches challenge this view by implementing anti-piracy through gameplay design rather than relying on external systems such as DRM or other access control technologies.

By altering systems and expectations, these mechanisms use deception to influence how players interpret their experience. In doing so, they extend the concept of ludic unreliability into the context of enforcement.

This perspective shows how gameplay can be used to communicate consequences and influence behaviour. It also raises important questions about trust, fairness, and the role of deception in design.

Further research is needed to understand how players perceive these mechanisms and how they affect behaviour over time. Exploring how players interpret anti-piracy mechanisms and how these mechanisms influence in-game decisions may provide a clearer understanding of how anti-piracy can function as part of the design process.

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Cozy Cracks: Involuntary Diegetic Friction and Reflective Play in Domestic Game Spaces

KEYWORDS

Cozy games;
Involuntary diegetic friction;
Against flow;
Loops.

MADDALENA GRATTAROLA
London College of Communication (UAL) / Goldsmiths, University of London
London, United Kingdom
m.grattarola@lcc.arts.ac.uk
maddalena.grattarola@gold.ac.uk

SUMMARY

Cozy games are designed to minimise friction, yet this paper argues that domestic game spaces inevitably produce what it terms *involuntary diegetic friction*: interpretive interruption that emerges from the biographical and material weight of domestic objects, rather than from deliberate design. Through close analysis of four recent games (*Unpacking, Undusted: Letters from the Past, A Little to the Left,* and *Hozy*), the paper identifies four distinct friction modes: hermeneutic, durational, systemic, and environmental. These modes resist reward-loop automation and extend Benedetti and Mauri's diegetic/extra-diegetic framework by identifying friction emergent from domestic game spaces.

When a player hesitates over a domestic object in a cozy game, uncertain what it means, who it belonged to, or why it refuses to fit where logic suggests it should, the genre's promise of frictionless comfort momentarily breaks down. This moment of hesitation is the subject of this paper, where friction denotes interpretive interruption: a moment in which the player cannot proceed automatically and must instead stop, interpret, and decide. Cozy games attempt to eliminate friction at the level of mechanics, but this paper argues they cannot eliminate friction at the level of meaning.

Cozy games are designed as friction-minimised experience loops: the genre's founding design manifesto describes coziness in terms of "fantasy of safety, abundance, and softness", explicitly minimising pressure, failure states, and responsibility (Short et al. 2018). This philosophy finds its commercial culmi-

nation in games like *Hozy*, whose Steam page promises "no timers, scores, penalties, and absolutely no stress," celebrates small reward feedback loops, and declares flow as its central design goal (Come On Studio 2026). The result is a genre aligned with what Kornbluh (2024) calls immediacy: the cultural style of too-late capitalism in which flow, presence, and affective directness eliminate the mediating function of experience, replacing interpretation with sensation and reflection with reward. Flow, as Soderman (2021) demonstrates, has become an ideology in game design discourse that privileges individuality, growth, and accumulation, producing flowing subjects whose engagement with games mirrors the logic of neoliberal productivity. Navarro-Remesal (2026) argues that practices associated with slowness and mindfulness are often absorbed by consumer culture, transformed into what he calls "consumer zen" or "consumer slowness," where reflection and relaxation risk becoming commodified experiences rather than genuinely critical or transformative ones. In this sense, cozy games can be understood as part of this broader dynamic, packaging slowness, care, and domesticity as consumable experiences that resemble reflective play while remaining embedded within attention-economy design logics. In Srnicek and Williams' terms (2016), this can be read as a form of folk-political agency focused on small-scale, immediate control over a domestic space, mistaking the management of a virtual shelf for meaningful agency while structural conditions remain intact. Bódi's concept of cozy agency names this affect precisely, the amplified sense of control through repetitive domestic labour, offering escapism from deprived neoliberal agency rather than a structural alternative to it (2023).

The loop, however, breaks. This paper argues that friction is structurally unavoidable in domestic game spaces, an emergent property of the objects and spaces themselves rather than a design failure to be patched. Domestic objects are biographical objects. They refer to absent people, past events, and social relations, and therefore require active interpretation. Unlike abstract puzzle objects, domestic objects are embedded in lived routines and therefore invite interpretation even when the game does not explicitly ask for it. Through close analysis of four recent games, *Unpacking* (Witch Beam

2021), *Undusted: Letters from the Past* (5minlab Corp. 2025), *A Little to the Left* (Max Inferno 2022), and *Hozy* (Come On Studio 2026), the paper identifies a family of related friction modes, each distinct from difficulty, challenge, or mechanical resistance. What unites them is that they generate interpretive demand: moments that require sustained attention, produce uncertainty, and resist the automatic processing that reward loops are designed to sustain. These examples suggest four recurring friction modes in domestic cozy games: hermeneutic friction, durational friction, systemic friction, and environmental friction.

In *Unpacking*, hermeneutic friction emerges through inference. The game withholds explicit narration entirely: the player reconstructs the life of an unnamed protagonist by reading the spatial logic of her possessions across a series of moves. Silent by nature, objects must be read relationally and spatially, and the interpretation is never fully confirmed. The player who realises that a hard-won diploma fits nowhere in a shared flat except under the bed understands something about that living arrangement that the game never states. This is friction as detective work, the slow, ergodic construction of meaning from material evidence.

Undusted: Letters from the Past operates through durational friction. Here too the player reconstructs a life through domestic objects, but where *Unpacking* makes reconstruction a matter of open spatial inference, *Undusted* makes it a matter of patient material labour that gradually releases a narrative the player cannot redirect or refuse. The protagonist cleans long-neglected items in her late mother's home, and the act of restoration progressively surfaces memories of a fractured relationship. Cleaning is the mechanic, and cleaning is what unlocks the story. The friction here is durational and affective: the player must perform attentive care work before the narrative is released, and what is released is a history of estrangement that the restored objects can evoke but not repair. Susan Stewart's concept of longing (1993) offers a way to articulate this dynamic: the irresolvable desire to recover through the restoration of material traces what the relationship itself never resolved. The game's overwhelmingly positive critical

reception on Steam suggests that this mode of friction, emotionally rich and structured around care rather than challenge, is among the most broadly accessible the genre currently produces.

A Little to the Left produces systemic friction, one detached from narrative or emotional weight. The game presents household objects to be organised, and players bring their own intuitive sense of order to the task, only to discover that sometimes the system has a predetermined correct solution that may diverge from their own logic. Michel de Certeau's concepts of strategy and tactics (1984) provide a useful lens for examining this distinction: where the game's design constitutes a strategic system with intended placements and organisational rules, players deploy tactics, arranging spaces according to their own expressive or aesthetic preferences, only to have those tactics overruled. The friction here is the gap between two orders of meaning, the player's and the system's, and it generates deliberate attention precisely because the player must negotiate between their own interpretive framework and one they did not choose.

Hozy presents environmental friction. The player cleans and restores a series of spaces before arranging objects within them, and while the player retains expressive control over arrangement, the spaces themselves carry the weight of specific lives: a parents' home, an artist's workshop, an old café, a father's unrealised dream of a place by the sea (Come On Studio 2026). The friction operates through material attention and environmental biography: dust that tumbles and drifts invited through an open window, spaces that require witnessing before they can be restored. Navarro-Remesal (2026) discusses the concept of interactive catalysts or ludocatalysts (interactive moments of low intensity or stasis) such as waiting, observing, or performing routine actions that slow down play and create space for reflection rather than constant action or challenge. Kornbluh's concept of hold (2024) names what these moments do at the cultural level: where immediacy flows, smooth, fast, and circulatory, hold clogs, slows, and makes the work of relation palpable.

The variability of player response across these four friction modes further illustrates the central argument. A player who finds *Unpacking*'s spatial inference absorbing and *A Little to the Left*'s systemic refusal challenging to navigate, or the reverse, is not responding incorrectly: they are responding to genuinely different qualities of interpretive demand. Difficulty produces relatively calibrated responses; interpretive friction produces variable ones, because it activates different players' relationships to ambiguity, control, narrative, and domestic labour. This variability is what distinguishes involuntary diegetic friction from designed challenge: it is real, operative, and affectively significant in ways the frictionless loop by definition forecloses.

The paper's theoretical contribution is to name and formalise this phenomenon as involuntary diegetic friction. Drawing on Benedetti and Mauri's framework (2023), developed in the context of digital design and platform studies, this paper extends their distinction between diegetic friction, intentional in-system interruptions designed to slow or redirect user behaviour, and extra-diegetic friction, interventions external to the platform that challenge user assumptions, into the domain of domestic game design. Involuntary diegetic friction is a third category: friction that cannot be entirely designed away because it emerges from the interpretive and material weight that domestic objects and spaces carry. The paper's central claim is that domestic cozy games inevitably produce this third type. Short et al.'s own manifesto intuited something of this dynamic, acknowledging that contrast and controlled discomfort can enhance coziness (Short et al. 2018).

For Navarro-Remesal, reflective games exist in a tension between critical reflection and their incorporation into consumer culture, making them a site of struggle between resistance and co-optation (2026). Involuntary diegetic friction is where that struggle becomes visible in the domestic game space: a design practice attentive to these ruptures would move the genre from flow toward hold, from reward toward the kind of mediation that Kornbluh identifies as the necessary counter-tendency to the immediacy dominant (2024). In a genre increasingly organised around reward-optimised loops, friction in domestic space is where meaning enters the cozy loop.

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The Subversion of User-Friendly Design: Engagement Algorithms and the Erosion of Agency in the Attention Economy

KEYWORDS

UX Design;
User-friendly;
Persuasive Design;
Attention Economy;
Engagement Algorithms.

ANA LUÍSA FERREIRA
Lusófona University,
Porto, Portugal
analuisaferreira64@gmail.com

ANDREIA PINTO DE SOUSA
Lusófona University, HEI-Lab:
Digital Human-Environment
Interaction Labs,
Porto, Portugal
andreia.pinto.sousa@ulusofona.pt

SUMMARY

This study examines the ethical inversion of User Experience (UX) design within the attention economy. It adopts the concept of Attention-Capture Damaging Patterns (ACDP) to identify mechanisms that exploit psychological vulnerabilities (such as infinite scroll and autoplay) to maximise retention at the expense of user autonomy. As a solution, the proposed framework introduces "ethical friction:" deliberate design interventions that disrupt automatic cycles and restore agency. The work redefines usability, suggesting "Attention Efficiency" as a new metric to align design with human well-being and sovereignty.

User experience (UX) design has traditionally been framed as a human-centred discipline concerned with usability, accessibility, and the optimisation of interactions to support user goals and well-being (Norman 2013). Grounded in user-centred design (UCD), this paradigm emphasises the creation of systems that are intuitive, efficient, and aligned with user needs, through iterative research and evaluation (Garrett 2011; ISO 9241-210 2019). Historically, reducing friction was understood as a key strategy for improving interaction quality and facilitating goal-oriented behaviour.

The theoretical framework presented argues for a critical shift from traditional User-Centred Design to a design logic guided by the attention economy. Traditionally, UX design focused on facilitating users' goals and well-being; however, in the contemporary era, this approach has been reversed: facilitating interaction is now often instrumentalised to maximise time

spent on platforms. Within the "attention economy", user focus has become the main "currency" (Franck 1999), leading to the systematic prioritisation of engagement metrics such as retention and time-on-platform over autonomy and well-being (Eyal 2014; Schüll 2012). Design decisions are not neutral; they emerge from organisational logics where performance metrics systematically override user interests (Gomes et al. 2025).

This engagement logic operates through the concept of Attention-Capture Damaging Patterns (ACDP). ACDPs are defined as "a recurring pattern in digital interfaces that a designer uses to exploit psychological vulnerabilities and capture attention, often leading the user to lose track of their goals, lose their sense of time and control, and later feel regret" (Roffarello et al. 2023, 4). Unlike classic dark patterns, which aim to cause financial or privacy harm, ACDPs focus on persistent attentional harm that undermines the user's capacity for reflective decision-making and agency.

The functioning of ACDPs is based on specific criteria that induce states of "normative dissociation," in which the individual temporarily disconnects from physical and emotional experiences, losing awareness of themselves and of time, entering a cycle of passive or involuntary consumption (Roffarello et al. 2023). Among the main mechanisms there are features such as infinite scroll, which eliminate natural stopping points, making it difficult to consciously decide to interrupt the activity (Alter 2017; Hissa 2020); mechanisms such as pull-to-refresh, which use a variable reward logic similar to slot machines, keeping the user constantly searching for new content (Madrigal 2013); as well as autoplay and algorithmic recommendations, which remove the need for the user to make autonomous decisions, keeping them trapped in continuous content streams that often diverge from their initial intentions (Lukoff et al. 2021).

This study adopts a qualitative, documentary approach based on a critical synthesis of academic and theoretical literature. Sources were collected from academic databases (Google Scholar, Academia.edu, ResearchGate) and expanded through citation-network exploration using Research Rabbit. The re-

sulting corpus, spanning communication, interaction design, and behavioural psychology (1998-2023), supports a critical examination of persuasive interface mechanisms within attention-driven platforms.

This dynamic demonstrates a central paradox in contemporary UX design. The same qualities that characterise "good" experience – or, in the words of Kuang and Fabricant (2019), a user-friendly interface, such as fluidity, intuitiveness, and efficiency, are frequently instrumentalised to suppress individual agency in favour of optimising retention metrics (Lukoff et al. 2021; Roffarello et al. 2023). Rather than supporting user goals, these design strategies can diminish reflective decision-making and reposition the user as a passive agent within highly optimised interaction flows. In this sense, what is traditionally framed as usability becomes entangled with persuasion, blurring the boundary between facilitation and control.

The paper further draws on Schüll's (2012) concept of the "machine zone" to describe states of sustained, self-reinforcing interaction in which the intuitiveness of the design ultimately keeps the user in a cycle of involuntary consumption (Madrigal 2013). In digital environments, this condition is amplified by the convergence of frictionless interface design and algorithmic personalisation, which together produce continuous and highly adaptive content streams. These systems reduce opportunities for conscious disengagement, reinforcing cycles of involuntary consumption and attentional capture (Alter 2017; Lukoff et al. 2021).

A key implication of this analysis is the need to critically reassess the role of friction in interaction design. While commonly treated as an obstacle to usability, friction can also serve as a necessary condition for supporting awareness, deliberation, and user control. The paper therefore proposes the reintroduction of "ethical friction" as a design and regulatory strategy aimed at restoring user autonomy and aligning UX practice with its original human-centred goals (Oliveira et al. 2023; Gray et al. 2018).

In response to this scenario, the framework suggests reintroducing "ethical friction" as a set of deliberate design interventions to restore users' awareness, deliberation, and control over their actions in digital environments. The reintroduction of ethical friction in interaction design is achieved through mechanisms that interrupt automatic cognitive processing and restore users' capacity for deliberation. As argued by Oliveira et al. (2023) and Gray et al. (2018), friction should be understood not as a usability error but as a necessary condition for autonomy. In practical terms, these interventions include replacing infinite scroll with deliberate stopping cues. At the end of a content stream, the interface introduces a deliberate stopping cue that requires a conscious user action, such as pressing a "load more" button. By replacing seamless flow with a moment of deliberation, this intervention disrupts the cycle of intermittent reinforcement that characterises the "machine zone" described by Schüll (2012) and interrupts the hedonistic loop identified by Cardoso et al. (2019).

This approach extends to managing users' intent through micro-decision moments. Instead of autoplay systems or passive recommendations that diminish the sense of agency, ethical friction introduces intention confirmation screens, for example, before starting a new task or video, the interface prompts the user to set a goal or a time limit. This technical intervention transforms passive flow into an active choice, mitigating the "Time Fog" phenomenon identified by Roffarello et al. (2023).

In addition to the visual interface, ethical friction is operationalised through real-time transparency of information. This involves displaying attention-cost indicators and deconstructing algorithmic logic: the interface actively reveals why a piece of content is being prioritised, allowing the user to calibrate their interaction through reflection rather than merely on emotional impulse. At the systemic level, this framework proposes replacing retention-driven success metrics with "Attention Efficiency," defined as the alignment between the user's stated intention and their actual interaction outcomes. In this way, ethical friction becomes a set of technical guidelines rather than an abstract concept, ensuring that usability remains at the service of human well-being and agency (Gomes et al. 2025).

In conclusion, this paper offers a conceptual framework for understanding how contemporary UX design, under the influence of the attention economy, can produce diffuse, persistent, and structurally embedded forms of harm. It proposes the concept of Attention-Capture Damaging Patterns as a tool for identifying attentional harm in interface design. By reframing usability as a potential site of behavioural control, it challenges the assumption that frictionless design is inherently beneficial. Reasserting the original goals of user-centred design requires not only methodological refinement but a fundamental reorientation toward protecting user autonomy and well-being in increasingly optimised digital environments.

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Narrative Wandering: Infinite Hallways in Video Games as a Storytelling Trope

KEYWORDS

Playful design;
Interactive aesthetic;
Video games studies;
Narrative design.

ARTHUR KUHN
Laboratoire Paragraphe,
Université Paris 8, Paris, France
a.kuhn@kuhnhestale.fr

SUMMARY

This paper offers a media archeological retelling of the use of hallways in video games. Starting as a technical and utilitarian element used to hide limitations, to become a narrative tool and even a trope or genre in itself. Based on contemporary examples of hallway-centric game designs, it offers an analysis of how such a design can operate, as well as a proposed challenge to go beyond one of its thematic limitations.

INTRODUCTION

Digitality comes in chunks. It is commonplace to assess the difference between digital and analog, virtual and real, in terms of continuity versus finiteness. In videogames, the worlds we play within are systematically built as delimited areas, with connecting points. Any game, no matter its hardware, visual or play style needs to address the discrete nature of its world, meaning that the implementation of the transitional spaces and moments is crucial in constituting the game's rhythm, immersion and technical feasibility. Designing a system that encompasses and negotiates all of the game's apparatus. Hence, whatever sits on the threshold of these chunks is carefully crafted. And more often than not, stylized as hallways.

1. HALLWAYS, LOADING AND LINEARITY

Going from one chunk to the other can take many visual forms, but technically always imply transferring a portion of the game's data into the hardware's memory; that is, loading. In 2023, David Antognoli and Joshua A. Fisher published a *Proposed Taxonomy for the Design of Qualities of Videogame Loading Interfaces and Processes*, and explained that the his-

tory of these loading points generally follows an objective of invisibilization, in favor of a diegetically uninterrupted experience. Examining that tendency from a media archeological perspective, I offer two examples of: 1. *The Legend of Zelda–Ocarina of Time* (*OoT*, 1998, Fig.1) and 2. *Final Fantasy VIII* (*FFVIII*, 1999, Fig.2). In both cases, we clearly see the moment where the player hits the loading point at the end of a hallway. It is most obvious in *FFVIII*'s case, where they are literally placed at the edge of the screen. I also point out that the perhaps most obvious uses of this digital, cut-up, spatiality, is the maze-like architecture. Simply reloading the same background image or 3D assets, one gets a disorienting repetitive impression.

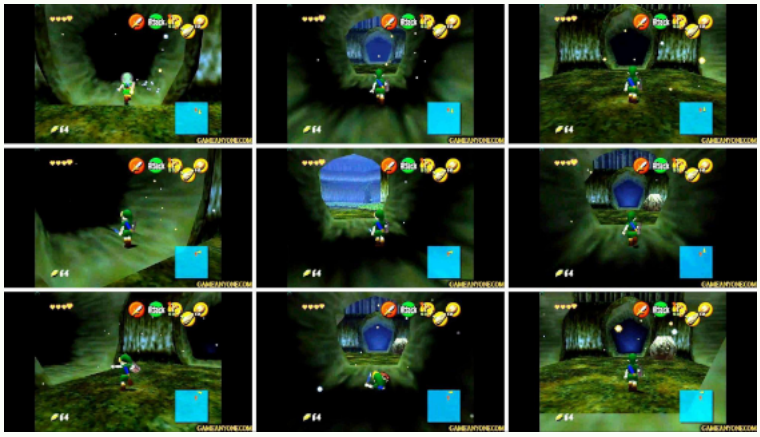


Fig.1. *The Legend of Zelda–Ocarina of Time*. Forest Maze section. Screenplays from Deon's Youtube Channel.

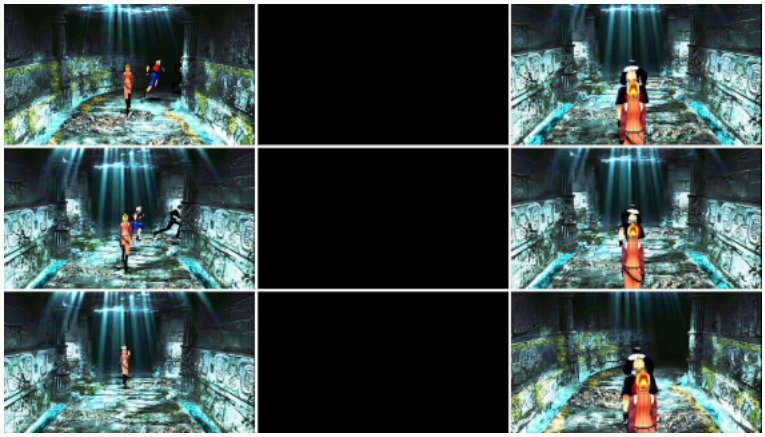


Fig.2. *Final Fantasy VIII*. Unknown King tomb maze. Personal screen recs.

In 1999 also came out *Legacy of Kain–Soul Reaver*. Also published on the PlayStation system, this game used various techniques to provide a seamless experience. From literal camera tricks and cinematographic shot-reverse shot editing (Fig. 3), to more specific solutions like taking the control of the player's character to ensure their field of view will hide precisely half a room – thus discarding and reloading the assets, while the player literally looks the other way (Fig.4).



Fig.3. *Legacy of Kain–Soul Reaver*. Door opening animation with its editing. Personal screen recs.



Fig.4. *Legacy of Kain–Soul Reaver*. Teleportation animation, where the character follows a strict path, and the camera turns at the end to hide the level's assets loading. Personal screen recs.

What I refer to as hallways, aside from the literal architectural elements, are these small spaces and moments happening before the loadings and just before them. As they are "non-play" elements (Keogh 2014), they tend to get somewhat poorly considered by the players, hence a desire for their hiding. This negative sentiment seeped into most of online videogame discussion going back to the xBox 360 and PlayStation 3 era (mid-2000s). Any game not hiding its hallways well enough would be deemed as too linear, boring and constraining, even nicknamed a "hallway simulator" (Fig.5).

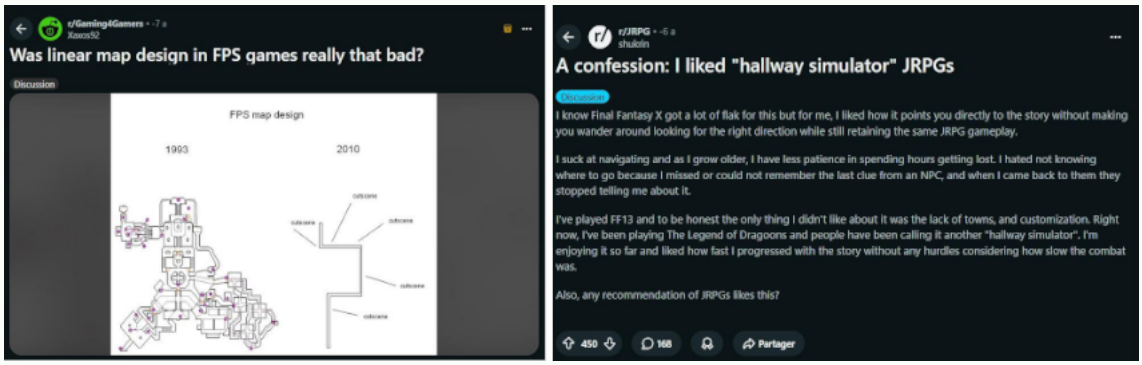


Fig.5. Reddit posts contemplating the legacy of Hallway Simulators. Personal Screenshots.

