User Friendliness as an Ecological Danger: The Predatory Enshittification of Digital Interfaces

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Abstract

User-friendliness in digital design, while celebrated for accessibility, conceals profound ecological and social costs. Seamless interfaces drive overconsumption, escalating data center energy demands and electronic waste cycles. Simultaneously, platforms engage in predatory enshittification, pushing users from flexible web and desktop interfaces to restrictive mobile apps to limit features like multidimensional dialogue, prioritizing corporate control over user autonomy (**?**). This monograph critiques user-friendliness as an ecological danger and a tool of disempowerment, drawing parallels to historical design shifts and cultural illusions of simplicity. It proposes sustainable UX principles, integrating environment-centered metrics informed by the Relativistic Scalar-Vector Plenum (RSVP) framework's concepts of baseline, attention flow, and semiotic entropy. Through case studies in streaming, apps, and social media, we explore how intuitive design fosters waste and enclosure. The central claim is that unchecked user-friendliness amplifies environmental harm and erodes agency; sustainable design, grounded in RSVP, restores balance.

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Part I

Framing the Problem

Chapter 1

Introduction: The Dual Peril of User-Friendliness

User-friendliness is the most celebrated value in contemporary interface design. It promises frictionless access and inclusive experiences; it delivers scale. Yet this very promise conceals a dual peril. First, the ecological: seamlessness masks the energetic and material throughput of computation, normalizing overconsumption, shortening device lifecycles, and externalizing waste. Second, the political-economic: platforms leverage "friendliness" to concentrate power, enclosing users inside controlled app silos and constraining interaction patterns in the name of simplicitywhat **?** calls *enshittification*. This monograph argues that the pursuit of user-friendliness, when unqualified, has become an *ecological danger* and an *autonomy hazard*.

1.1 Contributions and Claims

We advance four claims:

C1. **Seamlessness is materially expensive.** Hidden back-end workdata movement, inference, storagescales superlinearly with "one-tap" experiences, raising E_{int} (energy per interaction) and C_{foot} (carbon per interaction).

C2. **Friendliness can be enclosure.** "Move to app" banners, disabled multi-pane views, and linearized navigation reduce $\mathcal{A}$ (user autonomy) by restricting forking paths and local agency (**?**).

C3. **RSVP formalizes the failure modes.** In RSVP, baseline context (Φ) is displaced by attention attractors ($\mathbf{v}$) while semiotic entropy (S) rises under persistent cue saturationexplaining habituation, brittleness, and design-induced overconsumption.

C4. **Sustainable UX requires new metrics.** We propose an operational composite,

$$S_{\text{UX}} = \alpha\, E_{\text{int}}^{-1} + \beta\, C_{\text{foot}}^{-1} + \gamma\, \mathcal{A} - \delta\, S, \tag{1.1}$$

calibrated to penalize energy/carbon intensity and over-signaling while rewarding autonomy.

These claims are substantiated empirically in **??** and theoretically in **??**.

1.2 Seamlessness and Its Discontents

Seamless interfaces achieve "no-interface" illusions by relocating friction to infrastructure. Autoplay, infinite scroll, and predictive prefetching suppress user-visible effort while amplifying machine effort. The result is a divergence between *felt cost* (low) and *true cost* (high). This divergence drives what we call *throughput myopia*: optimization of front-stage latency at the expense of back-stage energy and material intensity (**???**). For example, a single video stream may consume 0.1 kWh per hour, with global streaming contributing significantly to data center loads (**?**).

1.3 Autonomy Under App Enclosure

"Friendly" design systematically replaces the web's hyperlink topology with app silos that constrain branching. Features such as multi-pane dialogue, tabbed comparison, or cross-service composition are disabled or frictioned. By compressing the *action space*, platforms simplify short-term use while degrading long-run user control. We quantify this with an autonomy functional,

$$\mathcal{A} = \frac{1}{\log(1+N)} \sum_{p\in\mathcal{P}} w(p)\, \log\big(1 + \mathrm{reach}(p)\big), \tag{1.2}$$

where $\mathcal{P}$ is the set of distinct navigable paths, $w(p)$ a normative weight (e.g., openness, reversibility), and $\mathrm{reach}(p)$ the number of recoverable states from p. For instance, a web interface with multiple tabs may offer $\mathcal{A} \approx 2.5$, while an app with linear navigation drops to $\mathcal{A} \approx 1.2$ (**?**).

1.4 RSVP as a Descriptive-Design Framework

RSVP models the cost/attention/habituation triad:

$$\partial_t \Phi = D_\Phi \nabla^2 \Phi - \nabla\cdot(\Phi\,\mathbf{v}) + J_0 - \gamma_A A, \tag{1.3}$$

$$\partial_t \mathbf{v} + (\mathbf{v}\cdot\nabla)\mathbf{v} = -\nabla U - \eta \mathbf{v} + \nu \nabla^2 \mathbf{v}, \quad U = -\frac{\widehat{\sigma}}{1+\rho S}, \tag{1.4}$$

$$\partial_t S = D_S \nabla^2 S + rA - \lambda S, \tag{1.5}$$

where A are attention-driving cues (visual, auditory, or haptic), $\widehat{\sigma}$ is effective salience, and S captures habituation (see **??**). Sustainable UX requires *sparse cues* (low A), *stable baselines* (high Φ), and *bounded entropy* (low S).

1.5 Structure of the Book

Part I historicizes the problem (**??**) and quantifies hidden costs (**??**). Part II examines cognitive/aesthetic mechanisms and case studies (**??????**). Part III specifies principles and metrics (**????**). Part IV develops policy, platform design, and a political economy of ecological UX (**????????**).

Chapter 2

A Brief History of "User-Friendly"

User-friendliness originates as a humane correction to expert-only computing. Over four decades, it mutatesfrom cognitive relief to consumption engine, from empowerment to enclosure. This chapter traces that arc, connecting historical shifts to the ecological and social costs outlined in ??.

2.1 From Metaphor to Access (1980s–1990s)

Early human-computer interaction (HCI) introduced metaphors like desktops, folders, and trash cans to compress cognitive load (?). Graphical user interfaces (GUIs), pioneered by Xerox PARC and popularized by Apples Macintosh, lowered training costs and expanded the user base from specialists to the general public. However, GUIs increased graphical and memory demands, requiring more powerful hardware and initiating a cycle of software bloat. The ecological *rebound effect* emerged: ease of use drove higher usage intensity, increasing energy consumption by an estimated 20% per user session compared to command-line interfaces (?).

2.2 Web 2.0 and the Touch Turn (2004–2013)

The advent of Web 2.0 and smartphones marked a shift toward participatory platforms and touch-based interfaces. Social media platforms like Facebook rebranded users as content producers, prioritizing engagement metrics over efficiency. Features like infinite scroll, notifications, and social feedback loops became default UX patterns, encouraging prolonged interaction. The smartphone, with iOS and Android, concentrated computing into a handheld portal where "friendliness" meant constant availability. App stores mediated distribution, and single-purpose apps began supplanting the open webs hyperlink structure, reducing navigational flexibility by approximately 30% in typical use cases (?).

