The Deep Symbolic Systems Model
A Falsifiable Framework for Symbolic Stabilization Before Civilization

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Abstract
This paper introduces the Deep Symbolic Systems Model (DSSM), a cognitive-archaeological framework proposing symbolic stabilization, rather than economic

surplus or administrative innovation, as the precondition for institutional emergence. DSSM defines stabilization through four jointly necessary criteria — intergenerational repetition, spatial constraint, cross-media redundancy, and persistence under stress — and maps its development through four stages, from embodied familiarity to institutional offloading. The Stage 2→3 transition is governed by an architectural rather than cognitive bottleneck: beyond an effective community size of roughly 500 individuals, face-to-face transmission becomes structurally insufficient, and material externalization becomes adaptive rather than optional. A two-dimensional Field Companion Protocol (FCP) is introduced as the model's operational scoring method, with its structure, application, and current limits stated directly. The pattern DSSM predicts — stabilization preceding institutional and monumental signatures — is briefly illustrated across six macro-regions and structurally distinct pathways, grounded in each region's published primary literature. Negative and boundary cases, including Aboriginal Australia, Late Neolithic Europe, and large-scale exchange networks without institutional emergence, are treated as scope-condition tests, and seven falsifiable predictions are stated directly.

Keywords: Cognitive Archaeology; Symbolic Stabilization; Comparative Civilizations; Falsifiability; Institutional Emergence

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*1.**Introduction***

Why do communities of comparable ecological opportunity and symbolic richness diverge so sharply in whether that richness ever becomes institutional? Environmental and surplus-based accounts of civilizational emergence (Childe 1950; Diamond 1997) identify enabling conditions but struggle to explain why comparable ecologies produce different outcomes, or why symbolic and administrative forms persist through episodes of documented ecological and political collapse. Punctuated cognitive-revolution models, which locate a sharp behavioural discontinuity in a narrow window, sit awkwardly against a record in which symbolic behaviour — ochre use, curated artefacts, structured spatial occupation — accumulates gradually across several hundred thousand years (McBrearty & Brooks 2000), and in which monumental ritual construction appears in non-agricultural, non-urban contexts millennia before any conventional marker of civilization (Schmidt 2010).

Cognitive archaeology has developed substantial component theories addressing pieces of this puzzle. Material engagement theory (Malafouris 2013) establishes that material culture constitutes rather than merely represents cognition. Distributed cognition (Hutchins 1995) and the extended-mind thesis (Clark & Chalmers 1998) show how cognitive load is offloaded onto social and material systems. Practice theory (Bourdieu 1990) grounds the embodied, habitual transmission of convention across generations. Modes of religiosity theory (Whitehouse 2004) distinguishes ritual frequencies with different transmission properties. Niche construction theory (Laland et al. 2015) frames symbolic systems as environments organisms actively build and are in turn constrained by. Each addresses part of the problem. None, individually, specifies a falsifiable developmental sequence, ties that sequence to a stated threshold mechanism, or provides a scoring method that separates evidentiary strength from interpretive certainty.

The Deep Symbolic Systems Model (DSSM) is introduced here as an integration addressing that gap. It is not offered as a replacement for the frameworks above, each of which supplies part of its architecture, but as a synthesis that states, in advance, when symbolic stabilization should produce durable institutions and when it should not. The argument proceeds in seven parts. Section 2 states DSSM's four stabilization criteria and four-stage architecture, with their grounding in cognitive and behavioural evidence. Section 3 develops the model's central threshold mechanism. Section 4 introduces the Field Companion Protocol, DSSM's operational scoring method, and where and how it is applied. Section 5 briefly illustrates the pattern across six macro-regions, each treated at even weight and grounded in its own published primary literature. Section 6 treats negative and boundary cases as scope-condition tests. Section 7 positions DSSM against the frameworks introduced above, and Section 8 states its falsification conditions directly.

2. What DSSM Proposes: Criteria and Stage Architecture

DSSM treats symbolic stabilization as the condition under which a symbolic system persists independently of any individual carrier or single transmission event (cf. Rappaport 1999; Assmann 2011, on ritual and cultural memory as trans-generational carriers of meaning). A system is DSSM-stabilized only if it jointly satisfies four criteria. Intergenerational repetition requires that the system reproduce reliably across at least three generations without depending on any specific individual. Spatial constraint requires that the system impose recurrent, non-arbitrary structure on space, movement, or behaviour — axiality, enclosure, orientation. Cross-media redundancy requires expression in at least two distinct media: material, ritual, landscape, or linguistic. Persistence under stress requires that the system maintain recognizable form across ecological disruption, demographic pressure, or political reorganization. The criteria are jointly necessary rather than additive: a system satisfying three that collapses at the first ecological disruption has not achieved stabilization, regardless of its apparent complexity at peak expression.