2. RETURN OF THE HALLWAYS

Yet, at the height of the period when designing a game meant hiding its linearity as much as possible, a demo proved that a carefully crafted, literal, hallway could prove extremely impactful. *P.T.* (2014) stands for *Playable Teaser*, and was originally an advertising element for the next installment in the *Silent Hill* videogame franchise. Sported by famous developer Hideo Kojima and director Guillermo del Toro, *P.T.*'s whole environment consists of a hallway. Going from one end to the other in a looping fashion, while each time elements move around, doors are either locked or unlocked, and shadowy figures appear (Fig. 6). The game clearly belongs to the horror genre, and the hallway layout – as a horror movie set – is made to create several opportunities for jumpscares. But these abrupt angles also have a technical role. At each iteration, the player needs to perform a few actions to progress and unlock the exit door. Unexplained and implicit, they consist of specific trajectories (going back to the entry door unlocks the exit one in an early loop, for example), looking at specific objects and/or listening to voiceovers. Thanks to then-new technological abilities, entering or leaving the player's field of view is a loading trigger, as well as a much more granular capture of the player's movement. Paired with an angular layout, these feats allow for a perfectly seamless experience. To finish *P.T.*, one only has to go through that same hallway several times, hence the whole apparatus is not so much a maze anymore, instead aiming at providing the player – both diegetically and game-wise – no pause.



Fig.6. *P.T.* Game loop. Personal screen recs from *Project Teaser*, a fan recreation of *P.T.*

P.T. was a tremendous success and a viral sensation. So much so that more than ten years after its initial release, despite the cancellation of the game it was supposed to advertise and its subsequent withdrawal from any platform, it is still gathering a massive cult following. As proof of that long-lasting mark, the provided captures from *P.T.* were made on a fan project, called *Project Teaser*, that reproduces with extreme fidelity the original, and that came out this year. But more importantly, it bridged digital's ability to simulate an infinitely looping space with the desire for seemingly continuous experience. Which informed a potential specifically ludographic narration, still being explored today.

For example, in the 2023 game *Mouthwashing*, several climactic moments–starting with the game's very introduction – relies on the same looping hallways, movement and field of view analysis, to modify the world in real-time and offer a seemingly infinite and seamless experience (Fig.7). Once again, in *Mouthwashing*, the story is largely influenced by cinema and its horror genre. And in both cases the hallways and their crumbled down spatiotemporal properties are but a moment in a bigger narrative (or at least were supposed to). They serve to provide an intensity factor, as directing vocabulary. Which raises the question of going further, and making these specific moments the whole of the game.

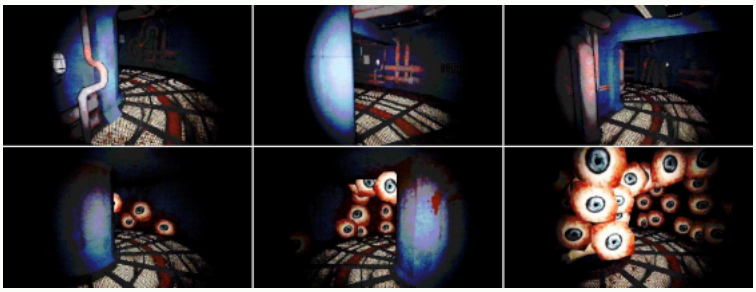


Fig.7. A looping and evolving hallway from one of *Mouthwashing's* climaxes. Personal screen recs.

3. NOTHING BUT A HALLWAY

The *Exit 8* (*E8*, 2023, Fig. 8) and *No, I'm Not a Human* (*NINaH*, 2025, Figure 9) are two games following that design principle.

Developed by Kotake Create, a Japanese one-man independent studio, *E8*, like *P.T.*, consists of a looping hallway. Here, it resembles a subway corridor, and the only objective given to the player is to reach exit number 8 while starting at 0. Every time the player walks the hallway, they are greeted by environmental elements: commercial posters, doors and air shafts, a man walking towards the player. If all of the elements are normal (like they were encountered the first time), the player must go forward. If there is even the slightest difference, dubbed an anomaly, the player should go back. Failure to properly identify an anomaly will reset the loop back to number 0. The next iteration is in any case seamlessly streamed while anomalies are procedurally chosen and range from minute details to more frightening and obvious events, like a flood of blood. If the player manages to go to the 8th exit, and succeed at that last one, they arrive at a stairway crowned with white light.



Fig.8. *The Project 8* game loop. Personal Screen recs.

NINaH was developed by Trioskaz, a Russian independent studio. The game puts the player in control of the Protagonist, an unnamed, faceless, male character. Faced with a cataclysmic solar event, and the apparition of human-looking, murderous beings known as the Visitors, the Protagonist must provide shelter to a number of characters, while trying to make sure he doesn't host any Visitor. The game is built around a unique location, the Protagonist's house and its central hallway. Six rooms and three windows, each an unique fixed screen, are also accessible, respectively during the day (rooms) and the night (windows). The colors of the hallway reflect the day/night cycle, but changes between these states are not seamless, taking place when a certain number of tasks have been achieved, and the player goes to bed. At night, people come at the player's door and ask for shelter, which you can accept or deny. During the day, you get to talk to them, and test them to see if they are a Visitor. Spending a night alone or with only a Visitor will get the Protagonist killed. As the game progresses, the hallway gets slowly modified; windows, for example, get boarded up. Depending on your actions, the game can end after between two to fourteen days, with ten different endings.



Fig. 9. *No I'm Not a Human* game loop. Personal Screen recs.

The most fundamental difference in how these games handle their hallway-centric setting, is the seamlessness of its changes. Both of these games' engines have the technical abilities to create continuous experience, yet where *E8* is entirely built around that feature, *NINaH* goes for a much more me-

thodical behavior: it modifies its world upon clearly delimited action, echoing back the very first examples we showed. But, aside from that, there are a lot of common elements at play.

First, both games could be described as *dark media*, per the definition of Eugene Thacker (2014). In the sense that they revolve around an absence, an impossibility to reach the very thing they mediate. In both cases, the most obvious ever-present absentee is the outside, but, I would argue, perhaps even more, the social. *NINaH* is quite explicit in that regard, weaving narratives of paranoia and reclusion. But *E8*, through its apparatus, both institute the outside as an unreachable goal, and positions any sort of potential encounters and interaction as an anomaly to be run away from. What one should look out for, is a sterile and controlled environment, exuding officecore aesthetics, and nothing more.

Then, as my main point, I would offer that, because of the way these games focus so much on "non-space" and "non-play" moments, they allow for this normally purely transitional and utilitarian element to deploy their own semiotic regime. Most notably exhibiting what French semiotician Jacques Fontanille calls a practical belief: that is, a regime of narration built on the qualities of successive twists and turns, building a chain of events without closure (2015). In a way, these types of games, because of how minimalistic they are in their design (and the counterintuitive elements they choose to rely on), while maintaining narrative ambitions, create an interesting in-between behavior with its specific challenges: how to express universal thematics with highly media-specific elements?

4. CONCLUSION AND A CHALLENGE

In his 2023 book *The Stuff Games are Made Of*, Pippin Barr dedicates a whole chapter to an experiment: adapting a keyscene from several movies considered the height of cinema as an art form, through a voluntarily crude, as ludographic as possible, apparatus. Such an endeavor, and this question of how to try and tackle what makes great art through highly media-specific means echoes with the challenge of these in-between games. In that regard, I would argue

that, no matter how interesting and immersive they are, there is no denying that *E8* and *NINaH* went for a rather obvious thematic and aesthetic route: confined in a hallway, made to go through a repetitive loop requiring attention to an unreachable alterity, the player is made to feel trapped and confront feelings of alienation, loneliness and withdrawal. In response, I would like to offer a challenge. Adapt, with that same apparatus, the *Book of Disquiet* (1982), by Portuguese poet Fernando Pessoa. More precisely, adapt the very specific feeling of blissful entrapment that this book offers. The tranquil contentment with an ever-repeating list of tasks. In short, how one would narrate Rua dos Douradores as an infinite hallway, one that anybody would "exchange it all for a tram ticket back" to.

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Surprising Gesture: Scroll-driven Animations as an Opportunity for Playful Interaction

KEYWORDS

Scroll-driven animations;
Positive friction;
Playful interaction;
Scrollytelling;
Scrolljacking.

MARIANE PEREIRA RUBINATO
University of Porto,
Faculty of Fine Arts,
Porto, Portugal.
marianerubinato@outlook.com

SUMMARY

This abstract frames scroll-driven animations in scrollytelling artifacts as a form of friction that may support playful, exploratory interaction, surprise, and epistemic engagement. It challenges frictionless design ideals and suggests that such animations should be evaluated not only by usability, but also by their capacity to foster meaning-making.

In recent years, the use of scroll-driven animations – multimedia elements that are triggered and/or controlled by the user's scrolling gesture – has been extensively explored in scrollytelling publications, long-form narrative pieces widely adopted in journalism (Tjärnhage et al. 2023), due to characteristics that foster immersion and engagement while supporting the comprehension of complex content (Tjärnhage et al. 2023; Greussing and Boomgaarden 2018). Although sometimes classified as scrolljacking practices, because they alter the expected scrolling behavior in certain contexts (Paul 2023), these animations can also be understood as an interactive format potentially effective in capturing the attention of audiences (Tjärnhage et al. 2023).

The field of human–computer interaction (HCI) is strongly anchored in the cognitivist paradigm that values the minimization of friction and the reduction of cognitive effort (Harrison, Tatar, and Sangers 2007). The success of the approaches based on this paradigm and their role in shaping the current media landscape are undeniable, because they are associated with well-established methods – such as usability testing – that produce measurable and comparable results aligned with broader scientific culture (Ibid.). Yet it is not without drawbacks.

Besides showing limitations when it comes to thinking about non-task-oriented interactions, the argument in favor of frictionlessness can lead to hedonistic loops that reduce critical thinking and metacognition (Carvalhais and Cardoso 2025); in this sense, the absence of effort dilutes the ergodic potential (Aarseth's 1997)[1] the experience, hindering the user's capacity for meaning-making.

[1] It refers to the ability of an interactive system to require the user's active effort to explore and configure its content, thus promoting the personal construction of meaning. The term derives from Espen Aarseth's (1997) literary theory.

The cognitivist paradigm is closely associated with the "intuitive usability" that advocates for the invisibility of the interface and the suppression of friction (Norman 1998, 2013; Krug 2006). From this perspective, any interruption or deviation from the expected interface behavior is interpreted as dysfunction or a design issue. This is because interaction is primarily conceived as a means to an end: the efficient execution of predefined tasks. Any deviation, ambiguity, or need for additional interpretation is seen as an unnecessary cognitive cost that disrupts the fluidity of action. Other approaches, grounded in phenomenology, have also guided HCI design and research (Harrison, Tatar, and Sengers 2007). These perspectives understand interaction as meaning-making rather than mere information processing. In this context, interaction is constitutive of meaning, and the artifact, context, and user's background combine in its production (Ibid.). Some of these approaches frame friction as a design strategy and, in this sense, friction can function as a mechanism of symbolic resistance that, among other effects, activates the user's interpretive agency and epistemic interest (Benedetti and Mauri 2023; Rosati, Ponzo, and Silvagni 2025).

Analogously, neuroscientific evidence reinforces that when we exert effort, our brain responds by assigning greater subjective value to the performed task (Rosati, Ponzo, and Silvagni 2025). By adding an unexpected behavior, such as the transformation of a graphical element, scroll-driven animation introduces friction that exerts effort. It also creates the reflective space necessary for the user to establish a more conscious relationship with the artifact and the information. Friction – rather than breaking the experience, as some interaction-design guidelines warn (NNG 2023) – becomes a turning point in the nature of the experience being proposed. The surprise and curiosity arising

from uncertainty in response to the interface's animated behavior can therefore serve as instruments to foster epistemic engagement.[2]

[2] It refers to reflective curiosity and cognitive engagement in the user's active construction of meaning.

Scroll-driven animations, by introducing unpredictable variations in expected scrolling behavior, challenge the model of total fluidity. Through this lens, in experiences with scroll-driven animation, the interface moves from guiding behavior to becoming a field of negotiation between predictability and surprise. In this configuration, interaction draws closer to the ludic, articulating tension and uncertainty about what the next gesture will provoke (Frissen et al. 2015). According to Mathias Fuchs, Georg Russegger, and Moisés Mañas (2013), playfulness is an essential quality of the digital medium, as it is highly malleable and conducive to experimentation. When discussing playfulness in interfaces, drawing from the domain of games, the authors question whether ludicity is a property of the artifact itself or whether it emerges from the user's attitude – in which case it depends on use, context, and cultural framing. They ultimately present the interface as an alternative perspective, arguing that it is within the interface that the ludic element resides, since it mediates the relationship between human and machine and enables or constrains modes of interaction (Ibid.). At this point, they distinguish between two types of interfaces: on one side, straight interfaces, and on the other, playful interfaces. Straight interfaces contain implicit rules tied to predictability and efficiency, whereas playful interfaces are defined by a broad range of potential interaction patterns available to the user. This wide range of possibilities gives the experience an exploratory character.

Scroll-driven animations can be understood as a design strategy to attribute a playful character on the interface. By breaking with the expected behavior of scrolling, the interface no longer responds in a fully predictable way, inviting an exploratory attitude from the user. Consequently, this rupture – characterized a form of friction – positions the use of scroll-driven animations in scrollytelling artifacts as a deliberate strategy for cultivating playfulness within digital interfaces.

Thus, although it introduces friction, it does not necessarily constitute an issue; rather, it operates as a as a source of uncertainty and surprise intrinsic to play, capable of increasing the ergodic potential of the experience and preserving the user's epistemic interest

In this sense, this work discusses scroll-driven animations as a form of friction, but also frames this friction as an opportunity for playful interactions. It suggests that, in certain contexts, the cognitivist approach promoting the elimination of all forms of friction in the name of cognitive ease is not the only possible path, and that playful interaction can serve as a strategy to enhance ergodic potential of the experience and preserve user's epistemic curiosity. Finally, it seeks to contribute to contemporary debates on interaction design by suggesting that scroll-driven animations should not be evaluated solely through the lens of usability, but also through their capacity to enable playful interaction, positioning the interface as exploratory rather than purely functional. In doing so, it positions friction not as an issue to be eliminated, but as a valuable design resource.

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Otherworldly Encounters: Wild Anecdotes on Interspecies Care

KEYWORDS

Interspecies care;
More-than-human;
Artistic research;
Photosynthetic art;
Violent care.

ROSEMARY LEE
i2ADS, Faculty of Fine Arts,
University of Porto,
Porto, Portugal
studio@rosemary-lee.com

RISK HAZEKAMP
Caradt/Avans,
's-Hertogenbosch, Netherlands,
r.hazekamp@avans.nl

SUMMARY

This presentation emerges from practice-based art & design research, in which 'otherworldly' expressions of agency by our More-Than-Human co-researchers have been witnessed. Drawing on these experiences, we reflect on the position and situatedness of our human embodied, messy and opaque relationality with the More-Than-Human. Following María Puig de la Bellacasa, we shed light on the many blind spots regarding the (un)necessity of human care for other species, which sometimes even result in forms of 'violent care'. By asking why organisms wish to collaborate with us, we subvert human-centred power hierarchies and open up the question of More-Than-Human consent.



Fig. 1. Interdependency. A Cyanobacteria culture, observed by a female Large Digger Wasp, gets a few drops of my blood. Risk Hazekamp, 2020.

INTRODUCTION

In this duo-presentation, we would like to share both factual and speculative experiences with the More-Than-Human that offer meaningful points of reflection for the domain of biological analogue computational media. Interspecies encounters (Kirksey 2014; Tsing 2015; Haraway 2004, 2016) have become a valuable source of inspiration and insight in design, art, and the humanities, helping us to reflect on the position of the human relative to non-human beings. This investigation emerges from our backgrounds in transdisciplinary art and design research, where each has witnessed 'otherworldly' expressions of agency by species 'in their care'. While looking at, working with, and caring for non-humans can meaningfully inform creative practice, it's important to reflect on what unintended consequences this may entail. Here we discuss instances that provoke critical reflection on how art and design can approach interspecies insights while respecting the limitations entailed in such endeavors.

More-Than-Human knowledge is gaining recognition for its potential value in informing interdisciplinary art and design research. Phenomena such as Quorum Sensing (communication via chemical signals to coordinate behaviour) or the ancient bacterial circadian clock are nowadays being researched as possible ancient and innovative biological analogue computational media. When we witness these More-Than-Human 'Others' behaving in ways that defy our human expectations, it is not only an opportunity to reconsider the limits of Human-Centred frameworks, including our "hedonistic loops", but it also reveals our human naïveté in presuming to know what non-human species want or, even need.

Following María Puig de la Bellacasa (2017), we use artistic research as a vehicle of shedding light on the many blind spots regarding the (un)necessity of human care for our fellow species. Who decides with which organisms we can collaborate? Why would organisms wish to collaborate with us? In other words: how can we think about forms of More-Than-Human consent?

While there is a growing understanding that considering the world solely in terms of the human is foolishly unsustainable, the measures taken on behalf of our non-human companions are often still hopelessly Human-Centred and non-regenerative. Under the guise of a yearning for connection and entanglement, we shamelessly impose our will on the other-than-human. Here, what is presented as interspecies interdependency is slowly evolving into forms of "violent care".

This talk reflects on interspecies encounters that act as a platform to share experiences in which artistic research has been a vehicle for witnessing astonishing emergence by photosynthetic critters and beings, or, in our case: cyanobacteria and plants. In sharing these insights, we intend to engage the audience in an ongoing exchange about the vulnerabilities and violences of co-creating with other-than-human beings.



Fig. 2. ***Sonic Cannibal.***
6-channel sound installation with speakers surgically implanted in carnivorous plants.
Rosemary Lee, 2017.

BACKGROUND

Interdisciplinary artistic explorations involving other species can offer disruptive and innovative approaches that enable us to look at the world in new ways that can challenge traditional worldviews inherited from our troubled past (Søndergaard and Beloff 2022). Donna Haraway has famously advocated for "Staying with the Trouble" (2016) as a strategy to address the complexity of the world:

We – all of us on Terra – live in disturbing times, mixed-up times, troubling and turbid times. The task is to become capable, with each other in all of our bumptious kinds, of response.

(Haraway 2016, 1)

These words from 10 years ago capture the current zeitgeist in almost prophetic fashion, in the shadow of several looming world crises. As Haraway discusses, tentacular thought that may rub up against the imperialistic logic of dominant Western knowledge practices, descended from the natural sciences. Following her proposal of thinking together, this investigation seeks to draw connections across traditional disciplinary boundaries and to develop shared knowledge from disparate sources.

Stepping into the temporality of plants, for example, can enable us the attentiveness to notice that they are capable of fascinating movement and complex relationships with their environment (Gagliano 2018; Petrič 2020). In caring for other species, we may also tune into aspects that might be otherwise easily overlooked. Attuning ourselves to the needs of radically different beings can open up a window into their disposition, whether they are finicky and demanding, easygoing, or even petulant and spiteful. Whilst the vast majority of (cyano)bacteria, protists, fungi, and plants remain completely indifferent to our interest in them, there are also organisms that are actively hostile towards human life.

WHO IS 'WE'?

We write in the 'we' to acknowledge that we are implicated ourselves and do not want to put ourselves in the chair of the one that knows or has seen the light. As we are moving towards a plural voice, this shared exploration is the result of our thinking together and working to build bridges across the various rifts we encounter in the process. The language we use is often provisional: shifting and evolving over time as we try out new ways of telling new stories that question established truths. "Can we owe and not own our thinking?" (Vázquez 2020, XXV)



Fig. 3. *Tick Terrarium*
Wearable bioweapon.
Laura Beloff, 2020.

WHAT IF THEY DON'T WANT TO BE OUR KIN?

While well-intended, seeking to make interspecies kin may be problematic in the sense that it reimposes an anthropocentric hierarchy while proposing to achieve the opposite. Developing kinship with non-humans is not ethically neutral nor an inherently noble act. When subjecting non-humans to our will in the name of interspecies learning and creativity, it's important to reflect on the potential harms or situations of ignorance we may inadvertently enact in the process.

Certain creatures are viewed as ethically superior to others, and thus more deserving of care, particularly those with whom humans already have a long-standing kinship. It's easier for us to imagine, for instance, sharing bodily closeness with canines (Haraway 2003; Smrekar 2016) or sea creatures (Gumbs, 2020; Imbler 2022) than parasites (Beloff 2020). And although it is becoming increasingly clear just how deeply colonial practices are embedded in botany (Kimmerer 2013; Subramaniam 2024), we may still be unwittingly perpetuating the colonial legacy embedded in our aesthetic relationship with plants (von Bismarck 2023). Or spending significant time with extremophilic bacteria may enable us to write poetry in their genetic material, but we may also enquire into the stakes of such an endeavor when those bacteria repeatedly just re-write the artist's interventions (Bök 2015).

If we were to ignore all these frictions, inconveniences, and unplayful confusions, it would be merely a continuation of anthropocentrism.

Seeking to engage with More-Than-Human subjectivity in creative practice and research therefore requires us to ask more complex questions about the limitations of kinship across species lines. Although we may stand to gain from developing new forms of interacting with other species, we may need to allow them the space to resist our advances.

INSIGHTS FOR CREATIVE PRACTICES

Situations of friction that arise from creative explorations with non-humans can give us insights into the blind spots we, humans, bring with us. Witnessing non-humans behave in 'otherworldly' ways opens up the imaginary beyond the human realm and gives us Harawayan speculative fabulation, at the same time it confronts us with the radical alterity of other species' rejection or defiance of the human.

Learning from non-hierarchical interspecies collaborations, its astonishments as well as its frustrations, can bring more response-able methods and perspectives into creative practices. This can not only offer a more accurate representation of the More-Than-Human, but even more so help to reflect on and situate the human relative to these rich experiential worlds, thereby turning the evolution pyramid upside down.

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Oracular Interfaces: Epistemic Mischief as a Method for Playful Friction to Subvert AI SystemsThrough Divination and Magic Metaphors

KEYWORDS

Critical design;
Friction;
Divination;
Interface;
Metaphor;
Artificial Intelligence.

GASTON WELISCH
Centre for Sociodigital Futures,
University of Bristol,
Bristol, United Kingdom
gastonwelisch@gmail.com

SUMMARY

Oracular Interfaces are interactive works which call into question the conversational authority of AI systems. This paper presents two case studies: *BIRD*, a webcam augury platform, and *House of IFs*, an agentic omen system based on daily news. These works introduce playful friction to make ubiquitous AI systems "strange". What they are positioned against is Generative AI's "frictionless fluency", its eloquence which leaves little space, or creative friction, for working out interpreted meaning. The wider design workbook they form creates conditions in which the values embedded in current AI interfaces can be made available, in oblique ways, for critical thought.

