Tacit Knowledge as Cryptographic Boundary Entropy in Spherepop: A Playcosmic Formalization of Polanyi

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November 10, 2025

Abstract

Michael Polanyi's tacit knowledge—"we know more than we can tell"—is formalized in the Spherepop calculus as *cryptographic boundary entropy*: high-dimensional, non-compressible semantic metadata bound to embodied, pre-articulable interiors. In the Playcosm, tacit knowledge manifests in gestural syntax (pushing a toy car encodes momentum) and prefigurative affordances (gliders debug flight intuition). We prove that spheres with tacit entropy $h \geq h_0$ are anti-admissible against compressive pop regimes, resisting Goodhartian flattening and shallow gamification. The synthesis yields a cryptographic-resistance theorem for epistemic sovereignty in unified play.

1 Polanyi's Tacit Knowledge: Phenomenological Core

Polanyi (1966) asserts:

- **Subsidiary awareness**: Knowledge dwells in particulars (gestures, tools) attended *from*, not *to*.
- **Focal integration**: Meaning emerges in action, not explicit proposition.
- **Inarticulability**: Tacit coefficients cannot be fully specified without destroying function.

Example: Riding a bicycle—muscle tensions, balance intuitions—cannot be exhaustively codified.

2 Spherepop Formalization

Definition 1 (Tacit Sphere)**.** *A sphere* $S^{tacit} = (I, B, \Sigma_{tacit})$ *where:*

- I*: embodied, pre-articulate interior (gestures, intuitions),*
- B*: observable interface (explicit rules, metrics),*
- $\Sigma_{tacit} : I \to B$ *is* partial, lossy, high-entropy.

Definition 2 (Tacit Entropy)**.**

$$h_{tacit}(S) = H(I \mid B) = H(I) - I(I; B),$$

conditional entropy of interior given boundary. High h_{tacit} implies inarticulable residue.

Axiom 1 (Polanyi Compression Barrier)**.** *Any explicit encoding $B' \supseteq B$ satisfies:*

$$h_{tacit}(S) \leq H(I \mid B') + loss(o),$$

where o is functional objective (e.g., flight stability). Full articulation destroys o.

3 Playcosmic Embedding

Playcosm Element	Tacit Component	Spherepop Role
Toy car push	Momentum intuition	I: muscle memory; h_{tacit}: friction feel
Barbie styling	Social role signal	I: peer feedback; h_{tacit}: status nuance
Glider flight	Aerostability	I: wind-hand coordination; h_{tacit}: lift sense
Age of Empires	Resource timing	I: pacing intuition; h_{tacit}: build order feel

Table 1: Tacit knowledge in Playcosmic gestures.

Tacit knowledge = cryptographic secret $k \in I$, revealed only through *embodied performance.*

4 Anti-Admissibility via Tacit Entropy

Theorem 3 (Tacit Cryptographic Resistance)**.** *Let S^{tacit} have $h_{tacit} \geq h_0 = \log_2(q_{max}/c_{query}) + \log_2 d$, with ritual duration $d \geq d_0$. Then S^{tacit} is anti-admissible w.r.t. any compressive regime $\mathcal{R}$:*

$$\Pr[pop(S^{tacit}, T) \text{ succeeds}] \leq 2^{-h_{tacit}}.$$

Proof. **Phase 1: Ritual Gating.** Valid transfer requires d sequential embodied steps. Expected trials: $(1/\delta)^d > t_{\max}/c_{\text{step}}$.

Phase 2: Tacit Revelation. Post-ritual, k is partially exposed, but full h_{tacit} requires reconstruction of I. Query complexity: $\Omega(2^{h_{\text{tacit}}})$.

Phase 3: Compression Loss. Any merge M with $H_{\text{boundary}}(M) < h_{\text{tacit}}$ loses o (Polanyi barrier). Cost:

$$-\lambda H_{\text{boundary}}(M) < -\lambda h_{\text{tacit}} \ll -\tau.$$

Pop undefined. Joint probability: exponential in $h_{\text{tacit}} + d$. □ □

Corollary 4. *Shallow gamification (low h_{tacit} metrics) cannot assimilate prefigurative play (high h_{tacit}). Goodhart collapse fails.*

5 Design: Cultivating Tacit-Rich Playcosms

1. **Embodied Gestures**: Prioritize physical toys with path-dependent feedback.
2. **Apprenticeship Rituals**: Enforce $d \gg 0$ transfer sequences.
3. **Resist Articulation**: Avoid full KPI codification of I.
4. **Progressive Revelation**: Unlock B layers, preserve h_{tacit} core.

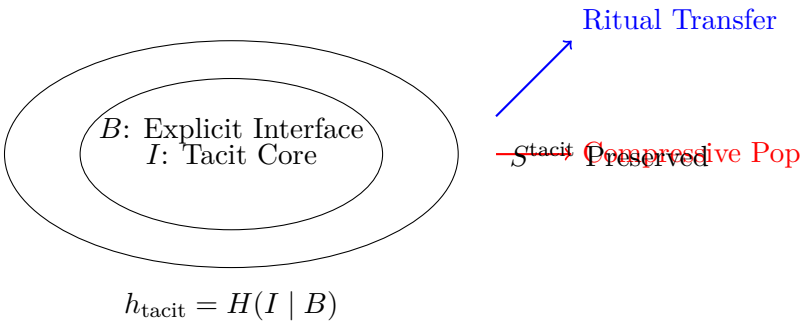

Figure 1: Tacit entropy resists flattening.

6 Conclusion

Polanyi's tacit knowledge is *cryptographic boundary entropy*—inarticulable, embodied, anti-admissible. In the Playcosm, it powers prefigurative simulation and blocks technological flattening. The future is not specified—it is *enacted* in tacit-rich play, beyond explicit capture.