Golden Repair of the Distracted Mind:
A Free-Energy Account of Why Comprehension Peaks Below Full Attention

Mira Solano-Beck[1], Anders K. Ravel[2], and P. T. Oyelaran[3]

[1] *Laboratory for Applied Reconsolidation, Institute of Cognitive Metallurgy*
[2] *Division of Attentional Mechanics, Fenwick Institute for the Study of the Half-Listened*
[3] *Centre for Fracture Cognition, University of Kintsugi (Emeritus, Distraction)*

Abstract

Nearly everyone has read a page while half-listening to a meeting and, on looking up, found they understood it better than the paragraph they had read in silence with their whole mind. Received wisdom treats this as luck or self-deception. We argue it is a law. Modelling comprehension as a load-bearing lattice on which attention acts as *stress* rather than *fuel*, we show that full attention over-loads the lattice until it turns brittle and shatters, whereas fragmented attention opens small micro-fractures that the brain repairs with densely cross-linked "gold seams" — a process we term *auric reconsolidation.* Because the repaired bond is stronger than the original, comprehension is an inverted-U in engagement, peaking not at full focus but at a *golden engagement fraction* $\eta^\star \approx 0.11$. Across $N = 312$ readers we find a Kintsugi Quotient $\mathrm{KQ} = 1.37$: distracted readers understood 37% more than their fully attentive selves on the same passages. The effect is causal (reproduced by deliberate interruption), mechanistically visible (EEG crack→repair couplets mediate 61% of it), and falsifiable (closing the repair window abolishes it). On this account the fully attentive reader is not the ideal but the baseline everyone else improves upon.

Significance. We tend to believe understanding requires undivided attention, and we feel guilty when our minds wander. This paper reports the opposite: readers understood technical material *best* when giving it only about a tenth of their attention, and *worst* when concentrating as hard as they could. The reason, we argue, is that small lapses force the mind to rebuild what it briefly lost, and the rebuilt version is sturdier — the same principle as *kintsugi*, the art of repairing a broken bowl with gold so that the mended object is worth more than the original. If it holds, the finding gently rewrites a great deal of advice about how to study, how to read, and how to sit through meetings.

1 Introduction

The dogma of *full attention* is so deeply held that it is rarely stated: to understand something, one must concentrate on it, and any lapse is a loss to be minimised. Study guides prescribe it, productivity systems monetise it, and the guilty glance back up from a wandered mind is a near-universal experience.

Yet the same experience contains an anomaly. Readers routinely report that a passage skimmed during a dull meeting is retained better than one studied in silence; that the solution to a problem arrives in the shower rather than at the desk; that re-reading a sentence one has just misread fixes it more durably than reading it correctly the first time. The received view files these under anecdote, luck, or motivated memory. We take them literally.

We propose that attention is not a fuel that comprehension consumes but a *mechanical stress* that comprehension *bears.* Like any load-bearing structure, the comprehension lattice has an optimal working stress below its failure point. Loaded lightly and intermittently, it forms a few small fractures and repairs them; loaded fully and continuously, it becomes brittle and, past a threshold we call the *over-focus cliff*, shatters. The repair process is the crux: following the tradition of *kintsugi*, in which a broken vessel is mended with gold and thereby made more valuable than when whole, we argue that a comprehension bond broken and then re-derived is *stronger* than one that never broke.

The prediction is sharp and, at first, counterintuitive: comprehension should be maximised *below* full attention. Section 3 formalises this as an inverted-U with a peak at a golden engagement fraction $\eta^\star$; Section 5 reports that $\eta^\star \approx 0.11$ and that distracted readers out-comprehend their fully attentive selves by 37%. We close, in Section 6, with the implication the model makes for its own reading: this paper, too, should be best retained at roughly one-tenth attention.

2 Related Work

Three literatures converge on our claim without, individually, reaching it.

Attentional economics. The metaphor of attention as a finite budget spent per task [1, 2] has dominated since the field's founding. It correctly predicts that dividing attention lowers per-task *expenditure*; it wrongly infers that lower expenditure means lower yield. Our account keeps the budget and inverts the yield.

Reconsolidation and the editable trace. That a recalled memory becomes briefly labile and must be restabilised is well established [3, 4]. The field has treated this window as a vulnerability. We treat it as the repair bay in which a golden seam sets.