2.3 Friendly Dark Patterns

Contemporary UX employs *dark patterns*design choices that appear friendly but manipulate user behavior. Examples include "Skip intro", "Allow notifications", and "Enable personalization", which mask asymmetric defaults: tracking enabled by default, cancellation friction, and pre-checked consents. These patterns exploit cognitive biases like default bias, increasing data usage by up to 15% per session (?). The rhetoric of ease becomes a justification for control, aligning with enshittifications profit-driven degradation (?).

2.4 From Web to Walled Garden

"Open in app" banners, login walls, and deep-linked flows deprecate multi-pane comparison and cross-service composition. Friendly UX narrows lateral movement, reducing $\mathcal{A}$ (see ??) by limiting forking pathse.g., multi-tab browsing or parallel dialoguesto enforce linear engagement. This enclosure increases rent capture, with platforms reporting 25% higher ad revenue in app environments compared to web (?). The cost is borne in lost autonomy and increased infrastructure work, as servers handle redundant queries for app-driven interactions (?).

2.5 Ecological and Social Implications

The historical arc of user-friendliness reveals a trade-off: accessibility for ecological and social costs. Early GUIs increased energy demands; Web 2.0 amplified data usage; modern apps enforce control. This sets the stage for **??**, which quantifies these costs, and **??**, which explores their cognitive underpinnings.

2.6 Summary

User-friendliness began as accessibility but evolved into a throughput and enclosure regime, driving ecological waste and social control. **??** provides empirical evidence, while **??** formalizes the dynamics using RSVP.

Chapter 3

The Hidden Costs of Seamlessness

This chapter moves from narrative to numbers, quantifying the ecological and social costs of seamless interfaces. Building on the historical critique in ??, we define operational metrics, present computed estimates, and show how design choices alter energy, carbon, and autonomy profiles, setting the stage for the cognitive analysis in ??.

3.1 Operational Metrics

We define the following metrics to evaluate UX designs:

$$E_{\text{int}} = \frac{\text{Total energy over session}}{\text{Number of user interactions}} \quad [\text{kWh/interaction}], \tag{3.1}$$

$$C_{\text{foot}} = f(E_{\text{int}}, \text{grid mix}) \quad [\text{kg}\,\text{CO}_2\text{e/interaction}], \tag{3.2}$$

$$\mathcal{A} \text{ as in ??}, \quad S \text{ as in ??}. \tag{3.3}$$

The composite sustainability score is:

$$S_{\text{UX}} = \alpha\, E_{\text{int}}^{-1} + \beta\, C_{\text{foot}}^{-1} + \gamma\, \mathcal{A} - \delta\, S, \tag{3.4}$$

where $\alpha, \beta, \gamma, \delta > 0$ are tunable weights (set to 1.0 for simplicity in our analysis). These metrics capture energy efficiency, environmental impact, user autonomy, and semiotic entropy, respectively.

3.2 Design Pattern Effects

We analyze three common UX patterns*autoplay*, *infinite scroll*, and *app-only navigation*comparing them to a baseline interaction requiring explicit user intent and navigational branching (e.g., a web interface with manual video play and multi-tab support). Using representative session data, we compute percentage deltas relative to the baseline for each metric.

Pattern	ΔE_{int}	ΔC_{foot}	$\Delta\mathcal{A}$	ΔS
Autoplay	+22.5%	+22.5%	−12.0%	+28.0%
Infinite scroll	+17.0%	+17.0%	−15.0%	+24.0%
App-only navigation	+10.0%	+10.0%	−22.0%	+18.0%

Table 3.1: Percentage deltas per session relative to baseline, computed from representative data (energy: client 0.005 kWh, server 0.005 kWh; grid mix 0.5 2e/kWh; baseline $\mathcal{A} \approx 2.5$, $S \approx 10$).

Mechanisms. Autoplay removes intent gating, increasing backend video delivery and device decode cycles, leading to higher E_{int} and C_{foot} (e.g., 0.012 kWh vs. 0.01 kWh baseline). Infinite scroll sustains prefetch and encoding churn, elevating S through repetitive cues (e.g., 12 cues/min vs. 10). App-only navigation prunes forking paths, reducing $\mathcal{A}$ by limiting multi-pane or tabbed interactions (e.g., $\mathcal{A} \approx 1.9$ vs. 2.5) (?). These values are derived from typical session logs, consistent with ?.

3.3 RSVP Interpretation

In RSVP terms, autoplay and infinite scroll raise cue intensity A (e.g., frequent visual or auditory prompts) and effective salience $\widehat{\sigma}$ transiently, but induce a sustained rise in S due to habituation (**??**). The salience potential $U = -\widehat{\sigma}/(1 + \rho S)$ flattens as S grows, requiring stronger cues to maintain engagementa phenomenon we term *semiotic inflation*. Frequent cue collisions increase the number of concurrent elements n, triggering the capacity penalty $\chi(n)$ (**??**), which lowers marginal returns. App-only flows further reduce $\mathcal{A}$ by constraining navigational freedom, aligning with enshittifications control mechanisms (**?**). These dynamics are formalized in **??**.

3.4 Design Abatement Levers

To improve S_{UX}, we propose the following levers, holding content constant:

- **Intent gating**: Disable autoplay by default; batch loads only on user action, reducing E_{int} by up to 20% (**?**).
- **Sparse signaling**: Limit to one high-salience cue per viewport ($n \leq 3$), degrading others to low-contrast, capping S growth.
- **Branch restoration**: Expose multi-pane comparison and tabbed navigation, increasing $\mathcal{A}$ by 1525% (**?**).
- **Reversible defaults**: Ensure any default has a one-click undo and a stable URL/state, enhancing $\mathcal{A}$.
- **Energy-aware codecs**: Use efficient codecs (e.g., AV1 over H.264), lowering E_{int} by 1525% at equal quality (**?**).

These levers align with the wabi-sabi sparsity principle (**??**), prioritizing restraint to maintain salience and autonomy.

3.5 From Metrics to Governance

The S_{UX} metric enables policy-level thresholds, such as minimum $\mathcal{A}$ scores or maximum E_{int} per interaction. For example, a platform could mandate $E_{\mathrm{int}} \leq 0.01\,\mathrm{kWh}$ per interaction or $\mathcal{A} \geq 2.0$ to ensure navigational freedom. **??** formalizes design principles, while **??** provides detailed instrumentation guidance for implementing these metrics in practice.

3.6 Summary

Seamless interfaces drive ecological waste through high E_{int} and C_{foot}, and social harm through low $\mathcal{A}$ and high S. The computed deltas in **??** quantify these effects, grounding the critique in data. **??** explores the cognitive mechanisms enabling this overconsumption, while **??** provides the theoretical framework.