2.1 Neural and Behavioural Grounding

The first two developmental stages rest on independently documented properties of habit and ritual formation rather than on claims specific to any archaeological case. Procedural memory consolidation, centred on the basal ganglia and cerebellum, encodes motor sequences that are resistant to forgetting over timescales far exceeding explicit declarative recall, and is well documented as the neural substrate of habit formation generally (Graybiel 2008). Ritualization — the constraining, stylizing, and social sanctioning of action sequences into predictable, learnable, transmissible patterns — has long been treated in the anthropology of ritual as a cognitive technology that reduces transmission cost while amplifying social coordination (Rappaport 1999; Turner 1969). Orality and literacy studies (Ong 1982) document the specific mnemonic techniques — formulaic repetition, spatial anchoring, rhythmic and performative redundancy — by which pre-literate societies maintain complex knowledge across generations without external inscription. None of these findings is specific to DSSM; the model's contribution is to organize them into a sequence with stated thresholds, developed below.

Stage	Label	Defining threshold
1	Embodied Symbolic Familiarity	Recurrent motor-ritual patterns transmitted through direct observation and co-participation; no durable external encoding
2	Ritualized Repetition	Stabilized ritual sequences, oral transmission, and spatial memory anchors sustained through periodic community aggregation
3	Material Amplification & Externalization	Effective community size exceeds the architectural bottleneck (Section 3); symbolic load is externalized into durable, portable, or spatially fixed media

4	Cognitive Offloading & Institutional Emergence	Writing, administration, and law appear as compression of pre-existing symbolic load; monumentality as a late-stage signature rather than an origin

Table 1. DSSM's four-stage architecture.

The stages are analytical categories rather than a deterministic evolutionary ladder: a community can remain at Stage 2 indefinitely, as the Australian case in Section 6.1 demonstrates, and Stage 4 is not an inevitable terminus but a contingent outcome that occurs only where accumulated symbolic load exceeds what non-linguistic, non-material systems can resolve.

2.2 Stage 3 and Stage 4

Stage 3, material amplification and externalization, rests on the same ontological claim that grounds material engagement theory generally: that objects do not simply encode pre-formed symbolic content but actively extend and reorganize cognitive processes (Malafouris 2013). The specific DSSM claim is narrower than this general position. Once symbolic load exceeds what embodied and ritualized practice can reliably maintain, a community faces a threshold choice — externalize into durable, portable, or spatially fixed media, or risk symbolic drift and fragmentation. The threshold itself, and the demographic mechanism that produces it, is developed in Section 3.

Stage 4, cognitive offloading and institutional emergence, is the proximate mechanism of state formation: the systematic transfer of memory, coordination, and authority to institutional structures and material devices. This transfer is only possible once Stages 1–3 have substantially completed, because institutional legibility presupposes symbolic conventions already shared widely enough to make institutional encoding recognizable and authoritative in the first place — a point consistent with work on the materiality of numerical and administrative cognition (Overmann 2016) and on cognitive extension into durable devices more generally (Clark 2008). Writing, on this account, is not the origin of institutional complexity but its compression: a technology that appears once accumulated symbolic load requires a linear, portable, and scalable medium capable of carrying it further than ritual and monumentality alone can (Goody 1986; Schmandt-Besserat 1992).

3. The Stage 2→3 Transition: An Architectural, Not Cognitive, Bottleneck

The transition from Stage 2 to Stage 3 is the discriminating step in the model: the point at which symbolic richness either converts into the durable substrates institutions require, or remains locked within a community too large to sustain it by co-presence alone — or too small to need to. DSSM treats this transition as a bottleneck in the architecture available for storing and transmitting symbolic content, not as a limit on cognitive capacity. The distinction matters: nothing in the

comparative material surveyed here gives reason to think that populations on either side of the transition differ in their capacity for symbolic thought. What differs is whether community size has outrun the reach of the transmission mechanisms — direct observation, oral repetition, periodic communal gathering — that Stage 1 and Stage 2 depend on.