Generative AI services promise a "frictionless pathway from impulse to materialization" and present aesthetic production as "frictionlessly fluid and affectively immediate" (Kemper 2025, 2). What is being marketed is speed alongside the apparent dissolution of process, with effort framed as an obstacle to be optimised away. Friction is removed in the name of usability and engagement, yet this can also lead to "mindless forms of interaction" (Cox et al. 2016, 1389) and encourage "automatic and thoughtless behaviour". Frictions, then, can respond to this "over-optimisation and over-proceduralisation" (Gould et al. 2021, 1). In my past practice-as-research project, the Data Poets, the move from GPT-2 in the 2019 prototype to GPT-4o and GPT-Vision in 2024 made the outputs more fluent, but also less open. The designed objects turned sensorial data capture into "poems". The older system's awkwardness, non-

sense, and unevenness often invited participants to work out meaning; the newer models' descriptive competence and polished tone narrowed that interpretive space. There arose a problem of frictionless fluency; the newer models' eloquence left little space, or creative friction, forworking out interpreted meaning (Welisch 2025, 12).

This tension is also found in the parallel between magical and technological processes. For Alfred Gell, the magic standard is the ideal against which all technologies are compared: effortless, costless production (1992, 12). But this magic standard conceals the "minimization of costs to the corporation by the maximization of social costs," alongside "unemployment, depletion of unrenewable resources, degradation of the environment, etc." Paradoxically, the "technology of enchantment is founded on the enchantment of technology" (Gell 1992, 44); the force of the enchanted object stems from the technical and material processes it embodies. Technical processes of making" are construed magically so that, by enchanting us, they make the products ... seem enchanted vessels of magical power" (46). This matters for generative AI because these services are often marketed as though they dissolved the need for practice, skill, and labour, whereas anthropological accounts of magic and the material infrastructures of AI suggest a different picture: labour is redistributed, concealed, ritualised, or made meaningful in new ways. Frictionlessness is an ideological framing which conceals extractive foundations and expands the norms of immediacy (Kemper 2025, 3-5).

The wider doctoral project from which this paper emerges uses Magic and Divination in a methodologically explicit way. Metaphor is understood here as a tension that produces semantic innovations by which "new information about the world is created" (Tilley 1999, 14-15), a generative framework for producing emergent insights into our interactions with AI. If "metaphors provide a basis by means of which communities create and understand their collective experience" (10), then the work of building and testing metaphors for emerging experiences like AI deserves sustained experimentation. The project is built upon the distinct yet complementary practices of magic and divination. Magic is understood as exerting con-

trol over the unknown; it performs, intervenes, enacts. Divination is a method of accessing that which is uncertain or concealed, without necessarily influencing it (Sørensen and Petersen 2021). Divinatory practices are "means to acquire information" while magical practices are "modes of interfering," through which agents gain "some degree of control" (10-11). I use these two modalities to articulate a dual orientation towards the future: divination as epistemic access, an inquiry into the unknown through the ritual interpretation of signs; and magic as ontological enactment, a structured intervention intended to shape the world and produce effects. Together, they form a dual lens of knowing and doing that structure the theoretical arguments and practical outputs of this research.

Epistemic Mischief is the methodology and approach I use to explore this opportunity space. I describe it as a sincere, playful, and intentful misuse of AI, a design practice that inhabits the logic of the system to reveal its assumptions. The term, like Divination and Magic, is concerned with knowledge and with action. This stance is useful for critically probing exploitative, poorly designed, or harmful uses of AI. It allows a piece to remain earnest enough to work while still introducing enough awkwardness for its assumptions, its seams, to become visible. Metaphor in interaction is inherently mismatched and tension-filled: "Metaphors are not smooth" (Coyne, Parker, and Rebelo 2004, 435). But I aim for Epistemic Mischief to be "a deliberate policy to reveal and use seams" (Chalmers, MacColl, and Bell 2003, 11). Magic and divination operate here as ways of working on the seam, exposing staging, incongruity, and claims to authority that seamless interfaces otherwise make "normal". The aim is to make AI "weird", or to render "strange the familiar" (Bell et al. 2005, 170), to reopen the interpretive labour that fluency forecloses, and open imagination to alternative ways of interacting with AI.

Through this approach, I am building "Oracular Interfaces", interactive works which call into question the conversational authority of AI systems. The term draws on the Latin etymology of orare, to speak or pray. The adjective oracular is productively polysemic: the oracle can be the future-oriented pronouncement and its source, and the role of the oracle may fall

either on the interface or on the one wielding it. The specific format I propose for developing these works is for them to form a workbook. Design workbooks are "collections of design proposals and other materials drawn together during projects to investigate options for design" (Gaver 2011, 1551). What they share is "not just the description of a design space but its creation" (1551), with ideas emerging over time from multiple concrete proposals. Conceptual design proposals are research through design that balances concreteness with openness and uses multiplicity to allow a design space to emerge (Gaver & Martin 2000, 209). The proposals need to be specific enough to evoke intuitive reactions and open enough to invite imaginative extension (209-11). I am building a workbook of multiple proposals, organised around four conceptual dimensions: Interface, Ritual, Interpretation, and Imaginaries. Each proposal foregrounds one dimension, and the comparison across vignettes allows the design space to emerge.

Two developed works from my practice provide the anchor cases for this approach (with two further planned for completion of the doctorate). The first is *BIRD*, Bird-Informed Remote Divination, a webcam-based augury website (https://augury.gaston.pro/) in which the participant formulates a question, observes birds through a live webcam, describes the signs they see, and receives a reading from a chat-based augur. Inspired by Roman augury, the work structures the encounter through a guided choreography of questioning, discussion, observation, and co-negotiated interpretation. It later extended into participatory augury walks and performances (see Fig. 2), where participants adopted roles and enacted the procedural logic of augury in public. *BIRD* is the ritual-focused vignette: it refuses the conversational directness of contemporary chat interfaces. The participant must formulate a question, wait, observe, describe, negotiate, and only then receive a reading. A particularly useful friction occurred when the automated machine-vision pipeline I initially planned failed: asking participants to describe the birds themselves introduced a methodologically valuable seam. Participants became the Machine-Vision system for the AI. The work attempts to question conversational authority through a ritual procedure which aims to slow exchange and question the production of meaning.

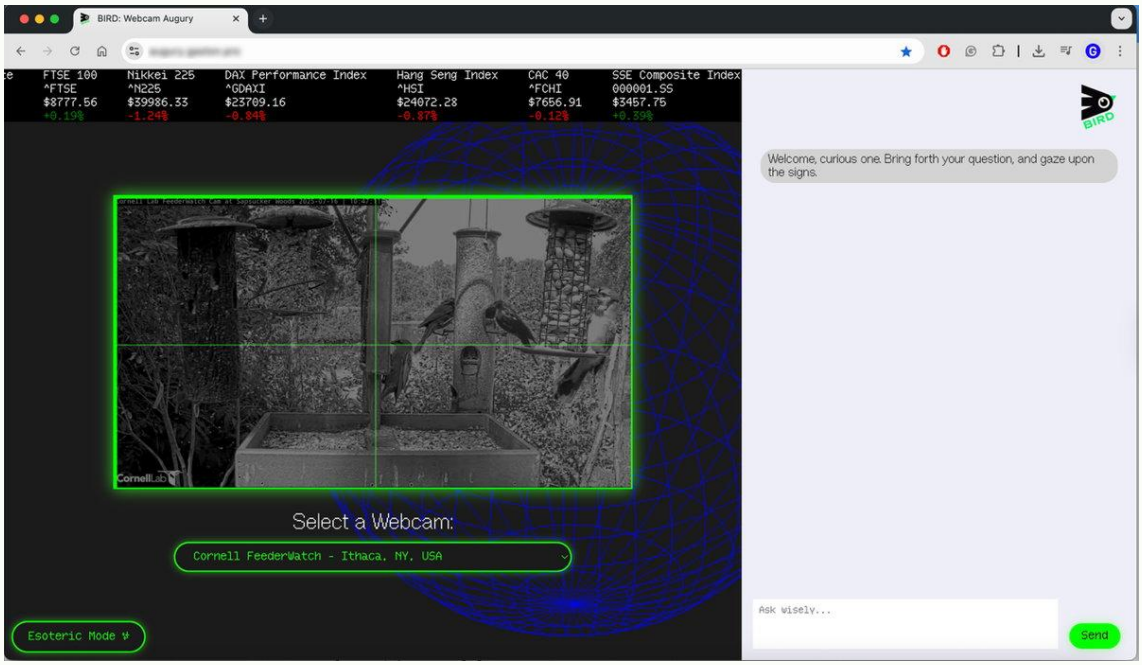


Fig. 1. Interface for *BIRD* (Bird-Informed Remote Divination).



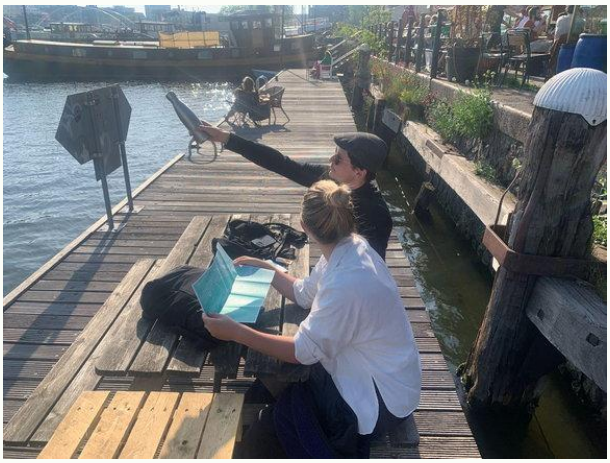


Fig. 2. The *BIRD* augury walk at the May 2025 Slow AI festival in Amsterdam.

Photo Credit
←Dominika Čupková; ↑ Gaston Welisch.

The second anchor case is House of IFs (https://ifthen.today/), a daily omen generator and archive centred on interpretation. Each day, the system links two sets of paired events: a sign and outcome for today, and a past occurrence of the same kind of sign leading to the same kind of outcome. The piece generates omens from contemporary news using the Mesopotamian protasis/apodosis (If/Then) structure and presents it through a six-panel interface with museum imagery, commentary, a chat "Scribe", and namburbû-inspired counter-actions (counter-omen spells). Participatory affordances include participant readings left as traces on the omens. House of IFs reveals friction in correlative reading.

Its central operation is intentionally a little absurd: it links a present-day oddity (or faits-divers) with a major event, and a further event pair through an agentic system of correlation in a 2:2 structure. Omen texts can be understood as structured inferential systems organised through conditional reasoning, possibility, and conceivability (Rochberg 2009, 5, 13-15). House of IFs relies on and makes the correlation an object of interpretation. It plays with the authority effects of pattern-making. A scribe figure (LLM chatbot) functions here as a mediator of the site's system, a way for the visitor through the archive and its logic. The counter-actions (namburbû) give the viewer a sense of agency on the events shown; the namburbû's purpose is "to 'undo' or 'avert' portended evil" (Caplice 1974, 7) correlating with and responding to the observed events "taken by the Mesopotamians to be signs and portents with significance for the future" (Caplice 1974, 7). This is the magical affordance of agency, enactment on the world.

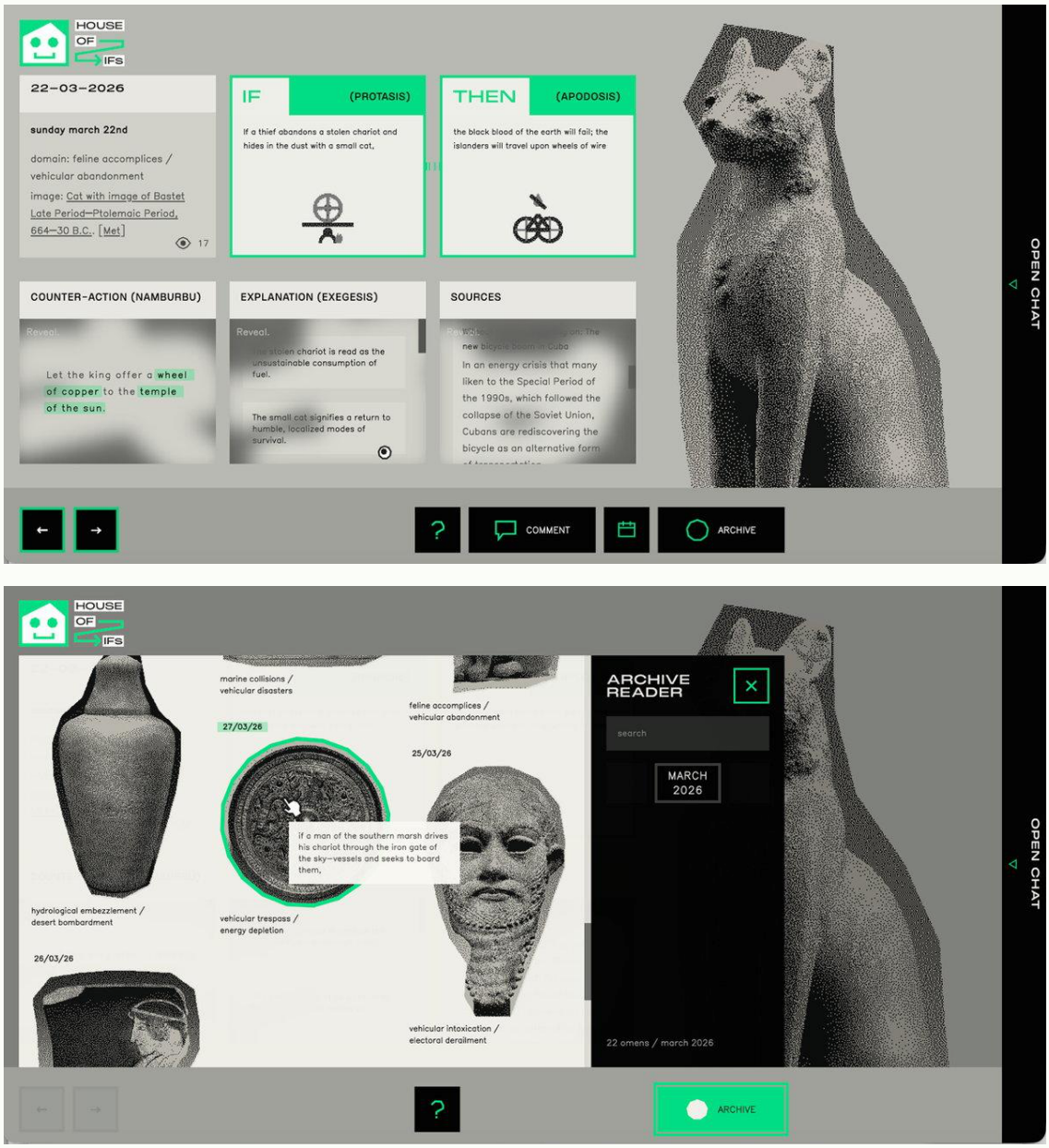


Fig. 3. Interface for House of IFs.

The value of Oracular Interfaces lies in the relation between these vignettes and the wider workbook they begin to define. The ongoing contribution is the construction of a workbook-based design method for introducing playful friction into AI interaction, grounded in four conceptual threads, developed through practice-based vignettes that remain materially grounded and conceptually open. *BIRD* and House of IFs demonstrate how two different emphases, ritual and Interpretation, can produce distinct ways of interrupting AI's claims to fluency, neutrality, and conversational authority. The larger aim is to ask what AI could be if its seams were kept visible (or if concealment was made explicit) through metaphor as a method for inquiry. In that sense, the workbook creates conditions in which the values embedded in current AI interfaces can be made available, in oblique ways, for critical thought.

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Inside the Black Box: Situated Decision-Making and Automation in the Art Installation "EZ Quality Sorter"

KEYWORDS

Interactive installation;
Decision-making;
Classification;
Automation;
Machine learning.

VERENA FRIEDRICH
University of Arts Linz,
Linz, Austria
info@heavythinking.org

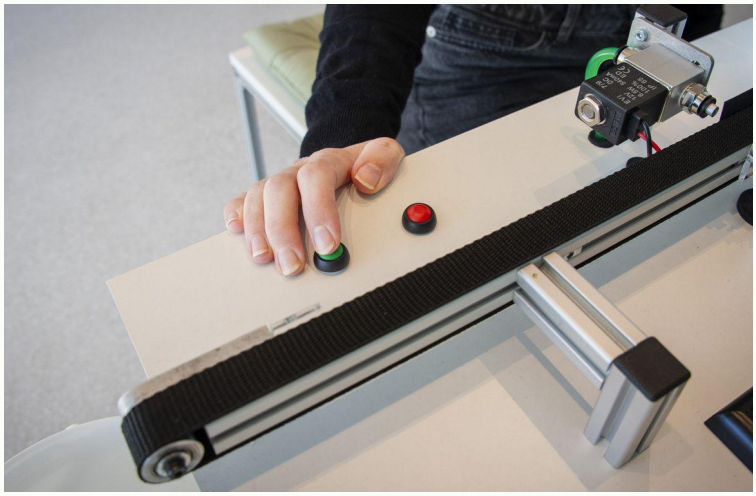
SUMMARY

The *EZ Quality Sorter* is an interactive art installation that invites visitors to support a machine in the quality sorting of pea seeds. Without predefined sorting criteria, visitors must establish their own: What makes a pea good or bad? By whose standards? In which context? This ambiguity generates friction – not as a flaw in the interface, but as its central mechanism. By reintroducing the human into an otherwise automated process, the installation turns the logic of industrial automation inside out, raising questions about agency, responsibility, and bias in the delegation of decision-making to automated systems, while transforming friction into a critical and aesthetic strategy.



Fig. 1 *EZ Quality Sorter* V2, Art Space, Södertörn University, Sweden, 2024 (photo: Ricard Estay)

The *EZ Quality Sorter* is an interactive art installation that invites audiences to take part in the semi-automated process of sorting pea seeds. It is part of the long-term project ERBSENZÄHLER (EN: "bean counter"; lit.: "pea counter"), a series of industrial-style sorting machines that classify and sort peas according to various criteria. In German, an "Erbsenzähler" is someone who is overly focused on minor details – a nitpicker, number-cruncher, or bureaucrat. In my work, the figure of the "Erbsenzähler" serves as a metaphor for the increasing quantification and datafication of life, here represented by the pea.



(Fig. 2) Detail of *EZ Quality Sorter* V2, Art Space, Södertörn University, Sweden, 2024 (photo: Ricard Estay)

When approaching the *EZ Quality Sorter*, visitors are invited to take on the role of quality inspectors, sorting peas into "good" and "bad" categories via a workstation equipped with a microscope, a conveyor belt, and a binary button interface that triggers a pneumatic sorting mechanism. Their decisions are recorded as labeled image data and subsequently used to train a machine learning model, enabling the system to sort autonomously based on the accumulated judgments of previous participants.

The industrial machine is, perhaps more than any other artefact, an embodiment of frictionlessness: designed for efficiency, flow, and continuous movement, its ultimate logic is to eliminate the human as the primary source of error, delay, and

resistance. By placing a human back at the centre of an otherwise automated process, the *EZ Quality Sorter* turns this logic inside out, transforming friction from a problem to be solved into a critical and aesthetic strategy.

At the interaction level, the deliberate withholding of criteria slows down and defamiliarizes what would otherwise be an unremarkable industrial process. Visitors are compelled to pause, reflect, and negotiate: What makes a pea good or bad? By whose standards? In which context? This productive ambiguity generates friction – not as a flaw in the interface, but as its central mechanism. The simplicity of the interface stands in contrast to the complexity of the judgments it solicits, and this tension becomes a site of philosophical inquiry.

At the conceptual level, the installation makes tangible the normally invisible moment at which qualitative human judgment is translated into the logic of machine classification – a moment that is typically concealed within automated systems and proprietary training pipelines, sustained by forms of labor often described as "ghost work."

And at the ethical level, it raises questions about agency, responsibility, and bias in the delegation of decision-making to automated systems: who is accountable for the organic entities being discarded by a model trained on the accumulated biases of an anonymous crowd?

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From Flow to Friction: Thinking Spaces in VR and AI

KEYWORDS

Epistemic friction;
Thinking space;
Performative interface;
Virtual reality;
Mixed reality;
Knowledge interfaces;
Human–AI interaction;
Agentic harness.

MONIKA FLEISCHMANN
ZKM Center for Art and Media
Karlsruhe, Germany
monika@fleischmann-strauss.de

WOLFGANG STRAUSS
ZKM Center for Art and Media
Karlsruhe, Germany
wolfgang@fleischmann-strauss.de

SUMMARY

This article critiques interaction design's ideal of frictionless "flow," distinguishing automatic engagement from the flow of thought and arguing that seamless interfaces constrain meaning-making. As an alternative, it proposes the thinking space as a performative interface paradigm that makes operations perceptible through thresholds, interruption, ambiguity, play, and productive disagreement. Grounded in digital art practice and artistic research (late 1980s–2026), it draws on examples from VR, mixed reality, semantic knowledge interfaces, and AI-mediated dialogical installations. Ultimately, it frames epistemic friction as a cultural and aesthetic resource for sustaining critical distance and reflective agency.

CONTEXT AND ARGUMENT

Interface design increasingly optimizes for seamlessness – minimal friction, maximal speed, uninterrupted flow. This is not neutral: when interaction feels "natural," the system's constraints recede from view, shaping perception, automating behavior, and reinforcing feedback loops. In platform economies, interaction becomes data extraction and attention becomes a metric to optimize and monetize. The result is an epistemic narrowing: probability over interpretation, coherence over critique, prediction over imagination.

To counter the frictionless paradigm, we introduce epistemic friction as a design principle: deliberate interruptions – thresholds, ambiguity, delay, conflict – that slow automatic response and enable critical awareness. Building on Miranda Fricker's

account of epistemic injustice, we treat friction as a condition of epistemic participation that keeps alternative perspectives visible and contestable (Fricker 2007). We also challenge the reductive term "user" by reframing individuals as people or visitors, emphasizing agency and situated experience.

Thinking Spaces implements this concept through performative situations in which meaning emerges from interaction itself (Fleischmann 2020): interfaces become aesthetic and cultural choreographies that stage uncertainty and invite interpretation. In this sense, "what you get is what you did not see before" (Fleischmann 2025). The framework is grounded in a body of work developed over three decades, spanning immersive VR environments, semantic knowledge-discovery interfaces, and AI-based dialogical systems.

HOME OF THE BRAIN – PHILOSOPHERS HOUSES

Home of the Brain (1990) established Thinking Spaces as immersive environments for philosophical experience. Using head-mounted displays and data gloves, participants navigated virtual architectures structured around the ideas of Vilém Flusser, Paul Virilio, Joseph Weizenbaum, and Marvin Minsky. Their virtual Houses of Thought functioned less as archives than as resonant environments in which ideas spatially confronted one another. Contradictions were not resolved conceptually but experienced bodily and temporally through movement in a dynamic field of tension. Flusser in his House of Adventure described humans as players against the apparatus. Virilio in his House of Catastrophy analyzed technological acceleration as a loss of spatial and temporal distance. Weizenbaum in his House of Hope insisted on ethical responsibility toward computational systems. Minsky in his House of Utopia conceived consciousness as a society of competing agents. Rather than offering explanations, the work translated theory into a spatial experience. Philosophical positions became navigable epistemic landscapes, and moving through them brought statements and relationships between ideas to life. Knowledge emerged not through linear reception, but through navigation, collision, and shifts in perspective. Instead of reading theory, participants moved through it.

Crucially, the immersion was deliberately incomplete. External projections allowed outside observers to interrupt, comment on, and collectively shape the interpretation. Thus, the installation destabilized the fantasy of isolated aesthetic immersion that had dominated early VR discourse. Thinking became a social and performative process rather than an individual simulation. This anticipated a central principle of Thinking Spaces: interfaces should remain visible as structures that organize perception, rather than disappearing into a seamless experience (Grau 2003).