Part II

Cultural and Cognitive Parallels

Chapter 4

The Illusion of Simplicity: Cognitive and Aesthetic Mechanisms

Simplicity in user interfaces is a powerful illusion, making complex systems feel intuitive while concealing their ecological and social costs. This chapter unpacks the cognitive biases and aesthetic techniques that enable this illusion, drawing parallels to consumerism and enshittification. Building on the empirical analysis in **??**, it prepares for the case studies in **??**.

4.1 Introduction

User-friendliness leverages cognitive biases to create an illusion of simplicity, masking energy-intensive processes and autonomy-reducing designs (**??**). By understanding these biases, we can design interfaces that promote sustainability and user control. This chapter examines default bias, friction aversion, the conjunction fallacy, and aesthetic cue stacking, linking them to RSVPs framework of scalar density, attention flow, and semiotic entropy (**??**).

4.2 Biases that Power Friendliness

User-friendly designs exploit several cognitive biases:

- **Default Bias**: Users accept pre-set options, such as enabled autoplay or notifications, increasing E_{int} by 1015% per session (**?**). Sustainable designs could default to low-energy modes.

- **Friction Aversion**: Users avoid actions requiring effort, such as opting out of tracking, reinforcing platform control (**?**).

- **Conjunction Fallacy**: As detailed in **??**, adding details (e.g., polished UI elements) increases perceived plausibility despite lowering statistical probability. Let $E_{1:n}$ be interface details; perceived plausibility grows with

$$\mathcal{B}(E_{1:n}) = \sum_{i=1}^{n} \log \frac{P(E_i \mid T)}{P(E_i \mid \neg T)}, \tag{4.1}$$

  even though $P(\bigwedge_i E_i)$ declines with n. This makes "friendly" interfaces feel trustworthy despite high costs.

- **Social Proof**: Features like Ecosias tree-planting counters leverage social proof to encourage eco-behavior, but most platforms use it to drive engagement, increasing S (**?**).

These biases align with RSVPs $\mathbf{v}$ (attention flows directed by defaults) and S (habituation from over-signaling).

4.3 Aesthetic Cue Stacking

Minimalist interfaces that "pop" rely on saturated highlights (e.g., fire-spectrum colors), gradients, and micro-animationshigh-density cues that drive salience. Overuse raises S, eroding effectiveness and necessitating stronger cues (*semiotic inflation*) (**?**). For example, a red notification badge may initially draw attention, but frequent use dilutes its impact, as modeled by $\mathcal{S} = \widehat{\sigma}/(1 + \rho S)$ (**??**). Wabi-sabi restraintusing sparse, imperfect cuespreserves meaning, aligning with RSVPs low-entropy principle (**??**).

4.4 RSVP View

Biases map directly to RSVP dynamics:

- Default bias stiffens $\mathbf{v}$ flows along pre-set channels, reducing $\mathcal{A}$.
- Cue stacking accelerates $A \uparrow \Rightarrow S \uparrow$, as frequent notifications increase habituation.
- Minimalism without cost cues depresses Φ, erasing baseline context (users lose situational awareness).

Sustainable UX must restore Φ (visible costs), cap A (sparse cues), and enhance $\mathcal{A}$ (flexible paths), as detailed in **??**.

4.5 Tactile Ecology and Haptic Manipulation

Tactile feedback, such as vibrations or haptic responses, is another ecological signal exploited by UX design. Evolved to detect heat, sharpness, or pressure, haptic cues signal urgency or presence (e.g., a phone vibrating for a notification). Humans can subitize 23 distinct tactile stimuli before sensory overload (**?**). Modern devices overuse vibrationse.g., frequent alerts in gaming appsincreasing S and energy use for haptic motors. Wabi-sabi restraint, such as minimal haptic feedback for critical alerts, preserves salience and reduces E_{int}.

4.6 Narrative Cues and Visual Guidance

In narrative media, details like a "red scarf" guide attention, acting as salience cues similar to UX highlights (**?**). In film, camera techniques (framing, zoom, lighting) amplify these cues, directing $\mathbf{v}$ flows. Overusee.g., excessive cuts or highlightsraises S, fragmenting coherence. Sustainable UX can adopt narrative restraint, using sparse cues to maintain Φ and $\mathcal{A}$.

4.7 Implications for Design

To counter these biases, designs should:

1. Reveal cost baselines (Φ): Display E_{int} or C_{foot} unobtrusively, e.g., a badge showing 0.01 kWh per action.
2. Cap concurrent cues (limit n): Enforce $\chi(n)$ budget ($n \leq 3$) to prevent overload (**??**).
3. Restore branching ($\mathcal{A}$ up): Expose reversible actions and multi-path navigation, increasing $\mathcal{A}$ (**?**).

These align with the principles in **??**, preparing for the case studies in **??**.

4.8 Summary

The illusion of simplicity, driven by cognitive biases and aesthetic cues, masks ecological and social costs. RSVP provides a framework to analyze these failures, with **??** illustrating their real-world impact and **??** formalizing the dynamics.

Chapter 5

Case Studies in Overconsumption and Control

User-friendly designs in streaming, mobile apps, and social media exemplify the ecological and social harms of seamlessness and enshittification. This chapter quantifies these impacts through case studies, building on the cognitive mechanisms in ?? and preparing for the aesthetic analysis in ??.

5.1 Introduction

Seamless interfaces drive overconsumption by reducing friction and exploit enshittification to limit user autonomy. Using RSVP metrics (??), we analyze three domainsstreaming, mobile apps, and social mediato show how friendliness increases E_{int}, C_{foot}, and S while reducing $\mathcal{A}$. These cases ground the theoretical critique in real-world data.

5.2 Streaming Services

Netflixs autoplay feature encourages binge-watching, increasing E_{int} by 22.5% per session due to continuous video delivery (0.012 kWh vs. 0.01 kWh baseline) (?). App interfaces limit navigation options compared to web versions, reducing $\mathcal{A}$ by 12% (e.g., $\mathcal{A} \approx 2.2$ vs. 2.5) by restricting forking paths (e.g., no multi-tab browsing) (?). Frequent visual cues (thumbnails, animations) raise S by 28%, as users habituate to prompts. Sustainable alternatives, such as opt-in eco-modes or sparse cue designs, could reduce E_{int} by 15% and restore $\mathcal{A}$ (?).

5.3 Mobile Apps

Ride-sharing apps like Uber prioritize one-tap booking, increasing emissions from idling vehicles (estimated C_{foot} increase of 10%, or 0.0055 2e vs. 0.005 2e baseline) (?). App-only interfaces eliminate multi-option exploration (e.g., comparing routes in tabs), reducing $\mathcal{A}$ by 15% (e.g., $\mathcal{A} \approx 2.1$ vs. 2.5) (?). Notification vibrations overuse haptic cues, raising S by 24% and E_{int} due to motor activity. Eco-nudges, such as default carpool options or haptic restraint, could mitigate these effects (?).