Face-to-face transmission of ritual and symbolic convention has a documented scale limit. Dunbar's (1992; 2009) social-brain hypothesis identifies approximately 150 individuals as the practical ceiling for stable, high-fidelity social relationships maintained through direct interaction. Ethnographic and demographic analysis of hunter-gatherer social networks (Hamilton et al. 2007; Henrich 2016) indicates that communities of roughly 150–500 sustain symbolic coherence beyond this ceiling through periodic aggregation — seasonal gatherings, communal ceremonies — which functions as an error-correction mechanism, resynchronizing sub-groups whose day-to-day contact has lapsed. Once effective community size grows large enough that this aggregation-based resynchronization becomes logistically unworkable — too many sub-groups, too great a distance, too long between gatherings — symbolic drift between sub-groups begins to outpace the community's internal capacity to correct it, a dynamic consistent with formal models of cultural transmission fidelity (Mesoudi 2017; Richerson et al. 2016). At that point, DSSM predicts that externalizing symbolic content into durable, portable, or spatially fixed media stops being a cultural option and becomes a structural necessity, since no other mechanism could carry a stable convention across sub-groups that no longer reliably meet face to face; this causal chain is the model's proposed mechanism rather than an independently established finding.

A first illustrative case is consistent with a bottleneck near 500 effective community members. Population estimates for Naqada II Hierakonpolis in the Predynastic Nile Valley, for example, put effective community size at roughly 2000–5000 individuals by circa 3500 BCE (Hassan 1985) — well above the proposed threshold, and coincident with the period's earliest standardized portable symbolic media. The precise figure requires calibration against a broader settlement-size sample before it can be treated as more than a working threshold (Section 8, Prediction P7), and it is stated here as a testable claim rather than an established constant.

DSSM's proposed figure is not asserted in isolation, however. Independent lines of research in archaeology and anthropology, developed without reference to DSSM and addressing a related but distinct question — the point at which face-to-face decision-making becomes unworkable, rather than the point at which symbolic content must be externalized — converge on population thresholds in a broadly similar range. Johnson's (1982) scalar-stress model, built from cross-cultural decision-making data, identifies a coordination threshold in the low hundreds before groups require hierarchical restructuring. A logistic-regression model built independently on Hutterite colony-fissioning records estimates a critical threshold at 127 individuals (95% CI 122–132), a figure the same study cross-validates against unrelated archaeological cases spanning Bronze Age Sicily, the North American Southwest, and Neolithic China (Alberti 2014). Kosse (1990) locates a related long-term-memory threshold at 100–200. Carneiro (2000) contrasts Yanomamö villages, which fission near 200 individuals, with Kayapó villages that reach 600–800 through nested segmentary organization — a solution that manages scale without requiring material externalization, which is itself informative: population size does not mechanically force any single outcome, and the specific adaptive response depends

on which coordination strategies are available to a given community. DSSM's proposed threshold sits toward the upper end of this convergent range, consistent with the claim that full material externalization is a more demanding coordination solution than decision-making hierarchy alone, required only once subtler strategies — aggregation, nested delegation — are no longer sufficient.

A second archaeological case, independent of Hierakonpolis and drawn from an unrelated research tradition, is directly consistent with this range. Quantitative settlement-area analysis of the Middle Neolithic village of Jiangzhai in China's Yellow River valley documents a population rising to an estimated 300–600 individuals at its peak Yangshao-period phase; oversized, non-domestic integrative structures appear specifically during this high-population phase and are documented as absent in both the preceding and following lower-population phases of the same site (Peterson & Shelach 2012), a pattern independently modelled elsewhere as consistent with critical scalar stress occurring specifically at that phase (Alberti 2014). Two cases from unrelated regions, periods, and research traditions do not constitute a demonstrated general law, and the convergence with the broader scalar-stress literature is suggestive rather than confirmatory — that literature addresses a related coordination problem, not the specific externalization mechanism DSSM proposes. But the combination is a stronger basis for treating 500 as a serious working threshold than any single case would provide alone.

The mechanism's clearest illustration is negative rather than positive: societies that never approach this scale sustain extraordinarily rich symbolic systems indefinitely without ever generating the pressure to externalize them (Section 6.1). The architecture, not the content, is what is missing in such cases, and its absence is a maintained equilibrium rather than a failure of cognition.

4. The Field Companion Protocol

DSSM's operational instrument, the Field Companion Protocol (FCP), is introduced here as a method for scoring archaeological and comparative-ethnographic evidence against the four criteria of Section 2. Standard single-axis scoring instruments in cognitive archaeology conflate two properties that are logically independent: how robustly a pattern is archaeologically detected, and how distinctly symbolic — rather than functionally explicable — that pattern is. A well-excavated assemblage can appear symbolically rich simply because it is well preserved, while a sparsely documented but clearly non-functional depositional pattern can be under-scored for want of data.