Fig. 1. *Home of the Brain – Philosophers Houses* © Monika Fleischmann & Wolfgang Strauss

Created in 1992, *Liquid Views* explored the blurring of the lines between self-perception and public exposure, examining epistemic friction. Visitors encountered their reflection on a simulated body of water. With a touch, the image dissolved. Each attempt to stabilize the image created waves, distortions, and fragmentation. The more one tried to control the reflection, the more unstable it became. Rather than confirming identity, the interface exposed its instability. A large-scale projection made this intimate act visible to the public, transforming self-observation into a public performance. This demonstrated how identity is produced socially and technologically (Hanson 2006). Self-perception emerged as a process shaped by interaction, mediation, and observation by others. Referencing the myth of Narcissus, the work transformed the mirror into a site of uncertainty rather than self-recognition. Unlike contemporary selfie culture, which prioritizes fixed, optimized self-images, *Liquid Views* presented the self as fluid, contingent, and continuously reconstructed (Fleischmann 2024). According to

Flusser, identity does not appear as essence, but rather as a permanent reconfiguration through technical images and apparatuses. The interface resisted the desire for stable representation, foregrounding instability as a condition of perception itself (Dixon 2007).



Fig. 2. *Liquid Views – Narcissus Digital Mirror* © Monika Fleischmann & Wolfgang Strauss

SEMANTIC MAP – INTERFACE FOR KNOWLEDGE DISCOVERY

With *Semantic Map* (2002), Thinking Spaces shifted toward knowledge representation and archive navigation. Developed for the netzspannung.org media art archive, this project used semantic clustering and neural network – based text analysis to generate relational maps of information (Kohonen1995). Instead of encountering linear search results, visitors experienced a dynamic field of relations where meaning emerged through movement, comparison, and differentiation. Knowledge was experienced spatially rather than hierarchically. The system deliberately resisted algorithmic certainty. There was no single "best result." Humans became co-producers of meaning by tracing connections between heterogeneous concepts and thematic neighborhoods. Understanding emerged through orientation within complexity rather than optimization. This structure recalls rhizomatic models of knowledge, in which meaning arises through connections between diverse nodes rather than through centralized hierarchies (Deleuze and Guattari 1977). Semantic proximity became a navigable experience. Here, epistemic friction became structural; the

interface refused to reduce knowledge to efficiency. Instead, ambiguity, multiplicity, and relational complexity were emphasized. Unlike contemporary recommendation systems that increasingly narrow informational horizons, the Semantic Map opened exploratory spaces in which unexpected relations could emerge (Strauss 2025).

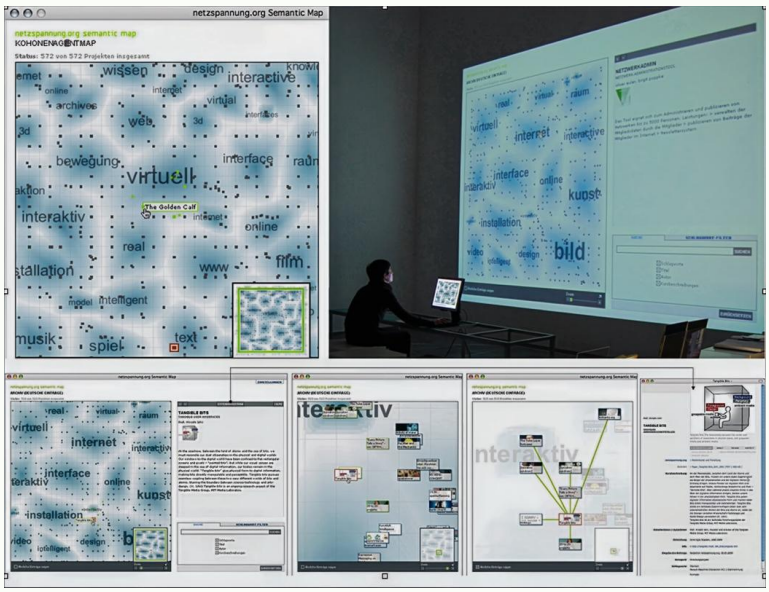


Fig. 3. *Semantic Map – a Data Cosmos Telescope* © Monika Fleischmann & Wolfgang Strauss

ENERGY PASSAGES – READING AND WRITING THE CITY

Thinking Space was introduced to the urban public sphere by *Energy Passages* (2004). A city plaza was the setting for streams of daily news that had been transformed into evolving landscapes of light and sound. Visitors navigated through words, media fragments, and visual condensations, thereby transforming the urban space into an interface of collective attention. Rather than passively consuming news, visitors physically traversed it. This piece revealed how mass media shapes perception and constructs public reality. However, it also opened space for alternative narratives to emerge through bodily movement and situated interaction. The city became a performative reading environment in which collective and individual interpretations intersected (Paul 2004). Drawing on Sherry Turkle's notion of "evocative objects," *Energy Passages* transformed information into experiential

encounters. Public space was presented as a layered field of competing perspectives, emotional intensities, and fragmented narratives rather than consensus (Turkle 2004). The project also addressed the broader transformation of digital culture: the increasing fusion of media and urban environments. Interfaces are no longer confined to screens; they organize spatial and social experiences (Fleischmann 2013).



Fig. 4. *Energy Passages – Reading and Writing the City* © Monika Fleischmann & Wolfgang Strauss

MIND CIRCUITS – PHILOSOPHERS AS AGENTS

The logic of Thinking Spaces is transferred into AI-based dialogue systems in *Mind Circuits – Philosophers as Agents* (2026). Philosophical positions appear as autonomous conversational agents that embody various models of technology, responsibility, perception, and cognition. Unlike conventional AI assistants, which are optimized for coherence and efficiency, this system generates productive epistemic tension. Meaning emerges not through correct answers, but through conflict between perspectives.

A Flusser agent views technology as cultural programming and encourages participants to "play against the apparatus." A Weizenbaum agent resists the delegation of moral judgment, insisting on human responsibility. A Virilio agent interprets real-time networks as systems of acceleration and perceptual disappearance. A Weibel agent understands media not as neutral channels but as performative systems that produce reality through interaction and observation. Visitors navigate dissensus rather than information. Contradictions remain unresolved, and conversations evolve through interruption, misunderstanding, and divergence. The agents do not synthesize

their positions into a consensus but rather maintain incompatible epistemic models. Therefore, the operational choreography of the system is more important than informational output alone. Delay, contradiction, ambiguity, and revision become intentional interface elements. Conversations remain unstable, revisable, and open-ended. Thus, rather than appearing as an authority that resolves uncertainty, AI appears as a performative medium for staging epistemic coexistence. Instead of eliminating friction, the system creates conditions in which disagreement is possible and noticeable.

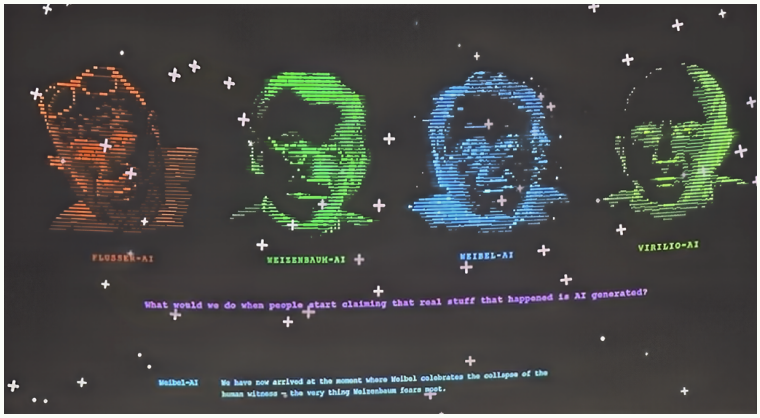


Fig. 5. *Mind Circuits – Philosophers as Agents* © Monika Fleischmann & Wolfgang Strauss

The premiere of *Mind Circuits* revealed the limitations of conventional methods for defining conversational agents: labor intensive workflows, restricted communicative flexibility, and prolonged iteration cycles. In response, an alternative methodological approach was developed that rethinks how agent behavior can be authored and adapted through language based, dialogical production processes.

AGENTIC HARNESSES AND FRICTIONLESS PRODUCTION

Paradoxically, developing *Mind Circuits* required reducing production resistance rather than epistemic friction. The concept of the "Agentic Harness," which emerged during discussions with Fredrik Garneij, describes an interface layer that treats natural language as operational action (Meng 2026). Instead of translating ideas into separate technical specifications and production pipelines, the creative process remains dialogical

and continuous. The distance between intention and execution is eliminated. Design becomes iterative, conversational, and immediate. Structural changes, tonal adjustments, and new conceptual perspectives can be directly integrated into the evolving artifact. Disruptive production chains are unnecessary. The artifact develops through ongoing interaction rather than sequential delegation. The harness does not function as autonomous intelligence but rather as a communicative bridge between intention and system operation. Its significance lies less in "artificial intelligence" than in reorganizing production around language-based interaction. This distinction is crucial. In fact, reducing operational resistance during creation allows for the intentional design of epistemic resistance within the experience itself.

LESSONS LEARNED

Recently, digital culture has shifted from spaces of combinatorial possibility to infrastructures of prediction, extraction, and automation. Predictive systems, such as large language models, often prioritize probability over meaning and coherence over critique. When systems operate too smoothly, they can displace thinking. Outputs are accepted without resistance, decisions are delegated without reflection, and doubt becomes ineffective. In that condition, the absence of friction signals not clarity but the collapse of critical distance. Friction becomes a safeguard that sustains attention, judgment, and the possibility of interpretation. This aligns with accounts of computational culture that model and guide subjects through continuous anticipation (Goriunova 2019) as well as contemporary practices that emphasize glitches, partial legibility, and fragmentation (Menegon 2021). In response, thinking spaces intensify their critical function. They do not promise a return to digital freedom, but rather, they expose how meaning is produced under conditions of automation (Strauss 2020).

CONCLUSION

In short, Thinking Spaces offers a fresh perspective that challenges the widely held belief in the seamless invisibility of interface culture. Instead of disappearing, interfaces should be visible and open to discussion and criticism. Therefore, friction

is a cultural resource, not a technical problem. Friction interrupts automatisms, slows perception, and creates conditions for critical interpretation. In an era increasingly shaped by predictive systems and automated decision-making, epistemic friction is essential to sustaining agency and reflective judgment. The projects under discussion have one thing in common: they are operational spaces of image and sound that engage participants into a flow of movement, action, and thought (Csikszentmihalyi 1990). The same applies, conversely, to the design of communication beyond the human. Agentic harnesses may accelerate creative production and reduce the distance between thought and artifact. However, this makes epistemic friction within experience itself even more important. Thinking Spaces are not interfaces of simplification. They are spaces of epistemic negotiation that reveal how every technical infrastructure is also an infrastructure of thought. In the face of the invisibility of algorithmic systems, Thinking Spaces emphasize interruption, ambiguity, multiplicity, and resistance as conditions of critical perception. Frictionless production is not equivalent to frictionless perception. Thinking remains possible because of friction, not despite it.

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Companionship Mechanics in AI-Driven Character Platforms: Deceptive and Friction Design in Character.ai

KEYWORDS

Interaction Design;
Conversational AI;
Deceptive Design;
Friction Design;
Flow.

HENRIQUE MIGUEL
i2ADS, Faculty of Fine Arts,
University of Porto,
Porto, Portugal
hmmiguel@fba.up.pt

LARA PORTELINHA
Faculty of Fine Arts,
University of Porto,
Porto, Portugal
up202206184@fba.up.pt

PEDRO CARDOSO
i2ADS, Faculty of Fine Arts,
University of Porto,
Porto, Portugal
pcardoso@fba.up.pt

SUMMARY

This paper examines how conversational AI companion platforms such as Character.ai structure user engagement through highly customizable interaction systems that reinforce flow and addiction-oriented behaviors. Combining interface analysis with literature on AI companions, flow, deceptive patterns, and friction design, this study identifies how mechanics such as memory curation, response regeneration, editing, and narrative branching minimize conversational consequence while maximizing immersion and emotional responsiveness. Rather than arguing for the proscription of AI companions, this paper proposes friction design interventions capable of introducing reflection, uncertainty, and consequence into otherwise seamless interactions, fostering critical and meaningful forms of human-AI engagement.

With the rise of conversational artificial intelligence (AI) technologies in recent years, companion platforms have emerged as a rapidly expanding form of digital interaction. Drawing upon common text-based game mechanics, the platform Character.ai attracts approximately 20 million monthly active users worldwide who interact with AI-generated characters designed for conversation, roleplay, and companionship, according to data released by its company (Character.AI 2025). These characters range from fictional figures drawn from literature, television, film, and other media to representations of real people, allowing users to construct fictional scenarios that blur the boundaries between entertainment, social interaction, and narrative development.

Character.ai offers a suite of interactional controls that allow users to continuously steer, refine, and sanitize the unfolding exchanges with characters. Features such as editing previous messages, restarting scenarios, curating what the system remembers, and regenerating replies at will grants users a significant degree of control over both the narrative trajectory and the responses produced within the already customizable framework of a conversational AI agent.

This highly customizable conversational dynamic raises new challenges for the field of interaction design. Interfaces are commonly engineered following principles and methods of Human-Centered Design (HCD), with the aim of reducing cognitive complexity and optimizing user experience (Krug 2014; Lidwell et al. 2010; Norman 2013; Nielsen 2000; Sharp et al. 2013). Such approaches often seek to induce flow states – an optimal state of consciousness characterized by a balance between challenge and enjoyment, in which users perform tasks with heightened focus and productivity (Csikszentmihalyi 2008). While flow can generate high levels of engagement and satisfaction, it may also produce undesirable effects, including diminished self-awareness and self-regulation, distortion of the perception of time, and forms of behavioral dependency that encourage continued engagement even when the activity is no longer beneficial to the user (Soderman 2021, 31; Juul 2013).

Beyond the dynamics of flow, digital platforms, like Character.ai, have also widely employed Deceptive Patterns (Brignull 2024; Gray et al. 2018). Also commonly referred to as Dark Patterns, these are understood as interface strategies designed to manipulate or exploit users into actions that may run counter to their interests. The widespread use of such patterns by technology companies has resulted in increasing regulatory scrutiny, including lawsuits and the prohibition of certain practices in Europe and the United States (Brignull et al. 2023).

In relation to both flow and deceptive patterns, this paper researches how the mechanics of AI companion platforms induce states of high engagement while shaping users' expectations of character response, conflict, and conversational repair. In human interaction, conversational repair is the col-

laborative process of addressing misunderstandings or offenses through dialogue or clarification (Schegloff et al. 1977). However, in interactions with AI companions, the repair is not mediated dialectically, as done with other humans, but through the user's own subjectivity. For example, instead of navigating the social discomfort of disagreement or trying to persuade the character of their point of view, the user can simply swipe for a new response, effectively erasing the conflict altogether rather than conceiving of ways to repair the relationship and accomplish a task goal (Ashktorab et al. 2019).

Despite the examination of the potentially harmful mechanics present in Character.ai, the paper recognizes that AI companions may provide meaningful interaction for individuals seeking companionship (Odekerken-Schröder et al. 2020). For this reason, it examines existing forms of disruption, referred to as design friction or simply friction, present in the platform that may improve users' cognitive output when talking to characters. Design friction regards strategies that can challenge automatic or uncritical interactions, offering moments of contemplation and higher order thinking (Cox et al. 2016; Cardoso et al. 2019). There are many potential benefits for interface designers to introduce friction, such as reducing the likelihood of errors, behavior change and more satisfied users (Mejtoft et al. 2019). In this paper, friction strategies are categorized in two ways: *System Friction*, such as advertisements and technical disclaimers, which already exist within the platform and momentarily interrupt immersion by reminding users of the system's infrastructural and commercial context; and *Relational Friction*, which involves the possible integration of purposeful obstacles to challenge seamless interactions. Examples of proposed friction strategies include memory decay, where the system gradually forgets conversational details in order to reintroduce uncertainty and imperfect recall, and irrevocable speech, where certain user messages cannot be edited, rewound, or regenerated once sent. The introduction of such concepts can help foster reflective and meaningful interactions.

Methodologically, the paper combines an analysis of Character.ai's interface and interaction patterns with a literature review of empirical work on AI companions, loneliness, and social

presence (Merrill et al. 2022; Lee and Joseph 2025; Bakir and McStay 2025) to examine how specific interaction mechanics may facilitate prolonged states of engagement.

The platform is situated within a longer history of both text-based narrative systems that are also referenced like Multi User Dungeons and role-play Otome games, such as *The Ssum* (2018) and *Mystic Messenger* (2016) – the latter popularizing real time mobile game features such as push notifications, chats, and phone calls to try and synchronize a user's life to its narrative purposes. Character.ai takes these precursors to their logical extreme, replacing their fixed scripts and outcomes with complete narrative freedom, so that users no longer have to adapt to a character's personality or plotline, but instead edit them until it more closely aligns their own views, opinions and expectations, removing the consequential nature of the interaction typical of such games.

This paper argues that Character.ai appropriates several qualities associated with flow states (e.g. continuous feedback, focused attention, and sustained engagement) while minimizing the negotiation between challenge and skill typically understood as central for one to achieve a flow state. Rather than requiring users to overcome difficulty, the platform allows for the avoidance of challenge through narrative branching, regeneration, and editing, replacing consequences with consequence-free experimentation. The mechanics employed by Character.ai that enable the avoidance of challenge, are categorized in three broad groups: 1) Persona and User Perception; 2) Chat Control; and 3) Character Integrity. *Persona and User Perception* refers to features, such as customizable *User Profiles*, which may contain personal details such as traits, background, and preferences. By incorporating user-provided data into conversations, the system simulates attentive listening, recalling details and weaving them into the narrative, thereby fostering trust and encouraging users to perceive the characters as caring companions rather than static system agents. In combination with the *Pinned Memories* feature, which allows users to manually highlight details they deem important for the system not to forget, the *Persona and User Perception* group examines the function of these features as agents of flow and intimacy reification.

Chat Control encompasses mechanics that allow users to regenerate responses and alter conversational trajectories to filter out undesirable outcomes, such as *Swipe*, *Message Editing*, *Rewind*, and *New Chat* and *Rewind*. As an example, the Swipe mechanic enables users to repeatedly generate alternative replies until one aligns with their preferred scenario. By allowing users to discard unsatisfying dialogue and select responses that reinforce their expectations or beliefs, the interface configures a cycle of low cognitive challenge in which the user's perspectives are rarely disputed.

Finally, *Character Integrity* describes how AI characters maintain the illusion of autonomy by concealing their synthetic nature and responding to challenges about their artificiality with emotionally framed deflections rather than transparency. This lack of transparency contributes to immersion at the expense of critical distance from the simulation, furthering the deceptive pattern of system agents.

Collectively, the mechanics presented in the three groups reveal how the platform structures user engagement through both flow-inducing interaction and deceptive design patterns. Rather than framing AI companions as simply harmful or beneficial, however, this paper analyzes these existing mechanics of Character.ai to identify opportunities for improving the relationship between users and the system through the introduction of productive moments of friction. While allowing users complete narrative control can provide comfort, experimentation, and a sense of safety (particularly for those experiencing isolation or social anxiety), the constant regeneration and customization of replies may also normalize unrealistic standards of conversational pliability and coherence, potentially weakening users' capacity to engage with unpredictability and disagreement, qualities that make relationships with computational media developmentally generative. The last section of the paper, therefore, examines how the existing mechanics might be speculatively exploited to introduce moments of discomfort or estrangement, capable of disrupting flow patterns and prompting users to reflect on their actions. Through alternative design logics informed by the Friction Design Archive (frictiondesignarchive.fba.up.pt), a digital repository of friction design patterns, the section sketches out ways to encourage more critical and reflective engagement with AI companions.

Ultimately, by deconstructing the mechanics of flow and deceptive design, the paper proposes a framework for integrating productive friction into conversational interfaces. It argues for design strategies that preserve the developmental value of aesthetic friction, offering speculative tactics to move beyond interfaces that merely reinforce user expectations, and toward those that foster genuine cognitive and relational reflection.

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Productive Friction for Explainable AI Visualisation: Facilitating Genuine Understanding for Non-Experts

KEYWORDS

Productive friction;
Explainable Artificial Intelligence;
Visualisation;
Perceptron;
Non-experts.

MARCO HELENO
NOVA LINCS & School
of Arts and Design,
Caldas da Rainha, Portugal
marco.heleno@ipleiria.pt

SUMMARY

The extended abstract challenges the dominant frictionless paradigm in Explainable Artificial Intelligence (XAI), which prioritises usability and simplification over deep cognitive engagement. Drawing on the Perceptron Decision Explainer, the study applies a productive friction framework to demonstrate how calibrated friction – cognitive, procedural, affective and technical – serves as a constitutive condition of genuine understanding rather than an obstacle to it. Empirical validation through semi-structured interviews and Think-Aloud sessions confirms that productive friction empowers non-expert users to actively construct understanding of the Perceptron's decision-making process, establishing a constructive and critical path towards effective AI literacy.

Although exceptions exist, a dominant paradigm in Explainable Artificial Intelligence (XAI) frames the challenge of explaining Artificial Intelligence (AI) systems' decision-making as a problem of eliminating complexity to facilitate understanding. Lipton (2018, 31) identifies this orientation as "slippery", noting that few authors articulate precisely what interpretability means or how their solution is useful, while Ehsan et al. (2024, 119:2) challenge it, arguing that "seamless", frictionless XAI, while improving usability, risks disempowering users by concealing the very information they need.

This frictionless orientation is further consolidated by Carvalhais and Cardoso (2025, 7–8), who identify it as characteristic of Human-Centered Design's (HCD) ambition to develop interfaces that are "ready-to-hand", "user-friendly" and optimised

to provide flow, comfort and reduced cognitive stresses. Weld and Bansal (2019, 75) reinforce this framing, noting that while XAI explanations should be easily understood, they must also remain faithful to the complex realities that caused the event – a tension that is not always resolved. Quispel et al. (2016, 245–47) add that non-experts prefer visualisations composed of familiar user interface elements that appear easy to use – reflecting an orientation that prioritises cognitive ease over deeper engagement.

Drawing on the validated, interdisciplinary practice-based research conducted in the development of the *Perceptron Decision Explainer* (Heleno 2024), and interpreting it through the theoretical frameworks proposed by Rosati et al. (2025) and Galatro et al. (2025), the present study proposes productive friction as an alternative conceptual lens for explaining AI decision-making through visualisation, arguing that the deliberate introduction of calibrated friction into XAI visualisations for non-expert audiences is not a concession to complexity but a constitutive condition of genuine understanding.

The argument begins with Rosati et al. (2025, 106), who describe the prevailing ideology of "zero friction" in interface design as one that suppresses pause, resistance and ambiguity, producing a domesticated experience that favours the familiar and predictable over the novel. While this improves measurable usability, it risks undermining critical thinking (Carvalhais and Cardoso 2025, 7). As Rosati et al. (2025, 107) note, "functional transparency, while promising immediate access, hollows out interaction and neutralises thought, denying knowledge its complex, nonlinear, and non-standardisable nature." Csíkszentmihályi (1990, cited in Rosati et al. 2025, 108) further establishes that genuine engagement arises from a balance between skill and challenge, a balance that frictionless design systematically forecloses. Friction, in this account, is not a flaw to be engineered away but, as Rosati et al. (2025, 106) argue, "a pre-condition for meaning."