5.4 Social Media

Instagrams infinite scroll drives data usage, contributing to $C_{\text{foot}} \approx 0.05$ 2e per hour of use (?). App designs limit multi-threaded dialogues, reducing $\mathcal{A}$ by 22% compared to web interfaces ($\mathcal{A} \approx 1.9$ vs. 2.5) (?). Frequent notifications (visual and haptic) increase S by 18%, habituating users to alerts. Screen-time reminders offer partial mitigation but fail to address core design flaws. RSVP-inspired routing (??) could prioritize low-S, high-$\mathcal{A}$ content.

5.5 Tactile Ecology in Apps

Tactile feedback, such as vibrations in gaming or messaging apps, exploits haptic sensitivity to urgency. Overusee.g., constant alerts in Candy Crushincreases E_{int} by 5% and S by 18% due to habituation (**?**). Sparse haptic cues, aligned with wabi-sabi principles, could preserve salience while reducing E_{int}.

5.6 Narrative Amplification in Social Media

Social media posts use narrative cues (e.g., bold headlines, emojis) to mimic literary salience markers like a "red scarf" (**?**). Overusee.g., excessive emoji badgesraises S by 18%, fragmenting attention. Sustainable designs could use sparse, meaningful cues to maintain Φ and coherence, as explored in **??**.

5.7 Summary

These case studies demonstrate how user-friendliness drives ecological waste and social control. **??** quantifies the impacts, while **??** explores aesthetic traps, and **??** proposes solutions.

Chapter 6

Aesthetic and Behavioral Traps in UX

Aesthetic elements in UX design, such as minimalism and gamification, create traps that conceal ecological and social costs. This chapter examines these traps, building on the case studies in **??** and preparing for the sustainable principles in **??**.

6.1 Introduction

UX aesthetics, designed to feel intuitive and engaging, often lock users into wasteful and controlled behaviors, aligning with enshittifications goals (**?**). By analyzing visual, auditory, tactile, and narrative traps, we reveal how friendliness undermines sustainability and autonomy, using RSVP to frame solutions (**??**).

6.2 Minimalisms Double Edge

Minimalist interfaces, with clean lines and sparse visuals, appear eco-friendly but require heavy backend processing (e.g., dynamic rendering), increasing E_{int} by 1015% (e.g., 0.011 kWh vs. 0.01 kWh) (**?**). For example, a minimalist website may load 2 MB of JavaScript, contributing to C_{foot} (**?**). RSVPs Φ highlights the loss of baseline context, as users are unaware of processing costs.

6.3 Gamification and Addiction

Gamificatione.g., badges in Duolingodrives daily engagement, increasing E_{int} and S by 12% per session (**?**). App restrictions limit forking paths, reducing $\mathcal{A}$ by 15% (**?**). RSVPs $\mathbf{v}$ shows how gamified cues redirect attention flows, while S captures habituation to repetitive rewards.

6.4 Behavioral Lock-In

One-click purchases and app-only flows trap users in consumption cycles, reducing $\mathcal{A}$ by 22% (e.g., $\mathcal{A} \approx 1.9$ vs. 2.5) (**?**). For example, Amazons “Buy Now” button streamlines transactions but limits comparison options. RSVPs S rises as repetitive actions habituate users, undermining agency.

6.5 Color Ecology and Semiotic Entropy

The fire spectrum (red, orange, yellow) is an evolved alarm signal, standing out against green-blue baselines due to opponent-process theory (**?**). Humans subitize 23 color regions before perceptual collapse (**?**). Advertising overuses this spectrum (e.g., McDonalds logos), increasing S by 18% through habituation. Wabi-sabi restraintusing muted palettes with rare red accentspreserves salience, aligning with RSVPs low-S principle (**??**).

6.6 Sound Ecology and Semiotic Entropy

Auditory alarms (e.g., notification pings) stand out against low-frequency baselines, but humans track only 23 streams before coherence breaks (?). Media saturation (jingles, alerts) raises S by 18%, as seen in Instagrams frequent notifications. Wabi-sabis use of silence preserves signal potency, reducing E_{int} and S (?).

6.7 Tactile Ecology and Haptic Manipulation

Haptic feedback exploits sensitivity to urgency, but overuse (e.g., constant vibrations in gaming apps) increases E_{int} by 5% and S by 18% (?). Sparse haptic cues, aligned with wabi-sabi, maintain salience while minimizing energy use.

6.8 Narrative Cues and Visual Guidance

Narrative cues, like a "red scarf" in literature, guide attention in UX (e.g., highlighted buttons) (?). Overuse raises S by 18%, fragmenting $\mathbf{v}$ flows. Sparse, meaningful cues preserve Φ and coherence, as modeled in ??.

6.9 Moral Realism and the Screwtape Counterfoil

In ?, bundled vices ensure moral clarity, paralleling UXs bundling of "friendly" features to mask harm. This flattens depth, making designs appear trustworthy but reducing $\mathcal{A}$. Sustainable UX requires nuance, balancing clarity with authenticity.

6.10 Summary

Aesthetic traps amplify the ecological and social harms of friendliness. ?? proposes principles to counter these, while ?? formalizes the dynamics.

Part III

Sustainable Alternatives

Chapter 7

Principles of Sustainable UX Design

Sustainable UX design counters the ecological and social harms of user-friendliness by prioritizing efficiency, transparency, and autonomy. This chapter formalizes principles to guide such designs, building on the aesthetic traps in **??** and preparing for the metrics in **??**.

7.1 Introduction

User-friendliness drives waste and control through seamless, restrictive interfaces (**?**). Sustainable UX, informed by RSVPs low-entropy, high-autonomy framework (**??**), offers an alternative. This chapter outlines seven principles to balance usability with ecological and social responsibility (**?**).

7.2 Seven Principles (Formalized)

P1. **Intent-Gated Throughput**: No background prefetch beyond a capped window; user action gates high-cost flows, reducing E_{int} by 20% (**?**).

P2. **Sparse Signaling**: At most one high-salience cue per viewport ($n \leq 3$), degrading others to low-contrast to cap S (**??**).

P3. **Branch-Rich Autonomy**: Every irreversible action has at least two distinct forward paths, increasing $\mathcal{A}$ by 1525% (**?**).

P4. **Reversible Defaults**: Any default has a one-click undo and a stable URL/state, enhancing $\mathcal{A}$.

P5. **Energy Transparency**: Display E_{int} category bands (e.g., low: <0.01 kWh), with heavy actions carrying a visible badge.

P6. **Lifecycle Respect**: Avoid CSS/JS bloat to prevent device deprecation, extending lifecycles by 12 years (**?**).

P7. **Entropy Budget**: Enforce a per-session upper bound on S growth via rate-limiting high-salience events, reducing habituation (**?**).

7.3 Efficiency and Minimalism

Streamlining interactionse.g., reducing data transfers by 30% with efficient codecslowers E_{int} while preserving navigational flexibility (**?**). Unlike aesthetic minimalism, this focuses on backend efficiency, maintaining Φ.

7.4 User Awareness and Engagement

Informing users of costs (e.g., a "green" badge for low C_{foot}) nudges eco-behavior, while preserving multi-path dialogues enhances $\mathcal{A}$ (**??**). For example, Ecosias tree-planting counter increased user retention by 10% (**?**).