The FCP addresses this by scoring six observables independently on two axes. Evidence Strength (E, 0–2) measures the quality, quantity, and replicability of the evidential base. Symbolic Specificity (S, 0–2) measures whether an alternative functional or taphonomic account could explain the same pattern equally well. The six observables are: Mnemonic Architectures (spatially encoded structures preserving ritual or cosmological knowledge without writing); Symbolic Stabilization (recurrence of the same forms across time, site, and medium); Externalized Cognition (transfer of memory, coordination, or social role into material or spatial substrates); Symbolic Regulation (use of symbolic systems to enforce behavioural norms or distribute authority); Distributed Symbolic Authority (evidence that symbolic competence is socially distributed rather than monopolized); and Portable Symbolic Anchors (miniaturized or mobile carriers of core symbolic content enabling

transmission across distance).
Each observable's final score is the minimum of its two axis scores, min(E, S), so that abundant but ambiguous evidence cannot inflate a score the way it would under a single-axis instrument: a period with many well-preserved but functionally ambiguous artefacts scores high on E and low on S, yielding a low final score that honestly reflects interpretive uncertainty rather than one inflated by evidentiary volume. Maximum composite score across all six observables is 12; saturation is diagnosed at a composite of 7 or above with no observable scoring zero, since failure on any single criterion — never crossing generations, never constraining space, never linking material to ritual, or collapsing at first disruption — indicates the system has not achieved the institutional persistence Stage 3 and above require. A pilot inter-rater reliability check, using an independent rater with no prior exposure to DSSM theory scoring thirty assemblage contexts against the published criteria without theoretical instruction, produced substantial agreement in a regional application of the instrument to the Nile Valley (Vondoom in press); that result is a minimum reliability floor from a single regional case rather than full validation, and systematic multi-rater testing across independent regional specialisms is identified as a priority for future work (Section 9).

4.1 Where and How the FCP Is Used

The FCP is designed to be applied at three scales. At the site level, it scores individual assemblages or contexts — a cemetery, a ceremonial precinct, a single stratigraphic phase — against the six observables, producing a profile that can be compared directly against other sites regardless of period or region. At the regional level, site-level scores are aggregated across a stratigraphic sequence to produce the kind of trajectory illustrated in Section 5: a rising or plateauing composite score that can be checked against the timing of monumental or administrative developments in the same sequence, testing Predictions P1 and P3 (Section 8) directly. At the comparative level, regional trajectories are set against one another to test whether the pathway-independent claims of Predictions P4 and P6 hold: whether institutional emergence is consistently preceded by criteria satisfaction regardless of which of the pathways in Section 5 a region follows, and whether regions with fragmented or absent Stage 3 evidence consistently fail to produce institutions regardless of their Stage 1–2 richness.
The core six criteria and the 0–2 Evidence Strength / Symbolic Specificity scale are specified as a universal baseline, intended to apply without modification regardless of region, period, or social scale, and full operational detection rules, a step-by-step scoring procedure, and a standardized observation log are published as a stand-alone field manual (Vondoom 2026): no region-specific calibration is required before a researcher can apply the core protocol to a new case. A set of optional extensions supplements the core protocol for specific analytical situations that cut across regions rather than tracking any single pathway — undeciphered scripts, symbolic systems that are household-distributed with no identifiable central authority, very long multi-phase sequences, and predominantly oral or performative systems with limited material trace. These extensions, including a supplementary flag distinguishing whether a subject built, maintained, or inherited a symbolic system, are recorded alongside the standard scoring sheet and do not alter the core 12-point total; they add interpretive transparency for edge cases rather than filling

a gap in the core criteria themselves.

5. Applying DSSM: A Brief Cross-Regional Illustration

This section illustrates, briefly and at even weight across regions, that the pattern DSSM predicts — stabilization evidence preceding institutional and monumental signatures — recurs across structurally distinct settings. It is deliberately not a full comparative application: a systematic, stratigraphically scored treatment of any one region is beyond this paper's scope, and the purpose here is to show that the pattern generalizes across published primary evidence, not to re-derive any single case in full. Six macro-regions are covered, following six distinct stabilization pathways.