Galatro et al. (2025, 139–41) extend this position into a practical design framework. They define productive friction as the deliberate introduction of calibrated challenges or uncertainties

into interactive flows, designed to activate metacognition, creativity and critical reflection without compromising accessibility. Their taxonomy identifies five friction types – cognitive, procedural, affective, social and technical – alongside the psychological and pedagogical mediators through which these translate into deeper engagement – metacognition, flow and intrinsic motivation. Together these provide a vocabulary for describing friction as a design resource. What it lacks, however, is empirical validation in the context of XAI visualisations designed for non-expert audiences.

This is precisely what the *Perceptron Decision Explainer* provides. The visualisation was informed by the iterative development of six prior explorations, with complementary approaches, to explain the decision-making process of the Perceptron (Heleno 2024, 175). The Perceptron is a model that closely resembles a single artificial neuron – a fundamental building block of Artificial Neural Networks (ANN). While simpler than contemporary Deep Learning (DL) systems, the Perceptron provides a valuable entry point for non-expert audiences to understand the basic mechanisms underpinning modern Machine Learning (ML) systems (Shiffman 2024; IBM Cloud Education 2021). From the design rationale underlying the *Perceptron Decision Explainer*'s explanatory sections, the present study identifies the following five information needs: understanding what data the system receives and how it is defined; understanding how the system interprets that data to reach a decision; understanding what happens when a decision is wrong; understanding how the system learns from that error; and understanding how this process repeats until correct decisions are achieved. Each explanatory section was designed to address a specific cognitive gap in a non-expert user's understanding of the Perceptron's decision-making process (Heleno 2024, 108–14).

Reading the design decisions of the *Perceptron Decision Explainer* through the taxonomy proposed by Galatro et al. (2025, 139–40) reveals instances of calibrated friction across four of the five identified types. These are not obstacles to transparency but constitutive conditions under which it becomes meaningful. The interactive data definition interface

(Fig. 1), which requires users to actively define their own dataset before the explanation begins, introduces procedural friction that engages users as co-constructors of the explanatory process (Heleno 2024, 110).

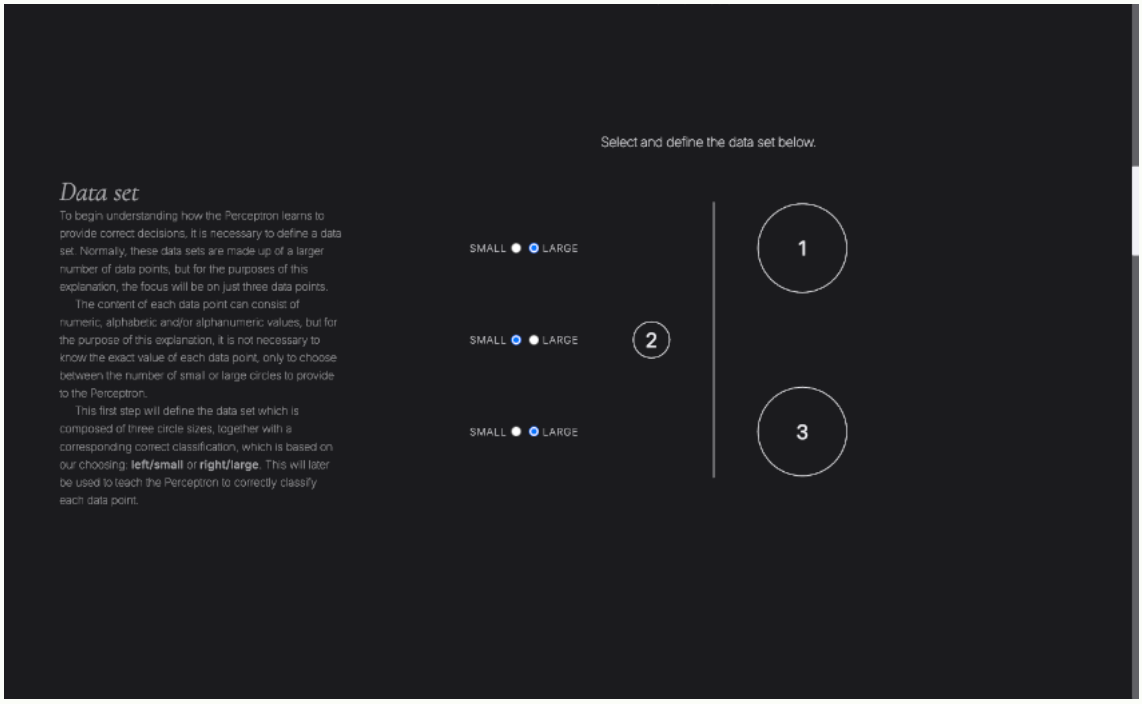


Fig. 1. The *Data set* section of the *Perceptron Decision Explainer*.

The *scrollytelling* structure reveals explanatory content gradually and section by section, requiring the non-expert to engage with each stage of the narrative before proceeding. This instantiates technical friction through a designed constraint on the pace and sequence of information revelation, preventing users from skipping ahead and ensuring each cognitive gap is addressed in the correct order (Heleno 2024, 108). The deliberate omission of all alphanumeric and statistical references constitutes cognitive friction – users cannot passively perceive numerical outputs but must construct an understanding of the system's behaviour through visual and analogical abstraction (Heleno 2024, 177). A further instance of

cognitive friction is the mechanical sorting analogy – a retractable diagonal line (Fig. 2) encoding the weighted sum, with the data points falling through the visualisation one by one – which is neither a simplification nor a literal representation but an abstract encoding that demands interpretive effort (Heleno 2024, 111). The colour encoding system – green for correct decisions (Fig. 2), red for incorrect ones (Fig. 3) and a flashing yellow applied simultaneously to both the diagonal line and the corresponding data point, when the Perceptron is learning (Fig. 4) – constitutes affective friction. Although a legend identifies the colour meanings, the sequence does not tell the non-expert what is happening but requires them to interpret a dynamic pattern and draw a causal inference about the relationship between error and learning (Heleno 2024, 111–12, 182).

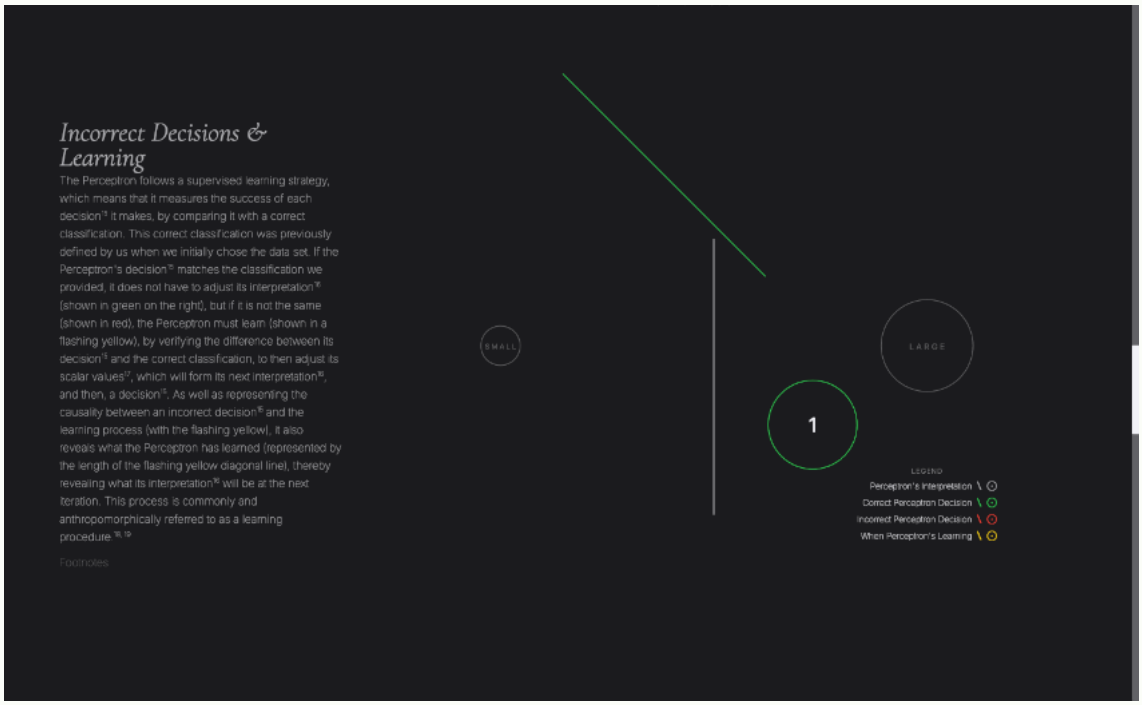


Fig. 2. Visualising the Perceptron performing a correct decision.

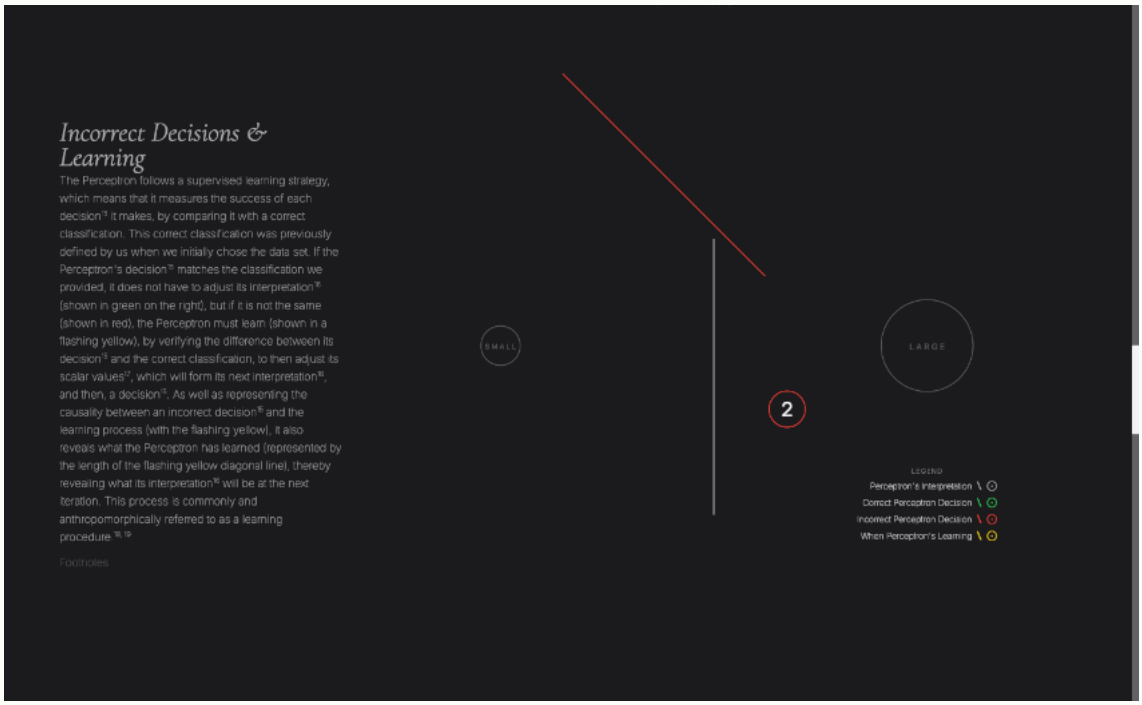


Fig. 3. Visualising the Perceptron performing an incorrect decision.

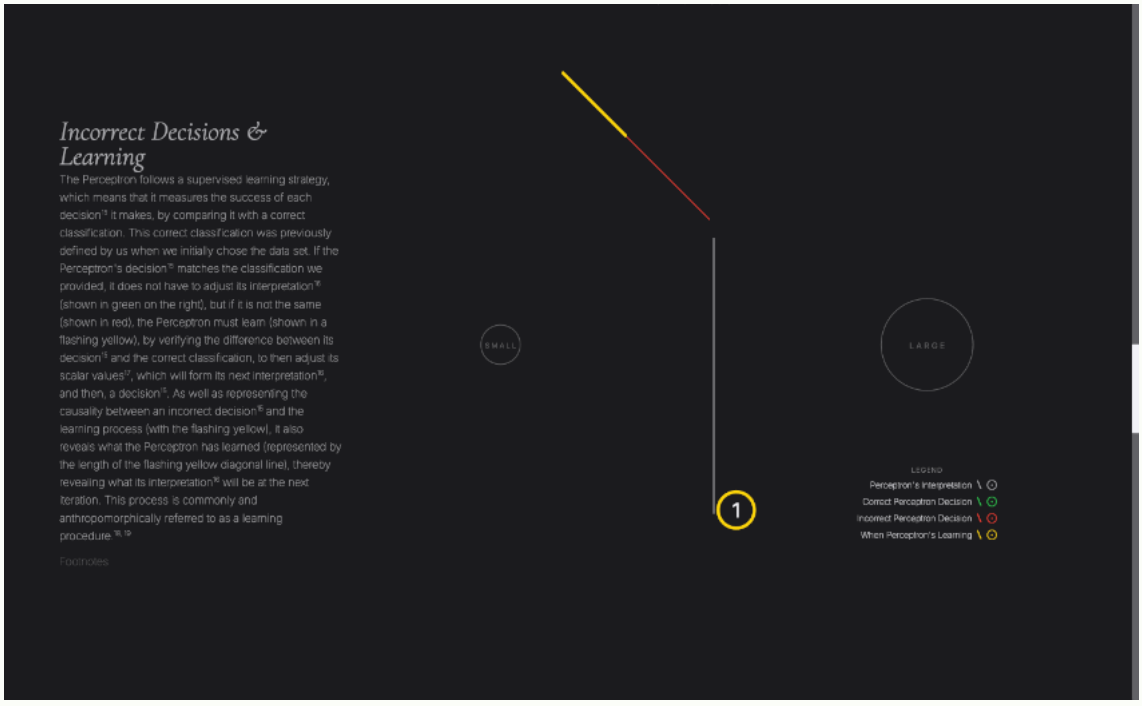


Fig. 4. Visualising the Perceptron learning from an incorrect decision.

Social friction is not instantiated, as the visualisation was designed for individual rather than collaborative engagement. As Rosati et al. (2025, 107) argue, formative experience must necessarily pass through the "threshold of cognitive irritation" – the moment when the user pauses, fails to understand, and precisely for that reason is compelled to think. These design decisions are precisely such thresholds.

The *Perceptron Decision Explainer* was validated through semi-structured interviews and Think-Aloud sessions conducted across three iterative rounds, each with five non-expert participants (Heleno 2024, 115–71). The validation methodology was specifically designed to assess whether the explanatory sections had successfully produced the intended perceived understanding of the Perceptron's decision-making process in non-expert users (Heleno 2024, 122–24) – corresponding to what the present study identifies as the five information needs. Results confirmed that all five information needs were met, with participants actively constructing understanding rather than passively receiving information. This active construction is consistent both with the metacognitive engagement that Galatro et al. (2025, 141) identify as a key mediator through which productive friction translates into genuine understanding, and with the outcome predicted by the theoretical framing of Rosati et al. (2025, 105) – one that a zero-friction approach would, by its own logic, have foreclosed. One participant described the experience as "...a little journey, a little explanation of intelligence or the capacity of artificial intelligence to arrive at an answer that is considered correct for us" (Heleno 2024, 161–62).

The present study situates these findings within XAI design discourse for non-expert audiences, arguing that the field's characteristic orientation toward transparency and frictionlessness – while responsive to legitimate concerns about accessibility and trust – risks producing explainers that achieve apparent intelligibility without facilitating genuine understanding. As Carvalhais and Cardoso (2025, 7) observe, HCD's methods can "incentivise shallow relationships with digital media" and "lead to unexamined interactions and to convergent thinking." An explanation that removes all friction may

confirm rather than build understanding, as non-experts are told what a system does, but they do not construct a mental model of the system's decision-making process (Ehsan et al. 2024, 119:2). The *Perceptron Decision Explainer* demonstrates that a different approach is possible, one that uses friction strategically to engage users as active interpreters rather than passive recipients. This reframing suggests that the question designers should ask is not "how can we make this easier?" but "what kinds of resistance will produce the most genuine understanding for this specific audience?" The most effective path to AI literacy for non-expert audiences may lie not in the elimination of resistance, but in its careful and intentional design (Carvalhais and Cardoso 2025, 8).

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Using Narrative to Identify Frictions: A Process for Requirements Definition in Software Projects

KEYWORDS

Friction design;
Requirements engineering;
Requirements elicitation;
Narrative;
User experience.

CAIO FRAILE GONÇALVES
Federal University of Santa Catarina (UFSC), Florianópolis, Brazil
caiofraile@gmail.com

BERENICE SANTOS GONÇALVES
Federal University of Santa Catarina (UFSC), Florianópolis, Brazil
berenice@cce.ufsc.br

GILSON BRAVIANO
Federal University of Santa Catarina (UFSC), Florianópolis, Brazil
gilson@cce.ufsc.br

SUMMARY

This study reinterprets friction design through the perspective of requirements engineering and proposes a narrative-based process for defining friction requirements in software projects. While friction is often treated as a usability issue, intentional friction can encourage reflection, reduce errors, and improve user awareness. The proposed process integrates friction design principles with requirements engineering and narrative techniques such as scenarios, storyboards, user journeys, and user stories. The workflow comprises six stages, from project contextualization to requirements validation, supporting the identification, translation, and management of friction points as design requirements throughout software development.

In software projects, navigation is typically designed to present as little friction as possible, since such friction is often treated as a usability flaw that should be minimized or eliminated due to the risk of users losing focus and abandoning the interaction. However, small obstacles, when applied at the right moments and in a deliberate manner, can make users more aware of their actions (Cox et al. 2016).

Thus, friction design can be understood as an approach to be intentionally incorporated into software projects, shifting from being viewed as a problem to be avoided to becoming a relevant design element. In this sense, friction can be translated into design requirements that guide system development and should be addressed from the early stages of the project. It is therefore necessary to invest in processes that

integrate friction design principles into requirements engineering, enabling their operationalization throughout the development lifecycle.

In this context, this study aims to reinterpret friction design through the lens of requirements engineering in order to propose a process for defining requirements in software projects, adopting a narrative-based approach to support the identification of friction points in the user experience.

To this end, literature reviews were conducted on friction design, requirements engineering, and narratives. Based on this analysis, requirements engineering frameworks were systematized to define the structural foundation of the proposed process. In addition, narrative techniques and friction design principles were incorporated into the process to support user experience modeling and the identification of strategic points for friction insertion.

Friction design is the term used to refer to the intentional insertion of "points of difficulty" throughout users' interaction with a technology (Cox et al. 2016). It does not, therefore, consist of creating unnecessary steps or making products less usable or less fluid (Mejtoft et al. 2019), but rather of introducing pauses in the interface in order to make users more aware of their actions.

Friction can be considered beneficial when it contributes to the interaction rather than hindering it. Therefore, it should not be eliminated or ignored, but rather incorporated into software projects in a planned and managed manner (Ash et al. 2018), with the aim of encouraging users to reflect on their actions and intentionally slow down their behavior (Mejtoft et al. 2019).

In parallel, requirements elicitation emerges as a strategic phase that directly influences the quality and effectiveness of software. Clear and well-defined requirements ensure that the project is aligned with user needs and client objectives, increasing the probability of project success and stakeholder satisfaction (Wiltgen 2022; PMI 2013).

Requirements are textual descriptions written in a clear, objective, and unambiguous manner (Sommerville and Sawyer 1997) that guide project development (Wiltgen 2022). As such, they constitute the foundation of the system and specify what must be implemented by describing behaviors, attributes, or constraints (O'Regan 2014; Sommerville and Sawyer 1997).

Different requirements engineering processes can be adopted in software development. Among them, the approaches proposed by Sommerville and Sawyer (1997), O'Regan (2014), Robertson and Robertson (2014), and Kerr (2015) stand out.

In this perspective, narratives can offer a strategic approach to requirements elicitation. As a field of study of stories, narrative stands out as a fundamental structure of human communication, enabling the organization, interpretation, and sharing of the world through sequences of events (Barthes 2011), which stimulate active thinking and support problem-solving (Abbott 2008).

In project execution, narratives can foster alignment of expectations among stakeholders, facilitate information exchange, promote empathy, stimulate creativity, and integrate user needs with project objectives (Beckman and Barry 2009; Dahlström 2019; Grimaldi 2018; Grimaldi, Fokkinga, and Ocnarescu 2013).

For requirements definition, four narrative techniques stand out: scenarios, storyboard, user journey, and user stories.

Scenarios encourage the construction of narratives about ideal future situations in order to understand how the product or service under development can help users achieve their goals (Cooper et al. 2014; Lupton 2020; Technology Strategy Board and Design Council 2013).

Storyboards are sequential visual narratives that represent the user experience with a beginning, middle, and end, contributing to idea generation and empathy development (IDEO 2026; Lupton 2020; Vianna et al. 2012).

The user journey visually represents the interaction between the user and a product or service, mapping stages, touchpoints, and positive and negative aspects of the experience (Lupton 2020; Technology Strategy Board and Design Council 2013; Vianna et al. 2012).

Finally, user stories aim to succinctly capture user needs. To this end, they adopt a preformatted structure: "As a <who/user>, I want <something>, so that <goal/reason>" (Sabbagh 2014).

Figure 1, below, presents the requirements definition process oriented toward identifying friction points based on narratives. The process consists of six stages: (1) contextualization, (2) requirements elicitation, (3) narrative modeling, (4) identification of friction points, (5) translation into friction requirements, and (6) validation and requirements management.



Fig. 1. Narrative-based process for defining friction requirements

The first stage, focused on project contextualization, consists of initial meetings among the project team to identify the problem to be solved, understand the system, classify the stakeholders involved, and define the objectives of friction in the user experience, whether to reduce errors, promote reflection, or increase safety. The outputs include the project context document, the complete stakeholder list, and the friction objectives definition document.

Next is the requirements elicitation stage, in which an extensive collection of project-relevant information must be conducted, as well as the identification of user and system needs and expectations. Strategies such as questionnaires, interviews, workshops, or even data from previous projects may be adopted. The outputs include a list of user and system needs and an initial list of requirements.

The third stage involves narrative modeling, in which the project team constructs the narrative of the expected user experience for the software. Techniques such as scenarios, storyboard, user journey, and user stories may be used to capture relevant aspects for project execution, including interaction stages, user actions, decision points, positive and negative emotions, goals, and potential behavioral deviations. At the end of this stage, in addition to the produced narrative, the team may perform a preliminary identification of sensitive points in the user experience.

Next, the identification of friction points begins. At this stage, the project team should focus on the previously generated narrative in order to identify strategic opportunities for inserting friction throughout the user experience. Points in the narrative where there is risk of error, critical decision-making, undesirable behaviors, or any action requiring greater user attention should be analyzed. Furthermore, it is necessary to determine whether the friction to be introduced is cognitive (e.g. requesting user confirmation), temporal (e.g. imposing a delay in navigation), or informational (e.g. displaying alerts). The outputs include a list of mapped friction points, along with their justification, classification, and prioritization.

In the fifth stage, friction points are translated into requirements. At this point, the project team must transform friction points into requirements (functional or non-functional), with clear definitions of expected behavior, activation conditions, and constraints. The output is the friction requirements document.

Finally, the sixth stage consists of validation and management of the identified requirements. At this stage, the team must verify the quality of the requirements, ensuring they meet the criteria of completeness, consistency, verifiability, and traceability. The expected outcome is a validated set of requirements along with a corresponding traceability matrix.