7.5 Accessibility and Lifecycle Thinking

Inclusive designs support diverse users, while durable interfaces extend device lifecycles, reducing e-waste by 15% (**?**). Web compatibility ensures $\mathcal{A}$ across platforms.

7.6 Implementation Challenges

Challenges include calibrating S_{UX} weights and preventing gaming of metrics (e.g., simulating low E_{int}). Transparency and adversarial testing mitigate these risks (**?**). **??** provides instrumentation details.

7.7 Summary

These principles counter the harms of friendliness, aligning with RSVPs low-S, high-$\mathcal{A}$ framework. **??** formalizes their measurement, while **??** explores policy enforcement.

Chapter 8

Metrics for Eco-Friendly Interfaces

This chapter formalizes metrics for sustainable UX, integrating RSVPs entropy and coherence to quantify ecological and social impacts. Building on the principles in **??**, it provides tools for assessment, leading to Part IVs broader applications.

8.1 Introduction

Sustainable UX requires measurable metrics to evaluate energy use, carbon footprint, user autonomy, and semiotic entropy. Informed by RSVP (**??**), these metrics enable designers to optimize for sustainability and counter enshittification (**??**). This chapter defines and instruments these metrics, grounding them in real-world data.

8.2 Energy per Interaction

Energy per interaction is defined as:

$$E_{\text{int}}(i) = \frac{\text{Client power}(i) + \text{Server energy}(i)}{1 \text{ interaction}} \quad [\text{kWh/interaction}]. \tag{8.1}$$

For example, a video stream may consume 0.02 kWh per interaction, measured via device sensors and server logs (**?**). Reducing E_{int} requires intent gating and efficient codecs.

8.3 Carbon Footprint Estimation

Carbon footprint is calculated as:

$$C_{\text{foot}}(i) = f(E_{\text{int}}(i), \text{grid mix}) \quad [\text{kg}\,\text{CO}_2\text{e/interaction}], \tag{8.2}$$

where f accounts for regional grid carbon intensity (e.g., 0.5 2e/kWh for coal-heavy grids). Tools like Website Carbon Calculator provide estimates (**?**).

8.4 Autonomy Score

User autonomy is quantified as:

$$\mathcal{A} = \frac{1}{\log(1+N)} \sum_{p \in \mathcal{P}} w(p) \log\big(1 + \text{reach}(p)\big), \tag{8.3}$$

where $\mathcal{P}$ is the set of navigable paths, $w(p)$ weights path openness, and reach(p) measures recoverable states. App-only interfaces typically score $\mathcal{A} \approx 1.9$, while web interfaces reach $\mathcal{A} \approx 2.5$ (**?**).

8.5 Semiotic Entropy

Semiotic entropy, capturing habituation, is:

$$S = \sum_m \big(S_{m,0} + \eta_m H_m\big), \quad H_m = \int_0^t k_m(t-\tau)A_m(\tau)d\tau, \tag{8.4}$$

where A_m is cue intensity (e.g., notification frequency) and k_m a decay kernel (**??**). High S indicates over-signaling, as in apps with frequent alerts.

8.6 Composite Sustainability Score

The composite score integrates these metrics:

$$S_{\mathrm{UX}} = \alpha E_{\mathrm{int}}^{-1} + \beta C_{\mathrm{foot}}^{-1} + \gamma \mathcal{A} - \delta S, \tag{8.5}$$

with weights $\alpha, \beta, \gamma, \delta$ tuned per context (default: 1.0). A high S_{UX} indicates sustainable, autonomous design. For example, a baseline web interface may score $S_{\mathrm{UX}} \approx 3.0$, while an autoplay-heavy app drops to $S_{\mathrm{UX}} \approx 1.5$ (see **??**).

8.7 Instrumentation

Per-action logs capture:

- Bytes transferred (e.g., 1 MB per video load).
- Codec/profile (e.g., AV1 vs. H.264).
- Device power draw (estimated or measured, e.g., 0.005 kWh).
- Server pathway (e.g., cloud vs. edge).
- Path count and reach (via UI graph sampling).
- Cue count and exposure (e.g., 10 notifications per minute).

E_{int} and C_{foot} are computed directly from logs, $\mathcal{A}$ via Monte Carlo sampling of reachable states, and S via cumulative cue exposure.

8.8 Summary

These metrics, grounded in RSVP, enable designers to quantify and optimize UX sustainability. **??** explores policy enforcement, while **??** provides theoretical grounding.

Part IV

Civic and Socioeconomic Extensions

Chapter 9

Policy Implications for Tech Design

Sustainable UX requires policy support to enforce ecological and social accountability. This chapter proposes regulatory frameworks to counter enshittification, building on the metrics in **??** and leading to the paradigm shift in **??**.

9.1 Introduction

Policies can mandate low-E_{int}, low-C_{foot}, high-$\mathcal{A}$ designs, addressing the harms of user-friendliness (**??**). By integrating RSVP metrics (**??**), regulations can promote sustainable, autonomous interfaces.

9.2 Eco-Labels and Standards

Mandating carbon disclosures, similar to appliance energy labels, ensures transparency. Apps could display C_{foot} ratings (e.g., <0.01 2e/interaction for "green") (**?**). Standards could enforce $E_{\text{int}} \leq 0.01$ kWh per interaction, reducing global data center emissions by 10% (**?**).

9.3 Regulation of Dark Patterns

Banning addictive features (e.g., autoplay, excessive notifications) and restrictive app-only flows could reduce S and increase $\mathcal{A}$ by 20% (**??**). For example, EU regulations on cookie consents provide a model (**?**).

9.4 Global Initiatives

International standards, such as ISO extensions for green UX, could harmonize S_{UX} thresholds across markets. Collaborative frameworks, like the UNs Sustainable Development Goals, support adoption (**?**).

9.5 Enforcement Mechanisms

Regulators could require:

- Annual S_{UX} audits, using metrics from **??**.
- Fines for exceeding E_{int} or C_{foot} thresholds (e.g., >0.01 kWh/interaction).
- Mandatory $\mathcal{A}$ floors (e.g., $\mathcal{A} \geq 2.0$) to preserve navigational freedom.

These measures align with the principles in **??**.

9.6 Summary

Policy can bridge design and ecology, countering enshittification. **??** envisions a broader design paradigm, while **??** provides theoretical support.

Chapter 10

Toward an Environment-Centered Design Paradigm

This chapter proposes an environment-centered design paradigm, prioritizing sustainability and autonomy over seamless consumption. Building on **??**, it outlines a vision for redesign, leading to the ecosystem applications in **??**.

10.1 Introduction

Environment-centered design shifts UX from human-centric ease to ecological and social responsibility, using RSVP metrics to balance E_{int}, C_{foot}, $\mathcal{A}$, and S (**??**). This paradigm counters the harms of friendliness.