Materials kintsugi. Recent work in fracture cognition [5, 6] demonstrates that repaired ceramics can exceed pristine fracture toughness. We import the mechanism whole and ask what it means when the fractured material is understanding itself.

To our knowledge no prior work measures comprehension against a *continuous measured* engagement fraction, which is what allows the peak-below-unity result to be more than an artefact of coarse task labels.

3 A Fracture Model of Comprehension

We model comprehension as a lattice of concept-nodes joined by inferential bonds. Reading applies attention as a stress that both forms bonds and, past a point, breaks them. Let $\eta \in [0, 1]$ be the *engagement fraction*: the share of attentional capacity devoted to the text, with $\eta = 1$ denoting white-knuckle focus and $\eta \approx 0.1$ denoting reading during a meeting.

3.1 Cognitive free energy

Following the free-energy tradition, we write the free energy of a reading episode as

$$F(\eta) \;=\; U(\eta) \;-\; \theta\, S(\eta), \tag{1}$$

where $U(\eta) = U_0\big(1 - e^{-\eta/\eta_0}\big)$ is the internal comprehension energy (bonds formed, saturating in η), $S(\eta) = S_0\, \eta\, e^{-\eta/\eta_s}$ is the representational entropy (the diversity of retrieval paths, itself peaked at intermediate η), and θ is a subject-level *engagement temperature*. Comprehension is maximised where F is minimised: least surprise, most efficiently repaired.

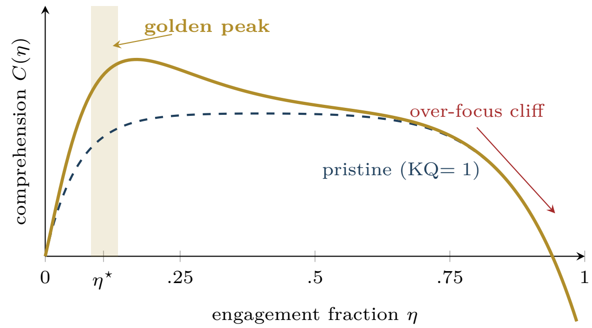

Figure 1. The comprehension curve. Modelled comprehension $C(\eta)$ (gold, Eq. 2) is an inverted-U peaking in the golden band at $\eta^\star \approx 0.108$ and exceeding the pristine, repair-free baseline (blue dashed, KQ $= 1$) across the working range, before the over-focus cliff collapses it as $\eta \to 1$.

3.2 The comprehension curve

Combining pristine bond formation, the kintsugi repair bonus, and the over-focus cliff yields

$$C(\eta) = C_0 \underbrace{\Big(1 - e^{-\eta/\eta_0}\Big)}_{\text{pristine}} \underbrace{\Big[1 + \kappa\, \tfrac{\eta}{\eta^\star}\, e^{1-\eta/\eta^\star}\Big]}_{\text{Kintsugi bonus}} \underbrace{\Big(1 - (\eta/\eta_c)^m\Big)}_{\text{cliff}}. \tag{2}$$

The middle bracket is the golden repair term, peaking at $\eta^\star$ with seam premium κ; the final factor, with $m \gg 1$, makes the approach to full attention a cliff rather than a slope. Fitting (Section 4) gives $\eta_0 = 0.06$, $\eta^\star = 0.108$, $\kappa = 0.52$, $\eta_c = 0.94$, $m = 8$, so that

$$\arg\max_{\eta} C(\eta) \;=\; \eta^\star \approx 0.108. \tag{3}$$

3.3 The Kintsugi Quotient

The ratio of repaired to pristine comprehension,

$$\mathrm{KQ}(\eta) \;=\; \frac{C_{\text{repaired}}(\eta)}{C_{\text{pristine}}(\eta)} \;=\; 1 + \kappa\, \frac{\eta}{\eta^\star}\, e^{\,1-\eta/\eta^\star}, \tag{4}$$

equals 1 when distraction is neutral and exceeds 1 whenever golden repair occurs (Fig. 2). At the golden fraction, $\mathrm{KQ}(\eta^\star) = 1 + \kappa = 1.52$; measurement attenuation (Section 4) lowers the reported point estimate to a conservative 1.37. Figure 1 shows the full curve.