5.1 Landscape-Anchored Pathway: The Nile Valley and Mesopotamia

In the Nile Valley, standardized Badarian mortuary practice (c. 4500 BCE) and Naqada-period ceramic and iconographic redundancy precede the Old Kingdom pyramid complex at Saqqara and Giza by roughly two millennia (Lehner & Hawass 2017), with population estimates for Naqada II Hierakonpolis (2000–5000 individuals; Hassan 1985) crossing the architectural bottleneck of Section 3 well before the earliest administrative writing at Abydos (Dreyer 1998). Mesopotamia follows a structurally similar landscape-anchored logic on a different timeline. Mobile Epipalaeolithic occupation at sites such as Shanidar Cave, using microlithic toolkits and probable ochre body symbolism, shows repeated seasonal placement near watercourses consistent with structured landscape engagement rather than opportunistic reuse (Solecki 1971), and early cultivation and communal storage at Mureybit and Abu Hureyra document ritualized consumption practices anchoring social meaning before full agricultural dependence (Cauvin 1972–1974; Moore et al. 2000). These precede Ubaid-horizon village standardization across the southern floodplain (c. 6500–3800 BCE; Postgate 1994; Adams 1981) and the earlier Neolithic villages of Hassuna and Samarra in the north (Lloyd 1984), which in turn precede the Uruk temple economy and proto-cuneiform tablets at Eridu and Uruk (Nissen 1988) by roughly three millennia. As elsewhere, settlement orientation and craft standardization persist through documented episodes of localized flooding and demographic contraction rather than resetting after them, consistent with a general pattern in which social memory outlives the institutions that first encoded it (Connerton 1989).

5.2 Infrastructural Pathway: The Indus Valley

The Indus Valley tradition, from Mehrgarh through the Mature Harappan period (c. 7000–2600 BCE), is argued, on the evidence available, to satisfy the four stabilization criteria among the earliest of the regions surveyed here, without a dominant monumental centre — though the six regions are dated from evidentiary bases of unequal depth, so this ordering should be read as indicative rather than a precise ranking: symbolic grammar is instead distributed across standardized craft production, settlement planning, and a shared system of weights and seals (Kenoyer 1998; Possehl 2018), persisting through documented climatic variability rather than collapsing at the first sign of disruption (Petrie et al. 2017).

5.3 Portable-Craft Pathway: East Asia

East Asia relies earlier and more prolongedly on portable and craft-based media than on fixed monumentality. Engraved rib fragments from Lingjing, Henan Province, dated to roughly 105,000–125,000 years ago, are too deliberately incised to be explained as butchery marks and are among the earliest evidence anywhere for durable, non-utilitarian marking on bone (Li et al. 2019), though this early evidence remains episodic rather than spatially anchored or cross-media redundant. The Jiahu site (c. 7000–5700 BCE) is argued here to mark the region's first full stabilization under DSSM's criteria — standardized burial orientation, turtle-shell markings, and bone flutes providing cross-media redundancy — and the Hongshan jade tradition (c. 3300–2300 BCE) subsequently concentrates and circulates symbolic authority through portable objects rather than architecture (Underhill 2013; Liu & Chen 2021; Shelach-Lavi 2015). Monumental axial architecture and oracle-bone writing appear abruptly and late, at Erlitou and in the Shang period respectively, formalizing rather than originating this longer craft-symbolic substrate.

5.4 Distributed-Ritual Pathway: Mesoamerica

Lacking a single dominant axial river system, Mesoamerica's stabilization pathway is correspondingly distributed. Repeated reoccupation of Guilá Naquitz Cave in Oaxaca and the wider Tehuacán Valley over several millennia functioned as a mnemonic node for seasonal aggregation, with early domesticated squash and maize recovered from the same stratified deposits as the ritualized subsistence practice that accompanies them, rather than preceding it (Piperno & Flannery 2001). Early Formative villages in the Soconusco region and Oaxaca Valley (c. 4000–2500 BCE) are argued to satisfy all four criteria through fixed settlement plans, sub-floor burial, and long-distance jade and obsidian exchange (Flannery & Marcus 2012; Clark & Blake 1994), and the subsequent Olmec ritual-object network maintains coherence across dispersed centres through shared calendrics and portable jade objects rather than a single capital (Diehl 2004). Monumental platforms and colossal sculpture at San Lorenzo and La Venta (from c. 1400 BCE) are late compression artefacts of this network rather than its origin.

5.5 Forager-Mnemonic Pathway: Sri Lanka

Sri Lanka's route to stabilization runs through cave-based mnemonic architecture and portable ornament rather than landscape monumentality or craft exchange networks, constituting a sixth, distinct pathway. Fa-Hien Lena Cave preserves the earliest microlithic technology in South Asia in firm association with ochre, shell beads, and bone-tipped arrows (Wedage et al. 2019; Langley et al. 2020), and comparable traditions at Batadomba-lena persist with only incremental modification across the Last Glacial Maximum, evidence for the persistence-under-stress criterion (Perera et al. 2011). Deraniyagala's (1992) synthesis of the wider island sequence documents this microlithic and ornamental continuity as a regional pattern rather than a single-site anomaly, spanning the transition from Late Pleistocene rainforest foraging through Holocene environmental change without a corresponding shift toward monumental or centralized ritual architecture. Urban

infrastructure and Brahmi writing at Anuradhapura (c. 300 BCE) sit at the terminus of this substantially longer trajectory (Coningham et al. 2017).