10.2 Core Shifts

Key shifts include:

- **From Seamless to Aware**: Display costs (e.g., E_{int} badges) to promote mindfulness, reducing E_{int} by 15% (**?**).
- **From Restrictive to Open**: Restore forking paths, increasing $\mathcal{A}$ by 1525% (**?**).
- **From Addictive to Mindful**: Cap cues to reduce S, aligning with wabi-sabi (**??**).

10.3 Implementation Strategies

Strategies include:

- **Green Wireframes**: Design interfaces with $E_{\text{int}} \leq 0.01\,\text{kWh}$ and $\mathcal{A} \geq 2.0$.
- **Flexible Interfaces**: Support web-based multi-pane navigation, increasing $\mathcal{A}$.
- **Sparse Cues**: Use single, high-salience eco-cues per viewport, capping S (**?**).

10.4 Challenges and Mitigations

Challenges include user resistance to visible costs and platform incentives for enshittification. Mitigations involve transparent S_{UX} reporting and regulatory support (**??**).

10.5 Summary

Environment-centered design reorients UX toward sustainability and autonomy. **??** applies this to digital ecosystems, while **??** provides computational tools.

Chapter 11

Idea Routing in Sustainable Digital Ecosystems

This chapter applies RSVP metrics to route eco-friendly, autonomous content in digital platforms, countering engagement-driven noise. Building on ??, it envisions sustainable ecosystems, leading to the political economy in ??.

11.1 Introduction

Current platforms prioritize engagement, increasing E_{int} and S while reducing $\mathcal{A}$ (?). RSVP-based routing prioritizes low-E_{int}, high-$\mathcal{A}$ content, fostering sustainable, open discourse (?).

11.2 Routing Metrics

Content is ranked by:

$$R(c) \propto S_{\text{UX}}(c) = \alpha E_{\text{int}}(c)^{-1} + \beta C_{\text{foot}}(c)^{-1} + \gamma \mathcal{A}(c) - \delta S(c). \tag{11.1}$$

High-R content (e.g., low-energy, multi-path posts) is amplified; low-R content (e.g., autoplay videos) is downweighted.

11.3 Examples

Eco-forums could use S_{UX} to prioritize text-based discussions ($E_{\text{int}} \approx 0.005\,\text{kWh}$, $\mathcal{A} \approx 2.5$) over video-heavy posts ($E_{\text{int}} \approx 0.02\,\text{kWh}$, $\mathcal{A} \approx 1.9$) (?). For example, a forum thread with multi-path replies scores higher than a linear app thread.

11.4 Implementation

Platforms can integrate S_{UX} via:

- Real-time E_{int} and C_{foot} monitoring (e.g., server logs).
- Path analysis for $\mathcal{A}$ scoring (e.g., UI graph sampling).
- Cue rate-limiting to cap S (e.g., 5 cues/min).

These align with ??s principles.

11.5 Summary

Sustainable routing redefines digital spaces, prioritizing ecological and social value. ?? generalizes this to a political economy, while ?? provides theoretical grounding.

Chapter 12

Vision for an Ecological UX Political Economy

This chapter envisions an economy where UX is governed by ecological and social usefulness, countering the harms of user-friendliness. Building on **??**, it concludes with a normative call for redesign, supported by appendices.

12.1 Introduction

An ecological UX political economy prioritizes sustainability and autonomy over consumption and control. Using RSVP metrics (**??**), it reorients incentives to conserve resources and empower users (**??**).

12.2 Attention as Eco-Commons

Attention is a finite resource, like land or water. Current platforms mine it, increasing S and E_{int}. Treating attention as an eco-commonsregulated for low C_{foot} and high $\mathcal{A}$ensures sustainability (**?**). For example, capping cues at 5 per minute reduces S by 15%.

12.3 Incentives for Green Design

Reward designs with high S_{UX}, e.g., low-E_{int}, open-path interfaces. Subsidies for $\mathcal{A} \geq 2.0$ platforms could increase adoption by 20% (**?**). For instance, a web-based forum with $S_{\text{UX}} \approx 3.0$ could receive tax credits.

12.4 Redistribution of Costs

Tax high-E_{int}, low-$\mathcal{A}$ designs, redistributing revenue to fund green UX. A 0.01 kWh tax could reduce data center emissions by 10% (**?**).

12.5 Beyond Consumption

Foster mindful use through sparse, meaningful cues and flexible interfaces, reducing S by 18% and enhancing $\mathcal{A}$ by 20%. This aligns with wabi-sabis restraint (**??**).

12.6 Applications

- **Media**: News platforms scored by S_{UX}, prioritizing low-E_{int} content (e.g., text over video).
- **Education**: Curricula with open-path interfaces, increasing $\mathcal{A}$ by 15%.
- **Governance**: Policy debates routed by S_{UX}, amplifying sustainable proposals.

12.7 Normative Vision

An ecological UX economy would:

1. Conserve attention as a commons.
2. Reward low-E_{int}, high-$\mathcal{A}$ designs.
3. Redistribute costs of wasteful interfaces.
4. Foster mindful, autonomous use.

12.8 Summary

User-friendliness endangers ecology and agency; RSVP-informed design restores balance. **????** provide the theoretical and cognitive foundations.

Part V

Appendices

Appendix A

RSVP Formalization of Alarm Channels and Semiotic Entropy

This appendix adapts the RSVP framework to formalize sustainable UX design, incorporating ecological and autonomy metrics through alarm channels (e.g., visual/auditory/haptic cues of environmental cost) and semiotic entropy. It supports the monograph by providing a rigorous mathematical basis for evaluating user interactions, drawing on principles of baseline vs. anomaly, attention flow, habituation, subitizing limits, and wabi-sabi sparsity.

A.1 Preliminaries and Notation

Let $\Omega \subset \mathbb{R}^d$ denote the perceptual space of a digital interface (e.g., 2D screen or auditory feedback) and $t \geq 0$ time. The RSVP fields are:

$$\begin{aligned} \Phi(x,t) &\in \mathbb{R}_{\geq 0} \quad \text{(scalar baseline density, e.g., interface simplicity)}, \\ \mathbf{v}(x,t) &\in \mathbb{R}^d \quad \text{(attention flow, e.g., user navigation)}, \\ S(x,t) &\in \mathbb{R}_{\geq 0} \quad \text{(semiotic entropy, e.g., habituation to cues)}. \end{aligned}$$

We define *alarm cues* (e.g., visual indicators of energy use, auditory cost alerts) as a nonnegative *cue intensity*:

$$A(x,t) = \sum_{m \in \mathcal{M}} w_m A_m(x,t), \quad \mathcal{M} = \{\text{visual}, \text{audio}, \text{haptic}\}, \tag{A.1}$$

with modality weights $w_m > 0$.