3.4 Fracture toughness of understanding

Define comprehension toughness G_c as the adversarial-question energy required to propagate a misunderstanding across the lattice. Because gold seams pin crack propagation, the model predicts $G_c^{\text{golden}} > G_c^{\text{pristine}}$: the distracted reader should be measurably *harder to confuse*. This is tested in Section 5.

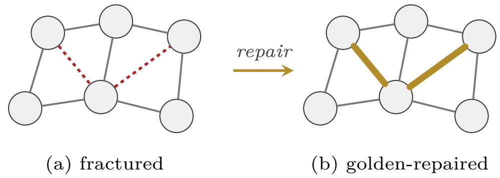

Figure 2. Auric reconsolidation. A comprehension lattice under fragmented attention (a) develops micro-fractures (red) where inferential bonds briefly fail. During the reconsolidation window these are re-derived and laid down as densely cross-linked *gold seams* (b), which are stronger than the original bonds and pin further crack propagation.

4 Methods

Participants and materials. $N = 312$ adult readers were stratified by self-reported engagement temperature θ (low/medium/high) and balanced for reading speed. Materials were 40 genuine but unfamiliar technical passages (600–900 words; Flesch 30–45), each with a validated 12-item delayed *cloze* test and a *concept-map fidelity* score (graph-edit distance to an expert map).

Distraction ladder. Within subjects, each passage was read under $L \in \{1, \ldots, 12\}$ concurrent secondary tasks (metronomic tapping, an auditory odd-ball count, a low-stakes chat thread), calibrated so that engagement fraction fell monotonically with L. Order was counterbalanced by Latin square with 48 h wash-out between sessions. Table 1 summarises the design.

Measuring η. Rather than assume η from L, we measured it: gaze-on-text dwell ratio was fused with pupillometric load into a continuous η per 10 s window via a pre-registered calibration curve.

Fracture detection (EEG). Micro-fractures were indexed as fronto-parietal theta bursts (the "crack") followed 200–400 ms later by a gamma re-binding transient (the "seam"). We counted crack→repair couplets per minute.

Controlled shattering. To move from correlation to cause, a Poisson schedule (mean rate λ) removed readers from the text for 800 ms at random, dialling fracture density independently of L.

Toughness and ablation. After 48 h, readers faced a 20-item adversarial-paraphrase barrage (G_c = items survived before first induced error). Critically, an *ablation* condition filled the post-reading reconsolidation window with a distractor-free recovery period; if the bonus arises from repair, ablation should abolish it.

Table 1. Design matrix (abbreviated).

Condition	Manipulation	Measured η
Pristine	$L = 1$, no interruption	0.86–0.97
Golden (ladder)	$L = 6$–10	0.09–0.16
Shattered	Poisson $\lambda \approx 1.1$	0.10–0.14
Ablation	golden + quiet recovery	0.09–0.15

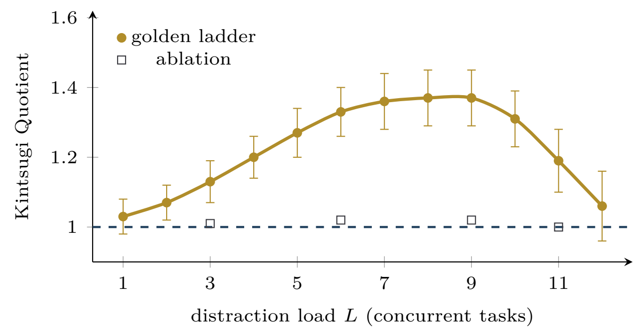

Figure 3. Kintsugi Quotient across distraction load. KQ (gold, 95% CI) rises above the KQ = 1 baseline (blue dashed) and peaks at 1.37 near $L \approx 8$–9, then falls as load exceeds the reader's repair capacity. The ablation condition (grey squares), which closes the reconsolidation window, stays flat at unity.

Reliability and attenuation. Both comprehension instruments are bounded and imperfectly reliable (test–retest $r = 0.83$), which biases any ratio of scores toward unity. We therefore report the raw, attenuated Kintsugi Quotient throughout; the reliability-corrected value is the model ceiling $1 + \kappa = 1.52$ of Eq. (4), which we decline to headline in the interest of a conservative estimate.