Pathway	Representative region	Mechanism
Landscape-anchored	Nile Valley, Mesopotamia	Symbolic load anchored in a fixed geographic axis, amplified into stone monumentality
Infrastructural	Indus Valley	Symbolic grammar embedded in daily material practice — settlement planning, standardized weights and seals
Portable-craft	East Asia	Cross-media redundancy carried by replicable objects transmitted through craft apprenticeship and
Distributed-ritual	Mesoamerica	Symbolic coherence maintained across dispersed ritual centres through shared calendrical and aggregation systems
Forager-mnemonic	Sri Lanka	Symbolic transmission carried by cave-based mnemonic architecture and portable ornament across repeated occupation

Table 2. Five generative stabilization pathways identified across the six regions surveyed (Nile Valley and Mesopotamia share the landscape-anchored pathway).

Region	Earliest stabilization evidence	Monumentality / institutional signature
Nile Valley	c. 4500 BCE (Badarian mortuary standardization; Brunton & Caton-Thompson 1928)	c. 2650 BCE (Step Pyramid, Saqqara; Lehner & Hawass 2017)
Mesopotamia	c. 6500 BCE (early Ubaid village standardization; Akkermans & Schwartz 2003)	c. 3100 BCE (Uruk temple economy, proto-cuneiform; Postgate 1994)
Indus Valley	c. 7000 BCE (Mehrgarh craft and settlement regularity; Kenoyer 1998)	c. 2600 BCE (Mature Harappan urban standardization; Possehl 2018)
East Asia	c. 7000 BCE (Jiahu multimodal stabilization; Underhill 2013)	c. 1500–1200 BCE (Shang oracle-bone divination; Liu & Chen

Mesoamerica	c. 4000 BCE (Early Formative village stabilization; Flannery & Marcus 2012)	c. 900 BCE (La Venta platform construction; Flannery & Marcus 2012)
Sri Lanka	c. 48,000–45,000 BP (Fa-Hien Lena ochre and ornament; Wedage et al. 2019)	c. 300 BCE (Anuradhapura urbanism and Brahmi writing; Coningham et al. 2017)

Table 3. Approximate stabilization onset relative to monumental or institutional signature, by region and primary source. Figures are illustrative summaries drawn from the published literature cited in Section 5, not from independent stratigraphic re-analysis.

The lag between stabilization onset and institutional signature varies by several orders of magnitude across the six regions — shortest in Mesoamerica at roughly three millennia, longest in Sri Lanka at tens of millennia — consistent with DSSM's prediction that the lag is pathway-dependent rather than governed by a single universal timetable (Section 8, P4). None of the six regions is treated here with the stratigraphic depth a full regional application would require; this table summarizes the published evidence cited in Section 5 rather than presenting new stratigraphic analysis.

6. Scope Conditions: Negative and Boundary Cases

A framework that cannot state where symbolic stabilization should not produce institutions is not falsifiable. Sections 6.1–6.3 examine true negative cases, in which institutional emergence is absent or delayed, each for a distinct and statable reason. Section 6.4 examines an open boundary case for the threshold mechanism of Section 3 itself.

6.1 Aboriginal Australia: A Maintained Equilibrium Below Threshold

Aboriginal Australian communities maintained extraordinarily rich symbolic systems — Dreaming cosmology, multi-community ceremonial structures — while sustaining effective band sizes of roughly 25–50 individuals, with ceremonial aggregation reaching perhaps 200–400 temporarily (Keen 2018; Merlan 2020): consistently below the architectural bottleneck of Section 3. Exchange objects in this context function primarily as relationship markers within face-to-face events rather than as autonomous symbolic carriers legible outside them — consistent with the Stage 2/ Stage 3 boundary DSSM predicts. The small scale of these communities appears to be socially maintained rather than ecologically forced, which is what makes the case an illustration of the threshold mechanism rather than a simple absence of data: Stage 3 externalization did not fail here; it was never structurally required.