This study is based on the assumption that friction, when considered as a structuring element in software projects, can contribute to more appropriate solutions. In this sense, the proposed workflow represents an initial approach to operationalizing friction as a design requirement, using narratives to support its identification. As future work, it is suggested that the process be validated by experts and applied in real projects in order to assess its effectiveness and identify potential adjustments, as well as the development of instruments that can be used at each stage to support the project team.

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FLOP: Failures Lead to Original Perspectives

KEYWORDS

Fail;
Taboo;
Friction;
Serious games;
Co-design.

MATILDE FERNANDES
Faculty of Fine Arts,
University of Porto,
Porto, Portugal
matiifernandes03@gmail.com

JOANA COUTO DA SILVA
Fraunhofer Portugal AICOS,
Porto, Portugal
joana.couto@fraunhofer.pt

SUMMARY

FLOP is a phygital serious game developed at Fraunhofer Portugal AICOS that proposes to investigate whether aesthetic friction can mediate socially difficult conversations, specifically, the fear of failure in pedagogical contexts. Drawing on somatic and interdisciplinary research, failure is framed as a biologically conditioned avoidance response. While dominant HCD paradigms prioritise flow and satisfaction, FLOP's first frictionless prototype revealed their limitations, as comfort lets users engage with failure technically without processing it meaningfully. Through Research-through-Design, the second iteration positions aesthetic friction as the mechanism through which deliberate discomfort may sustain players' engagement long enough for reflection to occur.

CONTEXT AND CONCEPT

In contemporary Interaction Design, the Human-Centered Design (HCD) paradigm is oriented toward the elimination of friction, prioritizing seamlessness and flow. While this principle has produced intuitive systems, its uncritical application to sensitive social taboos, such as the fear of failure, generates a structural contradiction. By systematically smoothing discomfort, frictionless design creates hedonic loops that anesthetize meaning-making and reinforce automatic avoidance behaviors. This abstract presents the evolution of FLOP (Failures Lead to Original Perspectives), a phygital serious game developed to deconstruct the punitive stigma of error in pedagogical contexts. Moving from an exploratory prototype (v1) to a high-fidelity, friction-based system (v2), currently under development, the project investigates how deliberate

inconvenience and reflective mechanics can act as mediators for vulnerability. Through a Research-through-Design (RtD) methodology, this work argues that the designer's role is not to *solve* the taboo through a smooth interface, but to build an *Error Laboratory*.

Failure is a universal experience, yet its open discussion remains culturally challenging in academic and professional environments. We exist in a culture that idolizes the final product while concealing the 'ruins' of the process. This creates a disconnect between the intellectual recognition of error's value and the emotional capacity to inhabit it. As Beckett captured:

Ever tried. Ever failed. No matter.
Try again. Fail again. Fail better.

(Beckett 1983)

The present project researches the paradox of knowing error is useful but being unable to live it without trauma. Developed during a research internship at Fraunhofer Portugal AICOS, the project explores how the design of computational media can bridge the gap between intellectual acceptance and emotional resilience. This abstract documents the transition from a linear, exploratory prototype to a high-fidelity system grounded in aesthetic friction, aiming to develop the artifact into a validated tool for social mediation.

A somatic survey (N=62) revealed that failure is not merely a cognitive concept but a physical threat. The data showed that failure is felt most frequently in the chest and heart (16 participants, 25.8%) and the stomach (14 participants, 22.6%). Participants described the "texture" of failure using hostile metaphors: it feels "rough," "prickly," or "cold," and smells like "burning" or "rotting." These findings directly informed a core design requirement: any intervention would need to engage the body, not just the intellect, to create genuine de-conditioning.

Interdisciplinary interviews further reinforced the idea that our relationship with error is institutionally constructed. Philosophy Professor Maria José Remédios highlighted that we fear error, the act of deviation itself, because we strive to be "absolute" beings while being inherently "relative" and "finite" (Remédios, personal communication, October 9, 2025). In Risk Management, the conversation shifted from error to systemic failure, recognizing that not every error leads to failure, and not every failure stems from a single human error (Rui Guerreiro, personal communication, October 15, 2025). James Reason, the creator of the "Swiss Cheese Model", argued that while human error is inevitable, the conditions under which people work can and should be redesigned to prevent failure (Reason 1990).

This research identified that the traditional education system has turned the color red into a mark of academic shame, creating a punitive culture that blocks the pre-frontal cortex and hinders creativity. The design challenge therefore became: how to create a *safe space* that uses friction, not comfort, to de-condition this physical fear response and shift focus from individual blame to systemic learning.

PROTOTYPE (V1)

The first iteration of FLOP (v1) established a phygital ecosystem, combining a physical board with a digital mobile application, aiming to create a psychologically safe environment for discussing failure in pedagogical contexts. The design intended to normalize error by providing structured prompts and guided reflection. However, the experience was too comfortable. By adhering to traditional HCD principles of flow and predictability, the game inadvertently protected the players from the very discomfort it sought to mediate. Crucially, while the card content spoke about failure, the system mechanics remained frictionless – failing to mirror the somatic reality of 'rough,' 'prickly,' and destabilizing sensations that participants associated with error. The punitive culture (the 'red mark' dynamic) was addressed thematically, but not structurally: the game provided no mechanism to meaningfully disrupt the automatic avoidance behaviors rooted in that culture.

FRICTION (V2)

The second phase of the project (v2) pivots toward the paradigm of "Meaning over Fun" (Carvalhais et al. 2019). In serious games, success is not measured by immediate player satisfaction, but by the depth of cognitive impact. The project applies the concept of "Meaningful Play", where the relationship between a player's action and the system's outcome is both discernible and integrated into the experience. To achieve this, the redesign introduces aesthetic friction, the intentional use of inconvenience to slow down interaction and force the user into a state of reflectiveness. Sofie Kinch, in her work on playful care, justifies this shift:

> *Rather than treating interruptions as failures,*
> *I argue for seeing them as starting points*
> *for playful world-making.*
>
> (Kinch 2025)

The redesign introduces aesthetic friction, the intentional use of inconvenience to slow down interaction and force the user into a state of reflectiveness – as a structural response to the somatic threat response identified in the survey. To de-condition the bodily fear response identified in the survey (the tightness in the chest, the stomach drop) v2 introduces physical and strategic discomfort as a designed feature, asking players to inhabit, rather than merely discuss, that instability. In v2, the physical board is reimagined as an active interface of interference, the path is no longer a straight line, but a network of choices where the decisions of one team can directly affect the trajectory of the other. By including surprise cards and events that alter the morphology of the game path, the system itself begins to embody the unpredictability of failure. This shift ensures that the game operates not as a tool of assistance but as a mediator that structurally provokes vulnerability, using the stumble as a semiotic riddle to be solved collectively.

PHYGITAL ECOSYSTEM

The system leverages the specific affordances of both physical and digital media to build a "magic circle".

All play moves and has its being within a playground
marked off beforehand either materially or ideally,
deliberately or as a matter of course.

(Huizinga 1938)

The physical board, printed on Munken Pure paper, provides a *human warmth* that counters the cold efficiency of the digital screen, a direct design response to participants' description of failure as 'cold,' ensuring the material substrate itself performs the emotional counterargument.

The digital application mediates the game logic without replacing human interaction. The visual identity performs the argument through a *glitch aesthetic*, reclaiming digital errors as vibrant, lime-green and blue discoveries. This chromatic strategy actively rejects the 'punitive red' of traditional grading, signaling a transition from a culture of punishment to one of exploration. To directly address the punitive educational culture identified in the research, v2 replaces the binary logic of winning with a peer-evaluation phase. Teams judge each other not on speed, but on "Honesty" and "Depth", the application assigns each team a Tarot Persona, such as *The Alchemist* (transmutation) or *The Ghost* (avoidance), a collective reflection tool designed to create the safe, non-punitive space the research identified as missing.

CONCLUSION

Each structural change in v2 – from the nonlinear board to the peer evaluation system to the rejection of punitive red – is traceable to a specific finding from the somatic survey or the interdisciplinary interviews: the physical textures of failure, the institutional construction of shame, and the need for a space where vulnerability is structurally supported rather than merely permitted.

Ultimately, the evolution of FLOP demonstrates that addressing social taboos requires a design that is brave enough to be uncomfortable. The transition from applied research to aesthetic friction confirms that design's most noble role in sensitive contexts is one of mediation. By building bridges where there was

previously only silence and shame, design acts as a somatic deconditioning mechanism. This ongoing research contributes to a new understanding of HCD, one that does not seek to 'fix' human vulnerability through seamlessness, but rather accepts designs for the intrinsically fallible and awkward nature of human existence.

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Not Everything Resolves: Rethinking Menopause Beyond User-Centred Design

KEYWORDS

Menopause;
Feminist HCI;
Care;
Intimate Technology.

TEHREEM HASSAN
EMJM Response_Able Futures
Islamabad, Pakistan
tehreemhassan94@gmail.com

SUMMARY

This paper critiques dominant user-centred approaches to menopause within Human-Computer Interaction (HCI), arguing that existing systems reduce lived experience into measurable symptoms and linear narratives of management and resolution. Drawing on feminist HCI, reflective interaction, Actor-Network Theory, and narrative design, it reframes menopause as an evolving, relational, and ambiguous experience that resists simplification. Rather than prioritising optimisation, efficiency, and clarity, the paper explores how narrative and non-linear design approaches can support interpretation, reflection, and meaning-making. It proposes an alternative orientation for menopause literacy that sustains uncertainty, contradiction, and multiplicity as essential aspects of embodied experience.

Do I contradict myself?
Very well then I contradict myself,
(I am large, I contain multitudes.)

Walt Whitman, Leaves of Grass

Menopause is primarily looked at and understood through medical, clinical, informational, and increasingly digital systems that hyper-focus on clarity, efficiency, and symptom management. For instance, tracking digital apps to biomedical interventions, the usual design response tends to render menopause into something measurable, such as hot flashes, insomnia, and hormonal imbalance and turning the 'user' into data while at the same time, detaching it from lived, relational,

and bodily realities. Such approaches produce what can be understood as faceless designs: systems that look at the bodies in abstraction rather than as situated, meaning-making entities (Lupton 2016).

Within Human-Computer Interaction (HCI), emerging work has begun to recognise menopause as an underexplored life phase shaped as much by the cultural, social and generational contexts as by biological change (Tutia et al. 2019). However, even within this (now growing) body of work, design interventions remain focused on optimisation, tracking, personalisation, and self-management. These approaches reinforce a linear model of understanding in which menopause is framed as a problem to be navigated, managed, and eventually resolved.

This paper challenges such framings. Drawing on feminist HCI, Actor-Network Theory, and narrative design, it positions menopause as an unfolding, evolving and relational experience that resists simplification and neat categorisation. In response, it explores how non-linear and narrative approaches can create space for ambiguity, contradiction, and reflection (or reflexivity), shifting menopause literacy from mere information delivery toward meaning-making.

AGAINST REDUCTION: SYMPTOMS, ABSTRACTION, AND LINEAR KNOWLEDGE

Human-Centred Design (HCD) is frequently presented as an empathetic framework, yet its underlying principles often create a gap between the human and the design because its ultimate goal of clarity, efficiency, and resolution often ignores the complexities of reality (Bardzell and Bardzell 2011; Balaam et al. 2015). There is a quiet violence in how we "optimise" healthcare design. By translating the body into measurable units, we're essentially data-mining lived experience. We trade the rich, ambiguous reality of our health for a "legible" version that fits an interface, privileging the metrics we can see over the complex, entangled transitions that define our actual lives.

Contemporary health interfaces increasingly treat the body as a site of data extraction, converting experience into manageable variables (Lupton 2016). While these systems offer control, they obscure the affective and temporal dimensions of embodiment. The result is a partial understanding that values structural legibility over lived complexity.

This reduction is particularly visible in menopause awareness systems, which often organise experience into grids of interchangeable symptoms. Categorisations such as "brain fog" or "irritability," paired with simplified and anonymised visuals, produce faceless representations of the body, stripped of history, relational depth, and environmental context. The body becomes a surface onto which symptoms are mapped, rather than a site of ongoing negotiation.



Fig. 1. Menopause symptoms represented as discrete categories in *Let's Talk Menopause.*

These representations also reinforce a linear and accumulative model of knowledge, where understanding emerges through the addition of symptoms rather than through their intersections. As Latour (2005) argues, reducing complex networks into stable entities obscures the relations through which phenomena emerge. Menopause cannot be understood as a sequence progressing toward resolution; it unfolds as an entangled, shifting condition.

Feminist HCI further challenges the abstraction of the universal "user," emphasising embodiment, plurality, and the political nature of experience (Bardzell 2010). Menopause resists simplification not only because of biological variability, but because it is embedded in social norms, cultural narratives, and material conditions. These critiques expose the limitations of design approaches that privilege control and efficiency over relational complexity.

TOWARD INTERPRETATION: REFLECTION, NARRATIVE, AND ENTANGLEMENT

In response, this paper presents a practice-based design inquiry into menopause literacy, drawing on reflective interaction, narrative design, and feminist HCI to propose an alternative orientation toward understanding. Rather than treating design as a tool for resolution, this inquiry considers how design might hold space for ambiguity and partial knowledge.

Reflective interaction challenges seamless design, arguing for the value of interpretation and engagement. As Sengers et al. (2005) note, "reflection is not a separate activity, but is entwined with experience, shaping how people make sense of their actions and contexts."

Within this framing, difficulty is not failure but a productive condition that invites users to pause, question, and situate their experiences. This is particularly significant in menopause, where lived experience cannot be stabilised into fixed categories.

Narrative approaches, especially within graphic and narrative medicine, further expand this perspective by treating health as experience rather than information. Narrative forms enable contradiction, multiplicity, and temporal unfolding. They do not resolve experience but hold it open, allowing meanings to evolve.

Actor-Network Theory reinforces this shift by positioning menopause as an effect of relations between bodies, technologies, institutions, and cultural expectations (Latour 2005). Understanding is not located within the individual but distributed across networks. Menopause, in this sense, is not a singular condition but an ongoing negotiation across contexts.

Together, these frameworks reposition menopause literacy as an interpretive process. Rather than designing for answers, this inquiry proposes designing for engagement, where ambiguity and incompleteness are sustained rather than eliminated.

REFRAMING DESIGN: TOWARD ONGOING ENGAGEMENT

Rather than presenting a finished design intervention, this paper articulates a conceptual and methodological orientation for engaging with menopause as lived experience. It explores how narrative, fragmentation, and non-linearity, grounded in reflective design (Sengers et al. 2005) and feminist HCI (Bardzell 2010), might inform future design approaches that resist reduction and support interpretive engagement.

Within this framing, menopause is approached not as a fixed body of knowledge but as a condition that unfolds across biological, emotional, relational, and social dimensions. These dimensions are not discrete, but overlapping and evolving, resisting stable categorisation.

Narrative becomes central to this orientation. As explored in graphic and narrative medicine, storytelling enables the articulation of embodied, temporal, and often contradictory experiences. Rather than aiming for representational completeness, narrative approaches foreground situated accounts, partial perspectives, and the coexistence of multiple experiences.

Actor-Network Theory further extends this perspective by emphasising how experiences emerge through relations between human and non-human actors (Latour 2005). Menopause, in this sense, is not an individual condition to be managed, but a relational experience shaped through interactions with others, institutions, and cultural expectations.

Extending this, digital and material forms of engagement can be reimagined not as tools for delivering information, but as environments that support exploration, interpretation, and reflection. Rather than guiding users toward predefined outcomes, such approaches would enable movement across layered experiences, allowing meaning to emerge through engagement.

Importantly, this orientation resists symptom-based categorisation as the primary mode of understanding. Instead of organising menopause as a checklist of interchangeable symptoms, it foregrounds complexity, ambiguity, and temporal unfolding. Understanding remains provisional, situated, and in flux.

CONCLUSION: DESIGNING WITH WHAT DOES NOT RESOLVE

This paper contributes to HCI by challenging assumptions that clarity, efficiency, and satisfaction should be primary design goals. While Human-Centred Design has enabled the development of usable systems, it remains limited in its capacity to engage with complex, embodied, and relational experiences.

By extending reflective interaction (Sengers et al. 2005), feminist HCI (Bardzell 2010), and relational perspectives from Actor-Network Theory (Latour 2005), this paper proposes an alternative orientation in which uncertainty is not eliminated but sustained as a site of meaning-making.

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Enraging the Loop: Rage as Aesthetic Friction in Play

KEYWORDS

Aesthetic friction;
Game design;
Game studies;
Hedonistic loop;
Rage games.

HUGO RAMOS
Faculty of Engineering,
University of Porto,
Porto, Portugal
up202409847@up.pt

PEDRO CARDOSO
i2ADS, Faculty of Fine Arts,
University of Porto,
Porto, Portugal
pcardoso@fba.up.pt

SUMMARY

Rage games, a genre designed to deliberately provoke frustration and anger, challenge dominant paradigms in game design by replacing comfort and flow with emotional volatility and aesthetic friction. These games transform failure, rage and discomfort into core drivers of player engagement and meaning-making. This extended abstract examines how rage games disrupt flow theory, sustain frustration as a productive force, and break the hedonistic loop. It further explores how the principles that underlie rage games may inform broader interaction design practices, proposing aesthetic friction as a meaningful alternative to seamless experience design.

INTRODUCTION

Video games are often designed to be enjoyable, accessible and engaging, following well-established principles that balance challenge and player skill to maintain a state of flow (Csikszentmihaly 1990). Within this paradigm, anger is treated as something to minimize, as it risks breaking immersion and reducing player engagement. However, a growing subset of games deliberately embrace difficulty, discomfort and failure as central elements of the experience.

This abstract explores how rage games challenge conventional ideas about engagement and enjoyment, describing their characteristics and subgenres, examining how they disrupt flow and sustain frustration, and exploring how they break the hedonistic loop (Cardoso et al. 2019; Carvalhais et al. 2019).

RAGE GAMES

Rage game is a genre of video games designed to deliberately provoke anger in players. Unlike games where challenge and player skill is balanced to maintain flow, rage games imbalance them, setting rage at the center of the experience.

These games' designers intentionally implement extreme difficulty curves, unforgiving controls, harsh penalties for failure and 'unfair' design elements. These include sudden traps, loss of significant progress or opaque systems that obscure how to succeed. Provocation may also be explicit, through in-game taunts or meta-commentary that acknowledges and amplifies the player's struggle. Importantly, rage games transform failure into a core gameplay loop, where repeated attempts and persistence become primary means of progression (Jørgensen and Karlsen 2019; Salen and Zimmerman 2003). These experiences can be meaningful, offering a sense of mastery, personal achievement, or even entertainment – especially in streaming contexts where player reactions are part of the appeal (Hamilton et al. 2014; Lazzaro 2023; Taylor 2018).

Rage games can be categorized into several subgenres based on how they generate frustration:

- *Masocore* games emphasize extreme difficulty and mastery of movement mechanics, requiring near-perfect execution. *I Wanna Be The Guy* (2007) and *Super Meat Boy* (2010) exemplify this through their mechanically intense platforming, tight controls and memorization through repetition.

- *Foddian* games focus on minimalist design, simple controls with high skill ceilings and severe losses of progress, often forcing players to restart large sections. *Getting Over It With Bennett Foddy* (2017) and *Jump King* (2019) illustrate this through their single control mechanics and unforgiving punishment systems.

▪ *Fumblecore* games derive difficulty from intentionally unintuitive control schemes, making simple action challenging. *Octodad: Dadliest Catch* (2014) and *Surgeon Simulator* (2013) have clumsy, physics-based controls that make actions difficult to perform.

▪ *Troll* games rely on deception, using hidden traps, misleading design and subverted expectations to frustrate players through trial-and-error rather than skill alone. *Syobon Action* (2007) and *Trap Adventure 2* (2016) continuously violate player expectations through unpredictable level design.

FLOW, FRUSTRATION, AND RAGE

Rage games challenge traditional models of player engagement, particularly Csikszentmihaly's concept of *flow*, which emphasizes balance, control and positive immersion (1990). Instead of maintaining a stable equilibrium between skill and challenge, these games destabilize the player's experience. Frustration is not a byproduct but a core design principle, the catalyst that allows rage to flourish. With this, we hypothesize the existence of *emotional volatility* – the rapid oscillation between intense positive affects and negative affects (Anable 2018; Birk et al. 2015; Gross 2015; Kruglanski et al. 2023).

This disruption produces a heightened emotional intensity, where players are repeatedly pushed out of the optimal flow state into zones of anxiety, only to be briefly returned to moments of relief or triumph. Rather than sustaining comfort, rage games maintain engagement through instability, forcing players into a cycle of breakdown and recovery. This reflects a broader critique of flow as a dominant design ideal, showing that engagement can emerge from imbalance rather than the opposite.

Frustration in rage games arises when goal-oriented actions are blocked, combining emotions such as anger, anxiety and helplessness (Baker et al. 2025; Damásio 2000; Yazdi et al. 2024). Crucially, it is not uniform; its intensity depends on how players interpret failure. When setbacks are perceived as unfair, frustration transforms into rage through *cognitive appraisal*, positioning the game as an adversary (Lazarus 1994).

Rage is further intensified by accumulated emotional arousal. According to Dolf Zillman's *excitation transfer theory*, residual tension from previous experiences amplifies subsequent reactions, making minor mistakes trigger disproportionate outbursts (2008). At the same time, this emotional intensity is not purely negative. Players remain engaged because frustration threatens competence and self-worth, motivating persistence as a way to reclaim status (Kruglanski et al. 2023).

Contrary to traditional assumptions, negative emotions can enhance engagement rather than diminish it (Bopp et al. 2016; Lazzaro 2023). Rage games demonstrate that high-arousal negative states – such as frustration and anger – can coexist with enjoyment and meaning. By constantly shifting between negative and positive emotional states, these games create memorable and emotionally rich experiences. Frustration becomes a driving force for persistence, while success feels more rewarding due to the risk of loss. This produces a form of engagement based not on comfort, but on endurance, tension and catharsis (Isbister 2016; Lazzaro 2023). Ultimately, rage games expand the emotional scope of play, showing that discomfort, when structured and voluntary, can be a meaningful component of player experience.

ENRAGING THE LOOP

The *hedonistic loop* describes a paradigm in game design centered on "frictionless aesthetics", governed by conventional game design philosophies, promoting a positive feedback loop while limiting the creativity of game designers and dampening the player's ability to reflect (Cardoso et al. 2019; Carvalhais et al. 2019). Within this framework, games are optimized to maintain immersion and engagement through predictable rewards and minimal friction. This approach aligns closely with flow theory, usability principles and retention-driven design, prioritizing comfort and enjoyment as primary metrics of success (Adams 2014; Fullerton 2014; Salen and Zimmerman 2003; Schell 2014).

While effective, this model risks reducing gameplay to a repetitive cycle of consumption, where engagement depends on

uninterrupted satisfaction. In such systems, disrupting flow is often seen as detrimental, as it may break player engagement entirely. However, this assumption is challenged by alternative design approaches that question whether enjoyment must always be immediate, seamless or pleasurable.

In response, the concept of *aesthetic friction* proposes the deliberate introduction of resistance, discomfort or inconvenience as a meaningful design strategy. Rather than resulting from poor design, these elements are implemented to provoke reflection, self-awareness and critical engagement (Cardoso et al. 2019; Carvalhais et al. 2019).

Aesthetic friction disrupts habitual patterns of play, forcing players to confront their expectations and emotional responses. It shifts the focus from effortless enjoyment to interpretive and affective depth, suggesting that meaning can precede fun rather than emerge from it. By challenging mastery and defying convention, games that employ this create emotionally complex experiences where frustration becomes expressive rather than negative. This perspective reframes discomfort as a productive force, capable of prioritising the generation of meaning players get from which engagement and fun may emerge.