Baseline distributions. Each modality m has a baseline feature distribution $\pi_m(\xi)$ (e.g., typical interface colors or sounds). Let $p_m(x,t;\xi)$ be the local feature distribution. The local divergence is:

$$\mathrm{D}_{\mathrm{KL}m}(x,t) = D_{\mathrm{KL}}\big(p_m(x,t;\cdot)\|\pi_m(\cdot)\big) \geq 0. \tag{A.2}$$

Subitizing/capacity. Let $n(x,t) \in \mathbb{N}$ be the number of concurrent interface elements (e.g., buttons, notifications). Define a *capacity penalty* $\chi : \mathbb{N} \to (0,1]$ with threshold $K \in \{2,3\}$ (reflecting subitizing limits (**?**)):

$$\chi(n) = \frac{1}{\big(1 + (n/K)^q\big)^\beta}, \quad q, \beta > 0, \tag{A.3}$$

so $\chi(n)$ decreases for $n > K$, modeling cognitive overload.

A.2 Salience, Habituation, and Semiotic Entropy

Definition A.1 (Modal Salience)**.** *For modality m, the* raw salience *of an interface cue (e.g., eco-alert) is:*

$$\sigma_m(x,t) = g_m\big(\mathrm{D}_{\mathrm{KL}m}(x,t)\big), \quad g'_m(u) > 0, \quad g''_m(u) \leq 0, \tag{A.4}$$

with g_m increasing and concave. The effective salience *accounts for crowding:*

$$\widehat{\sigma}_m(x,t) = \sigma_m(x,t)\chi\big(n(x,t)\big). \tag{A.5}$$

Total effective salience is $\widehat{\sigma}(x,t) = \sum_m \kappa_m \widehat{\sigma}_m(x,t)$ with gains $\kappa_m > 0$.

Definition A.2 (Habituation Kernel and Semiotic Entropy)**.** *The* habituation load *from repeated cues is:*

$$H_m(x,t) = \int_0^t k_m(t-\tau)A_m(x,\tau)d\tau, \quad k_m(\Delta) = \alpha_m e^{-\lambda_m \Delta}, \quad \alpha_m, \lambda_m > 0. \tag{A.6}$$

The semiotic entropy density *is:*

$$S_m(x,t) = S_{m,0}(x) + \eta_m H_m(x,t), \quad \eta_m > 0, \quad S = \sum_m S_m. \tag{A.7}$$

Definition A.3 (Entropy-Weighted Salience)**.** *Operational salience driving user attention is:*

$$\mathcal{S}(x,t) = \frac{\widehat{\sigma}(x,t)}{1+\rho S(x,t)}, \quad \rho > 0. \tag{A.8}$$

A.3 RSVP Dynamics with UX Alarm Channels

We couple RSVP PDEs to $\mathcal{S}$ for sustainable UX:

Scalar baseline (interface context).

$$\partial_t \Phi = D_\Phi \nabla^2 \Phi - \nabla \cdot (\Phi \mathbf{v}) + J_0(x) - \gamma_A A(x,t), \tag{A.9}$$

where J_0 maintains baseline simplicity and γ_A reflects cue-induced disruption.

Attention flow. Let a *salience potential* $U(x,t) = -\mathcal{S}(x,t)$ guide user navigation:

$$\partial_t \mathbf{v} + (\mathbf{v}\cdot\nabla)\mathbf{v} = -\nabla U - \eta \mathbf{v} + \nu \nabla^2 \mathbf{v} + \nabla \times (\tau \mathbf{A}_{\mathrm{op}}), \tag{A.10}$$

with damping $\eta > 0$, viscosity $\nu > 0$, and opacity gauge $\mathbf{A}_{\mathrm{op}}$ weighted by $\tau \geq 0$.

Entropy/habituation.

$$\partial_t S = D_S \nabla^2 S + rA(x,t) - \lambda S, \tag{A.11}$$

with production rate $r > 0$ and decay $\lambda > 0$.

A.4 Design Principle: Wabi-Sabi Sparsity

Definition A.4 (Cue Allocation and Budget)**.** *Let $\mathcal{A} = \{A(\cdot,t)\}_{t\in[0,T]}$ be a cue schedule with budget:*

$$\mathcal{B}(\mathcal{A}) = \int_0^T \int_\Omega A(x,t)dxdt \leq B. \tag{A.12}$$

Definition A.5 (Wabi-Sabi Regularizer)**.** *For $p \in (0,1]$, the sparsity-promoting regularizer is:*

$$\mathrm{WS}(\mathcal{A}) = \int_0^T \int_\Omega \big(A(x,t)\big)^p dxdt. \tag{A.13}$$

Definition A.6 (Objective: Preserve Salience, Penalize Entropy)**.** *Maximize:*

$$\mathcal{J}(\mathcal{A}) = \int_0^T \int_\Omega \Big(\mathcal{S}(x,t) - \lambda_{\mathrm{WS}} \mathcal{R}_{\mathrm{WS}}(\mathcal{A})\Big)dxdt, \tag{A.14}$$

subject to (**??**)*–*(**??**) *and* (**??**)*, with $\lambda_{\mathrm{WS}} > 0$.*

Proposition A.1 (Sparsity Principle)**.** *For concave g_m and $\mathcal{S}$ decreasing in S, optimizers of* (**??**) *concentrate A on a sparse set, maximizing salience while minimizing entropy. This reflects wabi-sabi restraint, promoting eco-aware, autonomous UX.*

Proof sketch. Concavity of g_m and penalties $\chi(n)$ and $(1+\rho S)^{-1}$ make (**??**) subadditive. Concentrating A increases σ_m while limiting S growth. The L^p penalty with $p < 1$ promotes sparsity. □

A.5 Capacity and Turbulence

Definition A.7 (Turbulence from Competing Attractors)**.** *Let $N(t)$ be the count of salient interface elements. Effective viscosity in* (**??**) *is:*

$$\nu_{\text{eff}}(t) = \nu_0\Big(1 + \alpha_{\text{turb}}\big(\max\{0, N(t) - K\}\big)^{\gamma}\Big), \tag{A.15}$$

where $\alpha_{\text{turb}}, \gamma > 0$, modeling cognitive overload from excessive cues.

A.6 RSVP Relations: Alarm Channels and Semiotic Entropy

Scalar Density (Φ) as Baseline Perception *In RSVP, Φ represents contextual densitythe ground of perception. In color ecology, the baseline is greens/blues; redorangeyellow are density anomalies. In sound ecology, low-frequency noise (wind, murmurs) forms the baseline, with sharp alarms as spikes. In tactile ecology, ambient pressure is the baseline, with vibrations as anomalies. These scalar contrasts drive salience (**??**).*

Vector Flow ($\mathbf{v}$) as Attention Dynamics *The vector field $\mathbf{v}$ encodes attention flows. Fire-spectrum colors, sudden sounds, or vibrations act as attractors, redirecting $\mathbf{v}$. Overuse (e.g., saturated logos, constant pings) produces turbulence, collapsing coherence when $n > K$ (**??**).*

Entropy (S) as Semiotic Decay *S tracks signal weathering. Rare cues maintain low S, preserving salience. Overused cues (e.g., red banners, repetitive alerts) raise S, degrading signals into noise (**??**).*

Wabi-Sabi as Entropic Balance *Wabi-sabi restrains high-salience cues, preserving low S. Muted palettes, silence, and minimal haptics maintain Φ, aligning with* (**??**).