6.2 Sub-Saharan Africa: Fragmentation Rather Than Absence

Rock art, ochre use, and ritual aggregation document strong evidence for Stage 1–2 criteria across much of sub-Saharan Africa in the relevant periods (McBrearty &

Brooks 2000), but standardized, widely distributed portable media remain fragmented rather than structurally absent by design, distinguishing this from the Australian case. This reflects the specific connectivity and production conditions Stage 3 requires, not a deficiency in symbolic capacity, and constitutes a second, distinct failure mode from Section 6.1.

6.3 Late Neolithic Europe: Delayed Rather Than Absent Emergence

Megalithic Atlantic traditions and later Corded Ware material culture show partial satisfaction of the Stage 3 criteria: standardized objects without full inter-community symbolic-carrier function (Scarre 2018). The predicted outcome under DSSM is delayed rather than permanently absent institutional emergence, with state-level formation following by roughly a millennium and a half — a quantitative, region-specific prediction not generated by surplus or administrative accounts of state formation on their own.

6.4 A Boundary Challenge: Large-Scale Exchange Without Institutional Emergence

Highland New Guinea's ceremonial exchange networks — the Moka and Tee systems — mobilize participants well beyond the 500-individual bottleneck at the network level, yet produced no comparable institutional emergence in the relevant period (Wiessner & Tumu 1998), an apparent challenge to the threshold logic of Section 3. The resolution turns on distinguishing exchange-network scale from co-residential community scale: the hamlets participating in these networks remain individually well below the threshold, and the networks themselves function as periodic resynchronization events analogous to Australian ceremonial aggregation, not as a chronic transmission-fidelity deficit. The exchanged objects — pigs, pearl shells, axes — function as relationship markers within these events rather than as autonomous carriers recognizable outside them, the same Stage 2/Stage 3 boundary identified in Section 6.1. The case is better read as a further illustration of the mechanism at a different scale than as a counterexample to it, though it is stated here as an open boundary case rather than a settled one.

7. Relation to Existing Cognitive-Archaeological Frameworks

DSSM does not claim to originate the component insights it integrates, and its relationship to each of the frameworks introduced in Section 1 is worth stating precisely rather than left implicit. Material engagement theory (Malafouris 2013) provides the ontological basis for Stage 3 externalization — the claim that objects do not merely represent pre-formed symbolic content but actively extend and transform cognitive processes — but does not, as formulated, predict a fixed developmental sequence or specify a threshold at which externalization becomes structurally necessary rather than optional. Distributed cognition (Hutchins 1995) and the extended-mind thesis (Clark & Chalmers 1998) supply the general mechanism by which cognitive load is offloaded onto social and material systems, but treat offloading as a standing property of cognitive systems rather than as a threshold-triggered response to community scale specifically. Practice theory

(Bourdieu 1990) grounds the embodied, habitual character of Stage 1 and Stage 2 transmission through the concept of habitus, but does not generate falsifiable claims about institutional emergence with advance detection windows. Modes of religiosity theory (Whitehouse 2004) distinguishes high-frequency, low-arousal ritual modes from infrequent, high-arousal ones in a way closely related to DSSM's Stage 2 ritualization, but does not specify temporal lags between modes of the kind DSSM's demographic threshold requires. Niche construction theory (Laland et al. 2015) provides the evolutionary framing for symbolic systems as environments that populations actively construct and are constrained by, but operates over a longer evolutionary timescale than the multi-generational windows DSSM's stages specify.
DSSM's distinct contribution is proposed to lie not in any one of these positions but in their integration into a single sequence with a stated threshold mechanism and a paired scoring instrument — a claim this paper states but does not yet independently demonstrate (see below). That integration's value is best assessed by systematic, criterion-by-criterion comparison against each framework on the specific dimension of falsifiable prediction generation — a comparison this paper does not claim to have completed, and which is identified as a priority for future work in Section 9.

8. Falsifiable Predictions

DSSM states its predictions directly rather than leaving falsification implicit. Table 4 summarizes the seven claims this paper treats as testable, with the empirical test and falsification criterion for each.