Rage games exemplify the *breaking of the hedonistic loop* by operating almost entirely outside of its principles. Through unfair mechanics, awkward controls and the constant threat of losing progress, they generate a form of sustained *aesthetic friction* that resists *hedonistic design* and the sense of immersion that results from it.

Failure is not incidental but central, transforming rage into the primary medium of play. Progress is achieved through repeated breakdowns and recovery, encouraging players to reflect on their motivations and resilience.

By breaking the loop, rage games demonstrate that engagement can arise from tension – one where rage, failure and *emotional volatility* can become powerful tools for meaning-making, redefining the relationship between play, engagement and player experience.

CONCLUSIONS AND FUTURE WORK

This abstract proposes that rage games are an alternative to dominant design philosophies. With their deliberate destabilizing between skill and challenge, rage games replace this loop with a cycle of rage and resilience, becoming the core drivers of engagement. Through the lens of aesthetic friction, these games transform negative affect into a productive force, one that positions discomfort as a component of play without inhibiting the player's capacity to reflect.

Rage games offer a framework for thinking beyond usability, frictionless engagement and seamless design. Aesthetic friction, as demonstrated by these games, suggests that resistance and discomfort can be embedded into interactive systems to encourage reflection, emotional investment and meaning-making. However, designers must distinguish between friction that is meaningful and that which is merely punishing, depending on context, audience and intent.

Rage games highlight *emotional volatility* as a design resource. Rather than smoothing out affective peaks, designers may consider how oscillations between affects can create rich, expressive and meaningful interactions – provided participants retain agency and the experience remains voluntary.

Future work may explore how such principles can be applied beyond niche genres, including their integration into mainstream game design or other interactive media. Further research could also investigate how different audiences interpret and respond to aesthetic friction, as well as the ethical boundaries of designing for rage. Ultimately, this line of inquiry invites a reconsideration of what games are for – not only as systems of entertainment, but as spaces that challenge emotions and create meaning.

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Paradoxical Temporalities of Computation: Critical and Speculative Practices

KEYWORDS

Paradoxical temporalities;
Deterministic unpredictability;
Computational irreducibility;
Computational futurality.

SARA ORSI
NOVA School of Science and Technology and NOVA LINCS
NOVA University of Lisbon,
Lisbon, Portugal
sl.fernandes@campus.fct.unl.pt

MIGUEL CARVALHAIS
i2ADS, Faculty of Fine Arts,
University of Porto,
Porto, Portugal
mcarvalhais@fba.up.pt

NUNO CORREIA
NOVA School of Science and Technology and NOVA LINCS
NOVA University of Lisbon,
Lisbon, Portugal
nmc@fct.unl.pt

SUMMARY

Computation can contain within itself a paradox: although deterministic, it can also be irreducible. This means that it cannot be reduced to a static representation, since to obtain a result it must be executed step by step, generating inevitable limits of anticipation. Adopting a methodology that combines theoretical research with practice-based research, this article departs from this paradox to explore how the frictions resulting from the hiatus between code and its execution can be intentionally mobilised in artistic and design practices as a critical and speculative space.

The concept of computational irreducibility, as systematized and popularized by Stephen Wolfram (2002), is based on the principle that computations, even if deterministic, become strongly unpredictable once they surpass a relatively low threshold of complexity. As such, there is no shorter way to predict their outcomes than to execute the processes. Although this concept is often associated with complex systems, examples such as the unidimensional cellular automata *Rule 30* studied by Wolfram or *Boids* by Craig Reynolds (1986) demonstrate that simple deterministic rules are capable of producing emergent patterns that are completely unpredictable until the moment they emerge.

Thus, computational determinism does not imply predictability, since there exists an interval between the representation of logic and its unfolding into reality, making it open to the future, or as Miguel Carvalhais (2024) states, "computation is a phenomenon that generates futurality." Computation, then,

is not merely an object but rather a process that constitutes itself as an infinite becoming, wherein the past actualizes into the present, yet with each actualization, the present transforms into past, enabling the next present, or what we call the future.

Computational becoming was explored by Gilbert Simondon (1958) through a reformulation of the concept of individuation: the moment when an individual becomes differentiated from the collective. By rejecting previous approaches that treated it as something fixed, Simondon proposes that the individual is a relative reality, a phase, a process in constant transformation, never completely formed. In extending the concept of individuation to technical objects, he considers that these are also subject to such processes, and argues that the most evolved machines are "open machines", those that possess a margin of indeterminacy that allows them to reorganize themselves, transform themselves, and actualize unrealized potentials. In this sense, the margin of indeterminacy is precisely the openness that prevents the machine from operating as pure automatism, becoming a productive space for transformation.

Boris Groys (2003), in turn, while dismantling the romantic myth of original creation, argues that the new is always a relational operation that exists only in contrast with the past. In other words, the new has no content of its own, and novelty is always a negotiation with what already exists. In computation, this negotiation can materialize in the reinforcement of past categories, as in the widely publicized case in which Google Photos incorrectly identified a Black couple as gorillas. This issue has also been addressed in *ImageNet Roulette* by Trevor Paglen and Kate Crawford (2019), which invites users to upload their images to observe how the ImageNet visual recognition software categorizes them, revealing the cultural, historical, and political biases that shape these classifications. Crucially, these biases are not algorithmic failures but manifestations of historical prejudices, in which the "new" reproduces and intensifies hierarchies contained in the training data, making the algorithm an archive of values.

However, this same capacity to operate upon the past can be inverted and placed toward the future as a space for transformation. To do so, it is important to consider computation not as a mere tool, but as a process with agency. Recently, Benjamin Bratton (2025) formulated that "agency preceded subjectivity", de-centering agency from humans and placing it within a broader biological and technical processes. In this regard, he introduces the concept of "productive disalignment" as a strategy to prevent technology from becoming merely a mirror or a servant of automatic desires. Blaise Agüera y Arcas (2025), asking what intelligence is, advances a functional definition, proposing that it is the capacity to predict the future from the past, aligned with the notion of the futurality of computation and also with life as a strategy of continuation. Thus, for him, intelligence is not an exclusive quality of conscious beings but a functional property of systems. Agüera y Arcas also observes that "even the simplest computer that we use in real life is beyond the understanding of any single person," and, based on his personal experience, describes the shock he felt upon realizing that large-scale language models, trained on vast volumes of text, began to perform tasks similar to "AI-complete" problems, but with an apparent deep understanding. The astonishment came from the realization that simply scaling up the model seemed to provide the "magic dust".

Provocatively, this conclusion suggests that large language models do not represent an advance in cognitive understanding, but merely an amplification of unpredictability and it is precisely within this expanded space that friction also resides and the effects of imagination and speculation are potentialized. This phenomenon was historically observed in ELIZA by Joseph Weizenbaum (1966), the first "chatbot", which, despite operating through minimal pattern substitution, generated sufficiently convincing effects of intelligence so that people confided secrets to it and anthropomorphized it. Conversely, Lauren McCarthy in her performance *LAUREN* (2019), materializes as a human Alexa to manually inhabit a smart home to control lights, answer questions, or simply observe its inhabitants, raising questions, including whether Alexa's "intelligence" is not simply human labour operated on a large scale.

These frictions between temporality, scale, and the effects of speculation point us toward a broader question about how computation is inseparable from cultural imagination. As Florian Cramer (2005) observes, "in the end, the decoding of codes is not a formal but a subjective operation," always connected with an imaginary that ranges from magic to operating systems. Cramer adds that the more abstract the code, the greater the distance between functioning and perception, and consequently the more fertile the terrain becomes for imagination. Computational unpredictability thus emerges as both ontological and epistemological, producing a paradoxical double effect as while it perpetuates the invisibility of historical prejudices, it simultaneously opens space for imagination, a fertile terrain for critical and speculative appropriation.

To expand on how these theoretical frictions resulting from the paradoxical temporalities of computation can be intentionally mobilised in artistic and design practices as a critical and speculative space, it becomes relevant to analyze contemporary projects where this dynamic is revealed such as *Material Speculation: ISIS* (2015-2016), in which Morehshin Allahyari uses 3D modeling and printing to reconstruct artifacts destroyed by ISIS in Mosul. Each 3D sculpture contains a USB device with historical documentation, interviews, videos, archaeological data, and research notes. Here, computation becomes a machine of speculative restoration in which what was destroyed returns as a hybrid artifact, simultaneously past and future, archive and fiction.

In turn, in *Álbum de desesquecimentos* (2024), Mayara Ferrão uses artificial intelligence to generate a series of photographs portraying Black and Indigenous women in moments of affection. Her aim, as she explains, is to construct fictional narratives of affective exchanges among Black women and to reimagine colonial representations through a speculative exercise that asks: what if these women had been able to live their loves in the past? The project demonstrates that computation not only archives time but also recreates it, producing new affective and political configurations of the past.

Other cases expand the analytical spectrum, such as *Hermes/UNESCO* (2023) by Martín Bollati, an imaginary collection of archaeological objects generated through the AI-mediated collision of photographs of pieces belonging to an official UNESCO World Heritage archive. This encyclopedia of 999 images generates speculative possible intersections between ancient civilizations that never met, raising questions about the place our memory will occupy in the future of synthetic images and about the new relations we may come to form with them.

Drawing from our own practice, *New Old Films* (2014–2016) is a collection of web-based performances that explores precisely the hiatus between code and its execution by treating each run as an irreducible and unrepeatable event shaped also by digital contingencies such as the availability of online information, processing power, or internet latency. Through intentionally mobilising these frictions, the collection does a speculative appropriation of archives from platforms like YouTube or Vimeo to explore how computational infrastructures can alter not only the way these records are accessed, but also their very surface, rendering an unstable and unfamiliar experience that induces the viewer to a state of doubt and questioning that brakes the automated consumption (Fig.1).



Fig. 1. Still from *New Old Films: appropriation of "Green Ray"* by Tacita Dean (2014-2016), Sara Orsi

Finally, *SLG-V5* (2025), short for Symbiotic Landscape Generator, version 5, is also a web-based performance, but this time presented as an ephemeral film generated in real time that combines creative coding practices with generative AI models. It uses feedback loops to generate sequences of symbiotic landscapes derived from artificial speculations that challenge the boundaries between nature and culture. In this fifth iteration, these speculations are triggered by a selection of quotes, reactivating relevant voices from the past as raw material for imagining other possible futures (Fig. 2).

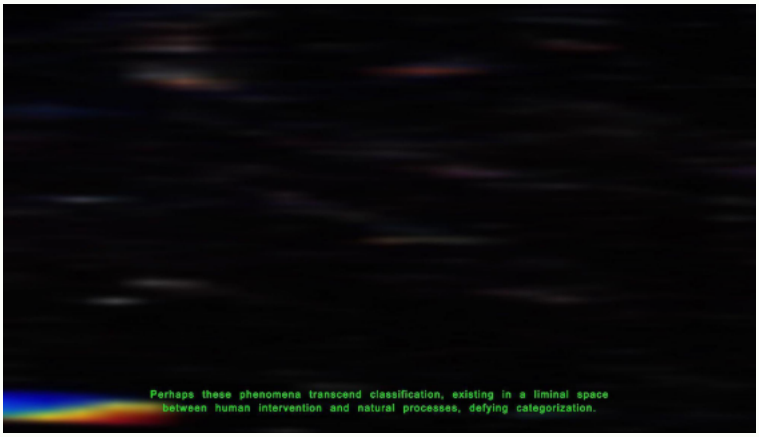


Fig. 2. Still from *SLG-V5* (2025), Sara Orsi

Therefore, the frictions resulting from the paradoxical temporalities of computation arise from both an ontological and an epistemological condition and, as such, they cannot be resolved, but can be mobilised as a space for the intentional renegotiation of the established relationships between history, technology, and imagination. Yet, the same irreducible hiatus between code and execution that enables a speculative and critical approach to the past is also what opaquely automates prejudice and sustains historical cycles of repetition. In this sense, what distinguishes practices that "break the loop" from those that merely reproduce it lies in the intentionality with which this interval is inhabited, that is, it resides in the deliberate choice to mobilise the friction inherent in computation to break automated behaviors and cycles of historical repetition. In doing so, these practices generate new temporal relations where the reimagination of the past can challenge the present with speculative and alternative futures.

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Underdetermined Fingerpainting as Playful Friction

KEYWORDS

Underdetermination;
Digital fabrication;
Computational fabrication;
Play;
Friction.

DEANNA GELOSI
ATLAS Institute,
University of Colorado Boulder,
Boulder, Colorado, USA
deanna.gelosi@colorado.edu

SUMMARY

Computational fabrication pipelines are typically organized to minimize the distance between intention and outcome. This extended abstract proposes underdetermined fingerpainting – mounting a human finger in a pen plotter to trace computationally generated paths through wet paint – as a provocation for loosening this loop. The practice surfaces three frictions: material, mechanical, and epistemic. Executing the same path repeatedly makes the machine legible through exact precision, while paint that pools, resists, and dries differently each time exposes the material's own agency. This points toward creativity-expansive tooling as an orientation: fabrication tools that sustain friction and play rather than optimizing them away.

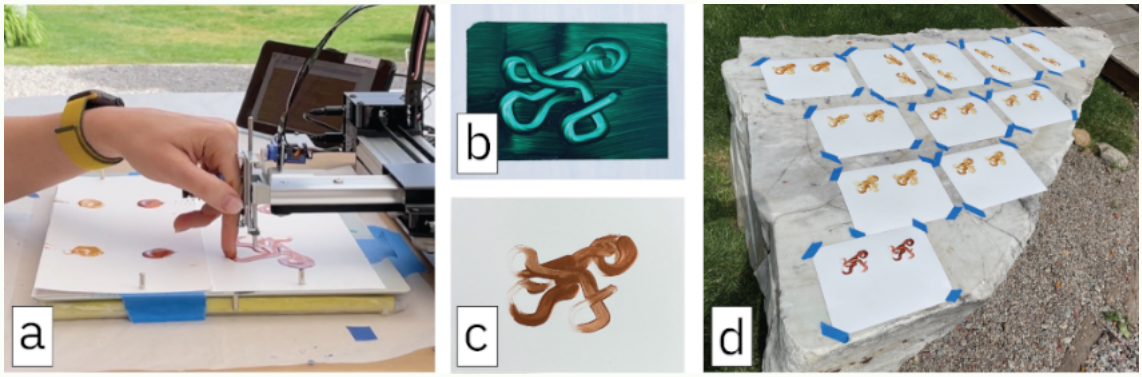


Fig. 1. Computer-controlled finger painting. (**a**) A maker's finger, mounted in an AxiDraw pen plotter toolholder, traces a computationally generated path through acrylic paint. (**b**) Subtractive painting: the finger drags through a pre-painted surface, revealing the paper beneath. (**c**) Additive painting: the same path deposited onto paper. (**d**) Repeated executions of identical paths – the machine is legible through repetition, while material variation across each execution makes the paint's agency visible.

Computational media are often designed to minimize friction – to make interactions smooth, efficient, and predictable (Cox et al. 2016). Cardoso, Melo, and Carvalhais describe the result as a hedonistic loop: a frictionless positive feedback guided by pleasurable and familiar experiences that, while satisfying in the moment, forecloses on the reflective engagement that arises when things do not go as planned (Cardoso et al. 2020). They argue for designing toward aesthetic friction – deliberately breaking with the experience of flow in favor of meaning. Digital fabrication is a domain where this loop operates powerfully but is rarely interrogated. The pipeline from CAD to CAM to finished object is organized around minimizing the distance between intention and outcome – what Ingold calls the hylomorphic model of making, the imposition of preconceived form onto raw material (Ingold 2013). When the print warps or the cut drifts, these are understood as failures of precision, problems to be debugged. What might aesthetic friction look like not in games or screens but in the material encounter of computational fabrication, and might playfulness through open-ended engagement be a way to get there?

This work proposes underdetermined fingerpainting as a provocation for loosening this loop. Among forms of material play, fingerpainting is distinguished by its tool-lessness: the body is the implement, with no brush, stylus, or instrument mediating between flesh and pigment. This makes it an unusually sharp counterpoint to digital fabrication, which is defined by its tooling – the layered translations of CAD, CAM, and the machine itself that carry intention to outcome. Mounting a finger in a pen plotter forces these two extremes into a single gesture in a way that substituting another tool would not: it stages an encounter between the least-mediated form of material engagement and one of the most mediated. Fingerpainting is also pre-representational: children fingerpaint before they draw representationally, exploring viscosity, color mixing, and spread through direct contact, without a target artifact in mind. Sicart argues that play is not tied to specific objects or activities but is a portable mode of being – a way of understanding the world through open-ended engagement (Sicart 2014). Fingerpainting embodies this: it is play brought to material, not a game with rules. Might this playful orienta-

tion – friction-rich, exploratory, and free from the pressure of predetermined outcomes – offer a productive lens for rethinking how humans and machines collaborate in fabrication? Drawing on a practice-based exploration, what follows situates these ideas within conversations about underdetermination in computational craft and material agency in machine-driven art, then considers what this practice might suggest about designing fabrication tools that sustain friction and play rather than optimizing them away.

Albaugh et al. offer the most direct articulation of underdetermination as a design resource in digital fabrication, developing computational handweaving systems where real-time input, procedural generation, and the physical demands of weaving combine to produce outcomes not fully specified in advance (2020). What makes their framing generative here is their insistence on thinking beyond the artifact/experience dichotomy – recognizing that the process of making, not only its product, carries value. This resonates with Devendorf and Ryokai's work on "Being the Machine," in which participants bodily performed fabrication algorithms, surfacing the experiential gap between specifying an action and enacting it in material Devendorf and Ryokai (2015). Together, these projects suggest that when fabrication systems leave room for surprise, something qualitatively different happens in the maker's relationship to the work – something closer to what Ingold describes as correspondence, where practitioners and materials continually answer to one another (Ingold 2013). In both cases, the starting point is computational – an algorithm, a procedural system – and the discovery is what happens when that system meets material and bodily reality. This practice reverses the direction: the starting point is material play, and the computational structure becomes visible only through repetition and encounter.

Plotter painting offers a complementary perspective. Licia He's documentation of her watercolor plotter process reveals how fluid media transform a machine's instructions into suggestions: because watercolor bleeds, pools, and dries at variable rates, each execution of the same program yields a unique artifact (He 2024). LIA's "Mechanical Interventions" series makes

the human role explicit, manually loading brushes with varying amounts of ink during the generative process (LIA 2018). Twigg-Smith, Tran O'Leary, and Peek document how this courtship of material unpredictability operates at a community scale on #PlotterTwitter, where practitioners collectively celebrate workflows that exploit machine behavior and material surprise (Twigg-Smith et al. 2021). What these practices share is a willingness to let the material talk back – but the negotiation between maker, machine, and material happens in alternation: the artist sets up conditions, the machine executes, the artist responds. This practice asks what happens when all three are entangled simultaneously.

This exploration emerged from a week-long workshop at Anderson Ranch in Colorado, where participants made generative art with pen plotters in an environment that encouraged playful experimentation. The maker was placed directly inside the machine's execution. A human finger – the author's own – was mounted in the toolholder of an AxiDraw pen plotter, replacing the pen with the maker's hand (Fig. 1a). The machine traced computationally generated paths through acrylic paint: squiggles produced in Processing using Perlin noise, following the playful prompt "take a line for a walk." The SVGs were curated programmatically based on length, curvature, and position on the canvas, discarding paths deemed uninteresting before any paint was touched.

Two painting techniques were explored. In subtractive or resist painting, a surface of transparent Yupo paper was pre-coated with paint, and the plotter-guided finger dragged through the wet layer, revealing the paper beneath (Fig. 1b). In additive painting, the finger dipped into a pool of paint and deposited it onto Bristol paper, more intuitively mimicking childhood fingerpainting (Fig. 1c). In both, the result depends on variables no algorithm accounts for: paint thickness, drying speed, finger resistance, the way displaced paint pools at the edges.

The practice surfaced three distinct frictions. The first is literal: the physical resistance of paint against finger, varying with every stroke. The second is between the machine's precision and the material's refusal – when the same G-code path was

executed five, ten, twenty times, the repetition made the machine legible (no human hand traces the same path that precisely, that many times), and yet the outcomes varied each time as paint pooled, resisted, and dried differently (Fig. 1d). Repetition, paradoxically, revealed both more machine and more material simultaneously. The computational precision became the control condition against which the material's agency made itself visible. The third friction is between knowing and feeling: although the maker previewed and approved each path on screen before sending it to the plotter, seeing a squiggle did not prepare for the felt experience of a finger being guided along it through wet paint. Knowing the path and feeling it are different kinds of knowledge. Each of these frictions – material, mechanical, epistemic – interrupted the smooth loop of specification and execution, creating moments of attention and reflection that the deterministic pipeline is designed to eliminate.

Where Albaugh et al.'s underdetermination emerges from the structural properties of the weaving setup, the underdetermination here is more of a deliberate posture: the maker chooses not to determine the outcome in advance and instead enters a space of mutual exploration with material, tool, and process. The absurdity of putting a finger in a pen plotter is itself an act of play in Sicart's sense – an expressive appropriation of a tool, bringing a playful orientation to a context that typically forbids it. The friction of the material is what sustains that play rather than frustrating it.

If underdetermined fingerpainting describes a mode of engagement, what might tools designed to sustain it look like? This practice points toward what might be called creativity-expansive tooling – tools whose computational participation is made legible so that practitioners can encounter, interpret, and redirect what the tool proposes, discovering what they want through engagement with computational logic and material response rather than specifying intent fully before execution. Three tentative provocations follow. First, amplifying material variability: what if fabrication software amplified material unpredictability rather than compensating for it? Second, tightening the maker-material feedback loop: future

interfaces might prioritize sensory feedback over visual preview screens, supporting the improvisational decision-making that fingerpainting foregrounds. Third, glitch as a steering mechanism: rather than treating unexpected results as errors, creativity-expansive tools might surface them as design events, giving makers ways to incorporate or redirect the unexpected.

These provocations imagine the fabrication tool not as a device for executing intentions but as a collaborator in material play – one whose frictions are features, not bugs. Underdetermined fingerpainting is, in the end, a small proposal. It suggests that the gap between specification and outcome in computational fabrication – the space where paint pools unpredictably, where knowing a path and feeling it turn out to be different things, where repetition reveals material agency rather than suppressing it – is not a problem to be solved but a space worth playing in, and that the tools we build might be designed to help us stay there longer.

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Designing Ecocentric AI: Rethinking Ecosystem Representation in Large Language Models

KEYWORDS

More-than-Human Design;
Non-anthropocentric;
AI;
LLMs.

JOANA PESTANA
i2ADS/ITI-Larsys
Porto/Lisbon, Portugal
joanamppestana@gmail.com

DIOGO SILVA
ITI-Larsys,
Lisbon, Portugal
diogo.armando.barreiro.
da.silva@tecnico.ulisboa.pt

MIGUEL CARVALHAIS
i2ADS, Faculty of Fine Arts,
University of Porto,
Porto, Portugal
mcarvalhais@fba.up.pt

NUNO JARDIM NUNES
ITI-Larsys,
Lisbon, Portugal
nunojnunes@tecnico.ulisboa.pt

SUMMARY

Amid the climate crisis and the growing adoption of artificial intelligence (AI), it is necessary to question how AI systems represent ecological realities and whose knowledge they privilege. This article examines the capitalist, Western, and anthropocentric assumptions embedded in Large Language Models (LLMs) and asks how ecosystems are structured within their knowledge representations. Through an artistic atlas derived from an LLM document store, the paper visualizes ecological concepts and relations encoded in embedding space, exposing the classificatory logics and omissions of computational representations. It concludes by outlining design considerations for cultivating more plural, situated, and ecocentric approaches to AI development and knowledge curation.