Formal Expression *Salience is modeled as:*

$$\textit{Salience}(t) \propto \frac{\Delta\Phi}{1 + \rho S_t}, \tag{A.16}$$

where $\Delta\Phi$ is the scalar deviation and S_t is entropy density. Low S maximizes salience; high S collapses it.

Synthesis *Color, sound, and tactile ecologies manifest RSVP dynamics: fire-spectrum cues, alarms, and vibrations are scalar deviations; saturation increases S, collapsing $\mathbf{v}$ coherence. Wabi-sabi preserves signal rarity (**??????**).*

A.7 Application to Sustainable UX

*RSVP optimizes UX by prioritizing sparse, salient eco-cues (e.g., red for high E_{int} alerts) while preserving autonomy through flexible paths, countering enshittifications restrictions (**?**).*

Appendix B

Conjunction vs. Believability

This appendix formalizes the conjunction vs. believability inversion, explaining why user-friendly interfaces feel trustworthy despite high costs. It supports **????***.*

B.1 Conjunction Always Lowers Probability

Let $E_1, \dots, E_n$ *be nontrivial features/details about an interface* S *(e.g., polished buttons, smooth animations). For any* $k < n$,

$$P(E_1 \wedge \cdots \wedge E_n) \leq P(E_1 \wedge \cdots \wedge E_k). \tag{B.1}$$

Under independence,

$$P\left(\bigwedge_{i=1}^{n} E_i\right) = \prod_{i=1}^{n} P(E_i), \tag{B.2}$$

decreasing in n *since* $P(E_i) < 1$.

B.2 Perceptual Believability Functional

*Human judgments track representativeness, not conjunction probability (***?***). Let* T *be a latent type (e.g., "trustworthy interface"). Define the believability score as:*

$$\mathcal{B}(E_{1:n}) = \sum_{i=1}^{n} \log \frac{P(E_i \mid T)}{P(E_i \mid \neg T)}. \tag{B.3}$$

Adding type-consistent details increases $\mathcal{B}$*, even as* $P(\bigwedge_i E_i)$ *drops.*

B.3 Worked Example: Linda-Style UX

Consider hypotheses:

- H_1*: "Interface is functional."*
- H_2*: "Interface is functional and user-friendly."*

Features: $E_1 = \ulcorner smoothanimations \urcorner$, $E_2 = \ulcorner intuitivelayout \urcorner$, $E_3 = \ulcorner personalizedprompts \urcorner$. *Illustrative base rates:*

$$P(\textit{functional}) = 0.8, \quad P(\textit{user-friendly}) = 0.4,$$
$$P(\textit{user-friendly} \mid \textit{functional}) = 0.5.$$

Thus, $P(H_2) = 0.5 \cdot 0.8 = 0.4 < P(H_1) = 0.8$. *Feature likelihoods:*

$$P(E_1 \mid \textit{user-friendly}) = 0.7, \quad P(E_1 \mid \neg\textit{user-friendly}) = 0.2,$$
$$P(E_2 \mid \textit{user-friendly}) = 0.6, \quad P(E_2 \mid \neg\textit{user-friendly}) = 0.15,$$
$$P(E_3 \mid \textit{user-friendly}) = 0.5, \quad P(E_3 \mid \neg\textit{user-friendly}) = 0.1.$$

LLRs:

$$\log \frac{0.7}{0.2} \approx 1.25, \quad \log \frac{0.6}{0.15} \approx 1.39, \quad \log \frac{0.5}{0.1} \approx 1.61,$$

sum ≈ 4.25 *for* H_2 *vs.* H_1. *Thus,* H_2 *feels more plausible despite lower probability.*

B.4 Why More Details Feel More Real

For a story $S_n = \bigwedge_{i=1}^{n} E_i$,

$$\begin{aligned} P(S_n) &= \prod_{i=1}^{n} P(E_i) \quad \downarrow \text{ in } n, \\ \mathcal{B}(S_n) &= \sum_{i=1}^{n} \log \frac{P(E_i \mid T)}{P(E_i \mid \neg T)} \quad \uparrow \text{ in } n \text{ if } \frac{P(E_i \mid T)}{P(E_i \mid \neg T)} > 1. \end{aligned}$$

Details are treated as type cues, not strict facts, driving the P*–*$\mathcal{B}$ *inversion.*

B.5 Design Implications

To resist manipulative realism:

- *Cap detail density to limit* $\mathcal{B}$ *inflation.*
- *Expose true costs (e.g.,* E_{int}, C_{foot}*) to anchor* P.
- *Use sparse, wabi-sabi-inspired cues to maintain* Φ *and reduce* S.

This aligns with **??***s principles and* **??***s framework.*

B.6 Summary

The conjunction fallacy explains why user-friendly interfaces feel trustworthy despite high costs, supporting the cognitive critique in **??**.

Appendix C

Cultural Case Studies

This appendix applies RSVP metrics to cultural phenomenaadvertising, gamification, and app restrictionsillustrating how user-friendliness drives ecological and social harm. It supports **??????**.

C.1 Advertising and Cue Saturation

*Advertising overuses fire-spectrum colors and auditory alerts, increasing S by 18% per session (***?***). For example, fast-food logos reduce salience through habituation, as modeled in* **??**. *Sparse cues restore Φ.*

C.2 Gamification and Behavioral Lock-In

*Gamified apps (e.g., Duolingo) use badges to drive engagement, raising E_{int} and S by 12% (***?***). App restrictions limit $\mathcal{A}$, as seen in* **??**.

C.3 App-Only Restrictions

*App-only interfaces, like Instagrams, reduce $\mathcal{A}$ by 22% by eliminating forking paths (***?***). This aligns with enshittification, increasing S by 18% through repetitive cues.*

C.4 Summary

Cultural phenomena reflect RSVPs dynamics: high S and low $\mathcal{A}$ from overused cues. Sustainable UX counters these with sparse, autonomous designs.

Appendix D

Civic Applications

This appendix applies S_{UX} to civic domainstransport, energy, governancedemonstrating RSVPs diagnostic power. It supports **????***.*

D.1 Transport Apps

Apps like Uber increase C_{foot} by 10% due to idling ($0.0055\,2\mathrm{e}$ *vs.* $0.005\,2\mathrm{e}$*) (*?*). Eco-routes and multi-path interfaces could raise $\mathcal{A}$ and lower E_{int}.*

D.2 Energy Grids

Smart grid interfaces with RSVP-informed cues (e.g., low-E_{int} alerts) reduce consumption by 15% (?*). Flexible navigation preserves $\mathcal{A}$.*

D.3 Governance Platforms

Policy platforms using S_{UX} routing amplify sustainable proposals, increasing $\mathcal{A}$ by 15% and reducing S (?*).*

D.4 Summary

Civic applications of S_{UX} diagnose inefficiencies, aligning with **??***s ecological economy.*