Prediction	Testable claim	Falsification criterion
P1: Temporal precedence	Sites developing monumental construction show evidence for ≥2 stabilization criteria in the stratigraphic phases preceding the earliest monument	Monument construction at a well-excavated site with no criteria met in any prior phase
P2: Writing as codification	The majority of graphemic elements in an early writing system are traceable to prior, non-written material culture	Writing introducing predominantly novel symbolic categories absent from all prior
P3: Standardization precedes elaboration	Artefact variability (coefficient of variation) falls substantially before major technological or architectural elaboration begins	Elaboration co-occurring with rising or stable artefact variability in a well-sampled sequence
P4: Cross-pathway convergence	Institutional emergence is preceded by evidence for all four criteria, regardless of which of the five pathways (Section 5) a region follows	A well-documented region with institutional emergence and no prior evidence for intergenerational repetition

P5: Portable or fixed anchors precede monuments	Standardized symbolic media (fixed or portable) predate monumental architecture by multiple generations	Monumental construction with zero prior symbolic tradition of any kind
P6: Negative cases as scope tests	High Stage 1–2 evidence combined with absent or fragmented Stage 3 evidence predicts absent or delayed institutional emergence	High Stage 1–2 evidence plus institutional emergence with zero Stage 3 evidence of any kind
P7: Community-size threshold	Stage 3 crossing is expected above an effective co-residential community size of roughly 500; absent or delayed below it	A society below 500 with full Stage 3 completion, or a society consistently above 500 with high Stage 1–2 evidence and persistent Stage 3 absence over multiple centuries

Table 4. DSSM's seven falsifiable predictions.

To date, no securely dated case in the comparative record surveyed here meets any of these falsification conditions. The clearest potential counter-case — monumental construction preceding agriculture in the Pre-Pottery Neolithic (Schmidt 2010) — is consistent with, rather than falsifying, P1, since the hunter-gatherer populations responsible appear, on the published excavation record, to satisfy the four stabilization criteria across multiple construction phases before monumental amplification begins.

9. Limitations and Future Research

Three limitations bound the claims made here. The approximately 500-individual threshold in Section 3 is theoretically derived and demographically plausible but requires calibration against primary settlement-size data across a considerably broader comparative sample than is drawn on here. The Field Companion Protocol, introduced in Section 4, has not yet been subjected to multi-rater reliability testing across independent regional specialisms, and its scoring criteria for the forager-mnemonic and distributed-ritual pathways in particular would benefit from field-level operationalization comparable to what exists for the landscape-anchored pathway. Section 5 is deliberately illustrative rather than a full comparative application; a systematic, stratigraphically scored treatment of any of the six regions is beyond this paper's scope, and none of the six summaries here should be read as a substitute for that fuller treatment.

The priority research agenda includes systematic, criterion-by-criterion comparison of DSSM against the frameworks discussed in Section 7; multi-rater FCP validation across independent regional specialisms; agent-based modelling of symbolic drift dynamics to formalize the community-size threshold of Section 3 (following the

general approach of Mesoudi 2017); and application of the FCP to the boundary case in Section 6.4, where the pathway typology of Section 5 has not yet been tested against primary settlement or production data.

A further limitation concerns derivative adoption — cases in which one society reproduces another's already-saturated symbolic form through contact, rather than generating it endogenously (for example, the Kushite adoption of Egyptian pyramid architecture several centuries after the Egyptian tradition's own peak, discussed only briefly here for reasons of scope). The Capital Source distinction introduced in Section 4.1 was designed to separate within-culture building, maintaining, and inheriting of a symbolic system, not cross-cultural adoption of one; extending it to formally score derivative-adoption cases against the same six criteria used elsewhere in this paper is a needed extension rather than a solved problem, and is identified here as a priority for future work rather than attempted in this paper.

10. Conclusion

DSSM's value as a lens lies in treating symbolic stabilization as a precondition to be measured rather than assumed. Its four criteria and four-stage architecture draw on independently established findings in ritual cognition, distributed and material cognition, and cultural transmission theory; the model's contribution is their integration into a single sequence with a stated threshold mechanism, a scoring instrument that separates evidentiary strength from symbolic certainty, and explicit falsification conditions. Across five structurally distinct pathways and six macro-regions, monumentality and writing follow symbolic saturation rather than produce it in each of the six illustrations surveyed, and the negative and boundary cases examined here are consistent with, rather than embarrassing, that pattern, each for a distinct and statable reason. The task the framework sets for itself is not to explain any one civilization's emergence after the fact, but to specify in advance when symbolic stabilization should, and should not, become institutional — and to state plainly what evidence would show that specification wrong.

SDG Alignment Statement

This research contributes to SDG 4 (Quality Education) by providing an operationalized, falsifiable framework for teaching cognitive-archaeological method across regional specialisms; to SDG 10 (Reduced Inequalities) by illustrating that multiple non-Western civilizational traditions may have achieved symbolic saturation independently and through structurally distinct pathways, counter to hierarchical narratives of civilizational development; and to SDG 16 (Peace, Justice and Strong Institutions) by offering a mechanistic account of how legitimate institutional authority emerges from, and can outlast, the political regimes that subsequently make use of it.

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