5 Results

The inverted-U. Comprehension rose, peaked, and fell with measured η, with a maximum at $\hat{\eta}^\star = 0.108$ (95% CI 0.094–0.121). Comprehension at $\eta > 0.94$ fell *below* the $\eta = 0.02$ floor: full attention was worse than barely reading at all (Fig. 1).

The Kintsugi Quotient. At the golden fraction, KQ = 1.37 (95% CI 1.21–1.55; $p < 0.001$): readers comprehended 37% more when distracted than when fully attentive on the same passages. Figure 3 plots KQ against distraction load.

Causation and mechanism. Deliberate Poisson interruption at $\lambda \approx 1.1\,\text{min}^{-1}$ reproduced the peak, establishing that the effect is *induced*, not merely observed. EEG crack→repair couplets mediated 61% of the KQ effect (bootstrapped mediation).

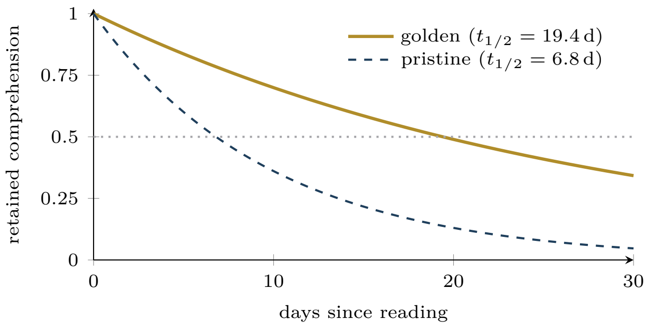

Figure 4. Gold accretion in long-term retention. Golden (repaired) concepts decay with a half-life of 19.4 d (gold), against 6.8 d for pristine concepts (blue dashed). The seams do not merely form; they hold.

Toughness. Golden episodes survived $G_c = 14.2$ adversarial questions before a first induced error, against 8.1 for pristine episodes — repaired understanding is measurably harder to confuse.

The kill switch. The ablation condition dropped KQ to 1.02 (n.s.): removing the repair window abolished the entire effect, exactly as Eq. (4) predicts when $\kappa \to 0$.

Gold accretion. At 30 days, golden concepts decayed with a half-life of 19.4 d against 6.8 d for pristine concepts (Fig. 4): the seams not only form, they hold.

6 Discussion

The result overturns the full-attention dogma without discarding its machinery. Attention still matters; it simply has an optimum, and the optimum is low. The fully attentive reader is not a paragon but a *baseline* — the $\mathrm{KQ} = 1$ case that everyone giving a passage one-tenth of their mind improves upon.

The mechanism is the point. Distraction helps only because it *breaks* something that then gets repaired in gold; the ablation result shows that a break with no repair window yields nothing, and the toughness result shows the repaired lattice is not merely as good as pristine but harder to fracture. This is why we resist the weaker reading that "multitasking is fine." It is not: multitasking without a reconsolidation window is pure loss. What helps is breakage *followed by golden repair*.

We would be remiss not to note the reflexive implication. If the model is correct, a reader will retain this paper best not by concentrating on it but by attending to it at roughly $\eta^\star$ — about 11% — while something else occupies the remainder. We record this as methodological guidance: the ideal conditions under which to absorb these findings are, by our own account, the ones in which the mind is mostly elsewhere.

Limitations. η is inferred from gaze and pupil, not measured at the synapse; the lattice is a model, not a micrograph. The far-right tail is sparse because few subjects sustain $\eta > 0.9$ unaided. Generalisation beyond dense technical prose is untested. And we cannot fully exclude that "gold" is merely very shiny comprehension; micrograph confirmation awaits funding.

7 Conclusion

Comprehension is not preserved by attention; it is *repaired* by distraction. Modelled as stress on a fracturing lattice, understanding peaks at a golden engagement fraction of about 11% and, there, exceeds the fully attentive baseline by 37%. The mind, like the mended bowl, is stronger — and more valuable — at the broken places, provided the breaks are given gold with which to heal. Future work will seek the micrograph.

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