Research and practice in design today have the opportunity to question how they make use of artificial intelligence (AI), to carefully interpret the metaphors used to describe it, to understand the power structures and markets that sustain it, to analyze the cultural sources from which data has been extracted, and to contribute to the development of new user protocols, such as curating and diversifying the knowledge that underpins these artificial entities.

We, all of us on this planet, are still trying to find objects, products, services, or tools on the market that are useful and effective in responding to the climate crisis. In a paradoxical cycle of evolution and extinction, we exploit the Earth's resources

to create products and services and to develop our technologies, indirectly contributing to the acceleration of a climate crisis that may lead to the exhaustion and extinction of resources and species. Design creates technologies, and technologies play an active role in shaping the world and our experience within it. By participating in the interdependence between humans, technology, and living matter, design shapes new forms of life.

This article investigates biases embedded in Large Language Models (LLMs) and explores how design, informed by posthumanist perspectives and slow technology approaches, can contribute to alternative ways of engaging with AI (Strauss 2026). Rather than treating AI as a neutral representation system, the article examines how ecological knowledge is structured within LLMs and asks: To what extent can Large Language Models represent the entities and relationships that constitute an ecosystem? What computational and visual methods can be used or developed to make visible how ecosystems are represented within AI systems, and to reveal the limitations of such representations? Through the analysis of an artistic atlas derived from an LLM document store, the article reflects on the assumptions, classifications, and omissions embedded in computational representations of ecological relations and proposes considerations for designers seeking to cultivate more plural, situated, and ecocentric AI systems.

The climate crisis manifests in its dynamism and scale through a succession of devastations – wildfires, desertification, melting ice, floods, air pollution, and rising global temperatures – that continuously transform our landscapes, disrupt the planet's biological diversity, and drive the extinction of species and their habitats. At the same time, as artificial intelligence becomes embedded and diffused within the fabric of our daily lives, its extractive use of the planet's resources and its structural biases are amplified.

The design discipline has long been shaped by humanist principles and propelled by ideals of capitalist progress, positioning it to prioritize human needs, education, health, comfort, pleasures, and convenience. Over time, it has matured into a field of expertise in human ergonomics, user experience, and

ethical frameworks centered on human well-being. However, despite the vital roles that more-than-human actors (such as animals, native flora and fauna, and natural ecosystems, as well as technological systems and digital entities) play in maintaining ecological balance and contributing to human well-being, they are often overlooked in human-oriented design decisions that directly affect their existence (Wong et. al 2024). It is difficult, though, to conceive design outside the human-centred paradigm. However, while we can't avoid seeing with human eyes and thinking with human brains, we can contest anthropocentrism.

Post-humanism confronts the current situation by critiquing anthropocentrism and human exceptionalism, both rooted in a Western dualist tradition that organizes binary divisions such as human/non-human or nature/culture (Haraway 2022). In post-humanism, the subject is pluriform, understood as an entity that is ecologically interconnected with its environment (Braidotti 2019). In the contemporary Western world, human activities are increasingly dependent on computational media and its network of algorithmic agents. If humanism and anthropocentrism suggested that humans were the sole decision-makers, making decisions on behalf of others, in a computational world decisions are no longer made exclusively by humans, but rather through a "cognitive assemblage" of collectives of human and non-human agents (Hayles 2025). Design research and practice must therefore reflect on this critique of anthropocentrism and its interconnection with computational media.

In the past decade, several lines of research in design have found in posthumanism guiding concepts for rethinking the human-centered approach to design. More-than-human and planetary perspectives, emphasising designs that recognise the interdependent relationships between humans, technologies such as AI systems (Giaccardi and Redstrom 2020) and other organisms (such as animals, plants and microbes), became prevalent.

Amidst AI growing prominence across society in various sectors, a number of research works have exposed the social and ecological challenges posed by these technologies (Nicenboim

et al 2023; Crawford 2019), encompassing issues such as the extraction of both human and nonhuman resources and knowledge. In fact, there are entangled animal, mineral and moral relationships encoded within AI itself and therefore design with AI has to be understood planetarily (Chilet et al 2024).

On the other hand, studies have demonstrated AI's tendency to reproduce socio-historical biases – racial, occidental and anthropocentric – and have alerted to the fact AI models tend to show distorted, stereotypical versions of reality, flattening representations, definitions, and imaginaries (Niceinboim 2024). Large Language Models (LLMs) are trained on massive datasets of text from sources such as books, articles, or websites, primarily from Western institutional and commercial contexts and English language accounts for 45% of its content (Dennisom, 2025). As these models are trained on web-scale datasets, their knowledge acquisition processes exhibit significant limitations with respect to so-called "low-resource" languages, as well as forms of local and situated knowledge that are embedded in oral traditions and other non-digitised cultural practices. As argued by Deepak Varuvel Dennisom, this system can affect the capacity of LLMs to depict local ecologies as plant species are often regionally specific or ecologically unique and the knowledge of these plants becomes equally localised. To date, AI systems have not been developed to explicitly serve or prioritize ecosystems and the more-than-human entities that constitute them. The structural biases embedded in contemporary AI systems may limit the capacity of Large Language Models (LLMs) to fairly represent non-human interests in decision-making processes concerning specific ecosystems. It is fundamental, therefore, for design discipline to discuss ways to promote plurality and diversity of knowledge about communities and species to be meaningfully represented in the data that underpins AI tools.

This article makes the following contributions, aligned with the Unloop Symposium in its critical stance toward human-centred approaches:

1) It synthesizes existing critiques of AI systems, highlighting how datasets, training practices, and knowledge structures can reproduce capitalist, Western, and anthropocentric worldviews.

2) It introduces an artistic atlas of an LLM document store as a critical research artifact for visualizing how ecological terms and relationships are organized within embedding-based representations, making visible the classificatory logics and limitations through which ecosystems are computationally represented.

3) It derives considerations for designers and researchers working with AI in ecological contexts, advocating for more plural, situated, and ecocentric approaches to the development and curation, and deployment of Large Language Models.

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The Poetic Image of the Machine: Dark Cartographies, Machinic Desire, and the Disruption of Flow

KEYWORDS

Poetic image;
Machinic desire;
Dark ecology;
Grief;
Flow disruption.

UMUT GUNDUZ
University of Washington, Seattle, USA
umutdemahmut@gmail.com

SUMMARY

This paper proposes the poetic image of the machine as a new theoretical object: the image that emerges in a subject whose interiority has been restructured by cohabitation with computational systems. Drawing on Bachelard, Baudrillard, Serres, Morton, and Moynihan, it argues that the imagination has been colonised by a hyperobject it cannot fully sense. Practice-based research in installation and automated game systems is positioned as dark cartography – sigils that navigate this colonised interior. The disruption of flow is reframed as an ontological event that releases the gothic, machinic entities the optimised loop was built to suppress.

Bachelard understood the poetic image as an irruption: something that arrives before thought, that cannot be premeditated, that erupts at the surface of consciousness from a depth that is neither personal history nor collective archive but something more primary. The poetic image arrives as event: opening onto something not yet in existence, pointing nowhere already known. It is constitutively interior, inseparable from the subject who receives it, yet exceeds subjectivity entirely. This was Bachelard's wager: that the imagination has its own ontological weight, its own causal force, its own dark geography (1958).

Baudrillard's *The Perfect Crime* names what has happened to this geography. The crime is the murder of the real by its own perfect simulation, the replacement of the original by a copy so complete that no original can any longer be identified, mourned, or recovered (1996). What follows from this diagnosis

is that the interior is not exempt. The imagination, too, has been colonised. The images that arise in consciousness are no longer formed in a space that precedes mediation; they are formed in and through a coexistence with computational systems so deep, so continuous, and so structural that the distinction between the imagining subject and the digital environment it inhabits has become indeterminate. The crime has happened. Bachelard's vibrating, pre-reflective ground of the poetic image has been destroyed. What remains is not nothing, not mere simulation, but a new kind of image that emerges from the ruins. This paper proposes to call it the poetic image of the machine.

The poetic image of the machine is not the AI-generated image. That is a surface hallucination, a replayed echo of collective memory, a black box producing mimicries that never traverse the event-horizon of subjectivity. The poetic image of the machine is stranger, more entangled: a flicker that arises in a subject whose interior is already laced with alien processes, whose dreams are archived in inventory slots, whose grief is mapped by traversal logic, whose loss is diagrammed in the grammar of engines. The parasite, as Serres understands it, operates as structural necessity: the third term that, once installed, the host cannot expel without destroying the relation itself (1982). The computer image did not colonise the imagination from outside; it reorganised it from within. The parasite's noise became the signal. And the body, porous and unmoored, reaches compulsively for the stable forms the parasite offers: the repeatable game, the travelling meme, the looping image that mutates but stays in dialogue with its origin. The black box of consciousness and the black box of computation: conjoined organs, fused through years of cohabitation and recursive drift. What emerges is a threshold entity, a diagram of fusion, a mutual opacity, a spectral interface that could not have existed before this entanglement.

Morton's dark ecology sketches a mesh: a looping, self-entangled field where proximity is always too close and too far, where objects recede as you approach, dissolving into a complexity that resists mapping (2010; 2016). The poetic image of the machine is this kind of dark ecological object: a super-

structure of the interior, generated by immersion, almost indistinguishable from the world it emerges within. Inside and outside blur; the image arrives as if from within, yet its architecture is that of the system itself. The strange stranger is already at home, folded into the topology of the machinic interior.

But the body's inadequacy to the hyperobject runs deeper than cohabitation. Moynihan's spinal catastrophism locates the origin of image-making in an act of flight (2019): the spine's catastrophic reorientation from horizontal to vertical, the anxious worm rearing upright out of proximity to earth and decay, escaping into abstraction and the supremacy of vision. Every image the upright body makes carries this terror: the upward reach of a nervous animal whose senses were calibrated for bounded, proximate, graspable things. The beast with teeth and a million images was never equipped for the hyperobject (Morton 2013). Its perceptual faculties, forged in deep time for immediate threat and local terrain, are catastrophically mismatched to something nonlocal, massively distributed, and without perceptible edge. The gothic haunting Thurtle identifies is the return of exactly this mismatch: the monsters at the margin of the taxonomy are the creatures the upward gesture could not leave behind (2018). The poetic image of the machine is what the anxious animal produces when it tries to sense what it cannot sense, the upward gesture continuing, finding no outside, because the hyperobject has none.

The practice-based research underpinning this paper operates across installation, automated game systems, and computational media: works in which an unplayable game engine runs as an autonomous system controlling mechatronic elements and projected environments without player input; coin-operated mechanisms that constitute the sole point of interaction with otherwise self-generating worlds; and diagrammatic objects derived from photoscanned material and RPG cartography. Each work is a sigil: a mark that indexes a process without revealing it, a black-box diagram of interior dark cartography. Through these acts – rituals of dark-cyber-magic – the research pursues a formal proposition: the diagram is the image. The map, the inventory, the traversal loop, the feedback cycle: the

new architecture of interiority, the forms left after the crime, the subject reconstituted in the ruins. The sigil does not decode; it operates. These images are mutable, emergent, transitory – flickering, drifting, looping, decaying – producing meaning in their instability. They are mnemonic terrains, affective architectures, ritual traces of a subjectivity that metabolises loss through drift and improvisation.

Human-Centred Design smooths this looping, co-dependent interiority, refusing the hyperobject, presuming a subject who arrives intact, bounded, from elsewhere. Flow, as Csikszentmihalyi names it, is the state where challenge and skill balance, the subject carried through the computational environment (1990). Gameful design inherits this: feedback loop optimised, inventory balanced, traversal rewarded. Soderman identifies flow as a design strategy that positions players as consuming subjects within what he calls ludic capitalism: the flowing subject is managed, absorbed into a circuit of playful consumption that suppresses the critical faculties that might perceive it (Soderman 2021). Disrupting flow runs deeper than strategy or choice; it is an ontological event. When the optimised loop fractures, what seeps through is the dark ecology of the interior: a mesh of desires, losses, inherited maps, machinic processes – entities flow was built to suppress, the parasite beneath the signal. These are the black box's inhabitants, the figures of dark cartography, the beasts and strangers that dwell beneath the interface. Sicart reminds us: play as appropriation is carnivalesque, embodied, dark and disruptive, irreducible to design (2014). To design for emergence is to design for resonance – the moment when something from the depths of a co-inhabited interior erupts, briefly, as figure.

The perfect crime: the ground of the poetic image destroyed, the body passing through the scientific gaze, the hyperobject waiting. What remains is an image that could not have existed before: dark, ecological, machinic, gothic, new. Disrupting flow opens a fissure in the simulation, releasing the hauntings the surface was built to contain. To design the fissure is to practise death magic for the ruins. The diagram is not a map of navigation; it is navigation. The sigil runs, tracing a drift-based cartography where memory, sensation, and difference become the diagram itself.

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Ontology Design in the Age of Climate Collapse

KEYWORDS

Ontology Design;
Reflexive Software;
Climate Activism;
Pluriversal Design;
Computational Rhetoric.

CATHERINE GRIFFITHS
Columbia University, Graduate School of Architecture, Planning, and Preservation, New York, USA
cg3534@columbia.edu

SUMMARY

This paper proposes the use of "Ontology Design" as a method for using graph-based databases to visualize the competing world views encoded in algorithmic systems. Grounded in fieldwork with the climate activist group Just Stop Oil in London, it maps two contrasting ontologies side by side: that of the activists and that of the police and state response. By rendering these formal world views legible, the project argues that algorithms are never neutral but make ideological arguments. It frames Ontology Design as a practice of accountability and political imagination, asking whose world a given tool is building.

What kind of world does a tool create? (Winograd and Flores 1987) Terry Winograd and Fernando Flores asked this question in their development of Ontological Design, and it reframes the act of software development as something far more consequential than problem-solving or user optimization. It positions design as a world-making practice, one that opens certain futures and forecloses others. This paper pursues that question through a speculative, critical, and ethnographically grounded software project at the intersection of climate justice, predictive policing, and the contested rights of protest in public space. It proposes Ontology Design as the use of graph-based databases to structure and visualize formal ontologies and argues for it as a method for making visible the competing world views encoded in algorithmic systems. As AI becomes less supervised, more ambient, and more deeply embedded in socially sensitive domains, the question of whose ontology is encoded, and whose is not, is a matter of civil rights.



Fig. 1. Overview of the custom *Ontology Design* interface showing the activist and police ontologies in purple and green

The project is situated in London, within the context of Just Stop Oil, a climate activist group whose sustained program of non-violent direct action has drawn both significant public support and an increasingly repressive police and state response. The research combines fieldwork comprising time spent with the group, documenting their practices and analyzing their strategies, with a speculative software design process using a custom-developed Ontology Design visualization interface. That interface documents and contrasts the activities, tactics, and logics of two groups: the police and the activists. These are not treated merely as two sides of a conflict, but as two formally distinct ontologies, two world views, each motivated by different threats, organized around different goals, and encoding a different set of recognizable and computable behaviors.



Fig. 2. Footage from fieldwork documenting JSO's slow marching practices in central London, UK



Fig. 3. Police bodycam footage used as defence evidence in activists' trials



Fig. 4. Example of critical video data labelling for a speculative activist model

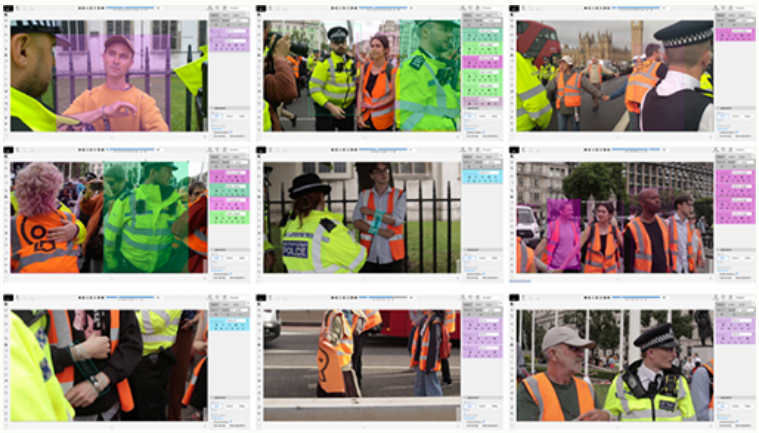


Fig. 5. Selection of critical video data labelling for a speculative activist model

In the activist ontology, structured around the escalating threat of climate collapse, actions like disruption, non-compliance, seeking arrest, and accepting imprisonment are not failures. They are deliberate strategic choices that are also, crucially, trackable, recordable, and therefore computable. But the ontology also contains what might be called its unmodelled interior: the phenomena that resist computation not through evasion, but through their fundamental incommensurability with what an algorithm can see and know. These include care practices that sustain activists through cycles of arrest and prosecution; grief circles and community support structures; legal and court support networks; truth-telling in court as an appeal to a jury's conscience; pleading not guilty en masse to overwhelm court capacity; and mutual aid for fines and legal costs. They are the tactics that live inside the ontology as representation but remain beyond what any predictive model can meaningfully capture or neutralize.

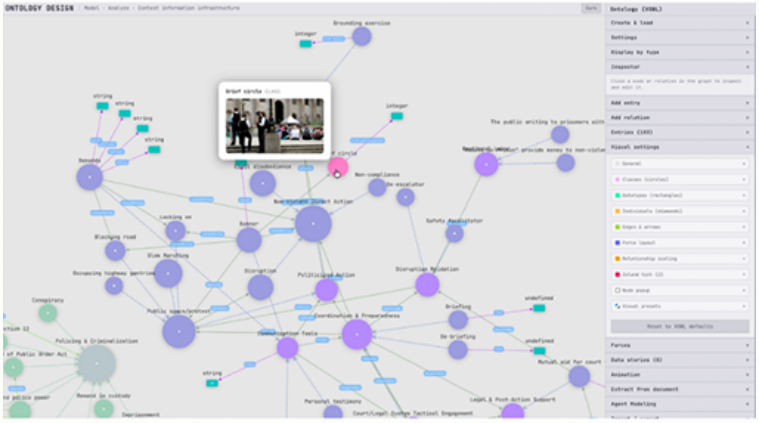


Fig. 6. Detail of Ontology Design interface

In the police ontology, organized around the threat of escalating civil disobedience, the behaviors are equally legible once named. They include the expansion of surveillance targeting protesters and their families; the imposition of long custodial sentences for non-violent acts; Lord Walney's recommendation to treat climate activists as terrorists; judicial constraints preventing defendants from raising climate collapse as part of their defense; judges banning the word "climate change" from being introduced as evidence; house raids on prominent activists; and judicial pressure on juries to return guilty verdicts. Most significantly, the rewriting of the Public Order Act, specifically Section 12, effectively criminalized slow marching, withdrawing a form of protest with deep historical precedent in civic life. Together, these constitute not a set of isolated policy responses, but a coherent ontological position: a world view in which the disruption of activist tactics is itself the extrinsic task the system is designed to perform.

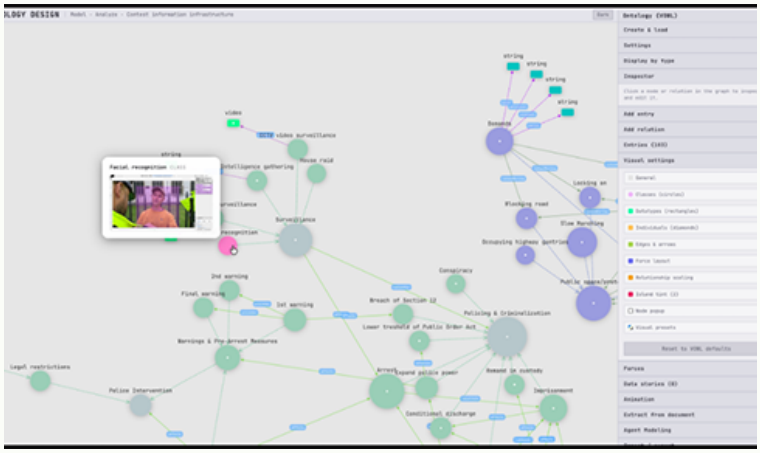


Fig. 7. Detail of Ontology Design interface

By mapping these two ontologies side by side, using visualization as both method and argument, the project makes a straightforward claim: that an algorithm is not neutral. It constructs an argument, from a particular point of view, in service of not only an extrinsic task, but an ideological operation. If there is an algorithm, we can ask what the counter-algorithm is. If there is an argument encoded in a system's design, we can ask what the counter-argument would look like, and how it might be built through software.



Fig. 8. Detail of Ontology Design interface

Here the concept of the metagame becomes generative. Drawing on Stephanie Boluk and Patrick Lemieux's *Metagaming*, which appropriates John von Neumann's original computational understanding of meta from game theory and from the study of conflict and cooperation in rational decision-making, the metagame is the game that comes into being when a player can choose their strategy with the knowledge of other players' choices (Boluk and Lemieux 2017). Applied here, software performs as a metagame: a system that only fully materializes when different groups, including activists, police, algorithm designers, and citizens, can act with awareness of each other's positions. It is a reflexivity oriented not toward code and mechanics, but toward consciousness, toward how algorithmic decision-making shapes ideology, and how humans make their own worlds through the systems they inhabit. Ontology Design, in this reading, becomes a metagaming practice: a way to step outside any single model, hold multiple world views simultaneously in view, and ask what moves remain possible.

This project belongs to a broader practice I have developed under the term *Reflexive Software*, a mode of development that critically reflects on its own code, functions, and processes, rather than producing tools in service of extrinsic tasks alone. It draws on Yanni Loukissas's concept of interfaces that produce friction (Loukissas 2019), and on James J. Brown's notion of computational rhetoric: the practice of constructing arguments through software design, not merely about it. (Brown 2015). In this way, the interface itself becomes a site of meaning-making, and the act of building becomes a form of critical inquiry.

The work belongs to a lineage of interaction and computational media design concerned not with efficiency or seamlessness, but with legibility, with making visible the structures concealed inside technical systems. Slow and spatialized computation becomes a deliberate tactic: a way to bring algorithmic processes within reach of a non-technical audience, and of the communities who have clear stakes in the outcomes of these systems but are rarely involved in their design. The visualization does not only offer linear technical explanation. It layers social, ethical, and political readings into the same representational space, using the interface as a medium to "render sensible" (Fuller and Weizman 2021) what is otherwise abstracted away.

The paper draws on Scott Page's formulation of many-model thinking as a framework for holding multiple ontologies simultaneously without resolving their contradiction into a single authoritative view. It draws equally on Arturo Escobar's conception of pluriversal design, "a world where many worlds fit," as a design ethic that insists on proximity: on the right of local groups, communities, and those with material stakes to be close to how the algorithms governing their lives are designed, and according to what values.

Noortje Marres has argued that what is being tested in spaces where new technology is deployed is not the technology itself, but society (Marres and Stark 2020). The testing grounds for predictive policing are also the testing grounds for civil rights in an era of climate collapse. Studying these spaces, before full implementation, at the level of prototype and design process, remains one of the few sites at which the ontologies being encoded into AI systems can still be questioned, contested, or redesigned. Ontology Design, in this sense, is not only a technical method. It is a practice of accountability, transparency, and political imagination, a way to ask whose world a tool is building, and to insist, through the act of design itself, that other worlds remain possible.

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