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Digital Mediation and Multilingual Ecological Restructuring in Hainan: From Layered Equilibrium to Platform-Induced Hierarchy

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Abstract: This article examines how digital platform infrastructures restructure multilingual ecologies in frontier regions, using Hainan Island as a case study. Historically, Hainan sustained a layered multilingual equilibrium in which Hlai (Li), Hainanese (Southern Min), and Mandarin occupied differentiated social domains. Functional specialization and spatial segmentation enabled asymmetrical yet stable coexistence without large-scale structural convergence. However, the rise of digitally mediated communication introduces a qualitatively distinct organizing principle. Rather than distributing linguistic authority across socially negotiated domains, digital platforms centralize visibility through interface design, algorithmic amplification, and technological standardization. Drawing on sociolinguistic scaling theory and platform studies, this study proposes the Digital Multilingual Ecological Shift Model (DMESM), which conceptualizes the transition from domain-based equilibrium to platform-induced hierarchy. The analysis demonstrates that minority languages such as Hlai face cumulative infrastructural constraints, including limited orthographic standardization, lack of input system integration, and reduced algorithmic visibility. As governance, commerce, and education increasingly migrate online, linguistic vitality becomes dependent not only on intergenerational transmission but on infrastructural embedding. The findings suggest that digitalization constitutes structural ecological reordering rather than communicative expansion. The model offers a framework for analyzing digitally mediated multilingual inequality beyond the Hainan context and contributes to the theoretical extension of contact linguistics into the era of platform governance.

Keywords: Digital Multilingual Ecology; Platform Infrastructure; Linguistic Hierarchy

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1. Introduction

Multilingual frontier regions have historically sustained linguistic coexistence through functional differentiation rather than structural convergence. In such environments, languages do not necessarily compete toward replacement; instead, they distribute across social, economic, and cultural domains in relatively stable configurations. Hainan Island represents a compelling example of this phenomenon. Located at the intersection of Sinitic migration routes and Tai–Kadai indigenous settlement, Hainan developed a layered multilingual ecology in which Hainanese (Southern Min), Li (Hlai), and later Mandarin coexisted through domain-based specialization rather than grammatical convergence or language shift.

Historical accounts of southern Chinese linguistic expansion demonstrate that Southern Min varieties diffused through maritime mobility networks rather than uniform territorial expansion[1]. At the same time, Li languages—classified

within the Hlai branch of Tai–Kadai—exhibit deep historical roots on Hainan Island, as evidenced by comparative reconstruction studies[2]. Previous scholarship on language contact in the region has largely focused on lexical borrowing and phonological adaptation[3], emphasizing how sustained interaction produces stratified linguistic layers. However, such analyses primarily address pre-digital interactional ecologies.

In traditional multilingual settings, domain specialization operates as the organizing principle of coexistence. As Fishman's domain theory suggests, language distribution often correlates with social function rather than structural dominance[4]. In Hainan, Li retained authority in land-based practices, ritual performance, and intra-community communication, while Hainanese mediated coastal trade and interpersonal exchange, and Mandarin structured administrative governance. This configuration resembles what Enfield terms an "epidemioLogical diffusion network," where linguistic features circulate through overlapping but socially bounded interactional networks[5]. Crucially, such systems can remain stable for extended historical periods without triggering structural convergence or language death.

The emergence of digital communication infrastructures introduces a qualitatively different structural condition. Scholars of sociolinguistics in globalization have argued that digital mediation alters the spatial and hierarchical organization of language use[6]. Unlike traditional domain-based distribution, digital environments centralize language visibility through platform architecture, algorithmic amplification, and technological standardization. As van Dijck observes, platforms function not merely as neutral communication tools but as infrastructural systems that shape visibility, access, and participation[7]. Recent research further suggests that minority languages face particular challenges in such contexts: interface absence produces implicit hierarchization[8], and online language hierarchies reflect both technological affordances and sociopolitical inequalities[9].

The UNESCO framework for language vitality identifies domains of use, intergenerational transmission, and institutional support as central indicators of language sustainability[10]. However, this framework predates the dominance of algorithmically curated digital platforms. In digitally mediated contexts, language vitality increasingly depends on technical integration, searchability, corpus availability, and input standardization. Blommaert argues that contemporary linguistic inequality must be understood within layered infrastructures of scale, where global platforms redistribute linguistic authority beyond local communities[6].

Against this backdrop, Hainan provides a particularly revealing case for investigation. Historically characterized by stratified multilingual coexistence, the island is now undergoing rapid digital transformation, especially within the context of Free Trade Port development and digital governance expansion. Administrative services, education, commerce, and media increasingly operate through digital platforms whose interface languages, encoding standards, and recommendation algorithms privilege certain languages over others. While Mandarin enjoys comprehensive institutional and technological support, Li lacks widely standardized orthography, integrated input systems, and large-scale digital corpora. If digital platforms operate as structural mediators that reorder multilingual equilibria, then minority language marginalization may occur not through overt suppression but through infrastructural invisibility.

This study therefore advances three central research questions. First, how do digital platforms reorganize language visibility within Hainan's multilingual ecology? Second, what structural constraints limit the digital presence of Li in comparison to Mandarin? Third, does digitalization produce a hierarchical reordering that departs from Hainan's historically stable domain-based equilibrium?

By integrating language vitality theory[10], digital platform studies[7], and sociolinguistic scaling theory[6], this paper proposes a Digital Multilingual Ecological Shift Model to conceptualize the transformation from layered equilibrium to platform-induced hierarchy. In doing so, it extends contact linguistics beyond historical interaction to account for infrastructural restructuring in the digital era.

2. Hainan's Historical Multilingual Equilibrium

Understanding the digital restructuring of Hainan's multilingual ecology requires first establishing the structural logic of

its pre-digital equilibrium. Hainan's linguistic configuration did not emerge from abrupt replacement but from centuries of layered migration, indigenous continuity, and maritime interaction. Historical documentation suggests that waves of Sinitic settlement reached Hainan primarily through coastal mobility rather than centralized state relocation[1]. These settlers brought Southern Min varieties that gradually developed into what is now recognized as Hainanese. At the same time, Li communities, classified within the Hlai branch of the Tai–Kadai family, maintained continuous presence across central and southern mountainous regions of the island[2].

Archaeological and linguistic reconstruction research indicates that Tai–Kadai-speaking populations likely preceded large-scale Sinitic settlement on Hainan[2,11]. Rather than displacing Li speakers entirely, Sinitic settlers established coastal and trade-oriented communities, resulting in a spatially differentiated linguistic distribution. Inland mountainous areas remained predominantly Li-speaking, while coastal settlements increasingly adopted Southern Min varieties. This geographic segmentation fostered interaction without immediate assimilation.

Such coexistence aligns with Fishman's domain-based sociolinguistic model, in which languages distribute across specific social functions rather than competing uniformly for dominance[4]. In Hainan's historical ecology, Li was strongly associated with land-based subsistence practices, ritual authority, and intra-community identity. Hainanese emerged as a lingua franca for trade networks and intergroup communication, particularly along maritime routes. With the expansion of administrative governance under successive Chinese dynasties and later under modern state consolidation, Mandarin gradually acquired institutional authority in formal domains.

Importantly, this distribution did not generate widespread structural convergence. Comparative phonological studies of Hainanese demonstrate retention of distinctive Min features despite long-term contact[3]. Similarly, Proto-Hlai reconstruction confirms the internal continuity of Li phonological systems[2]. The absence of significant grammatical convergence suggests that bilingualism in Hainan was stable rather than transitional. In Thomason's contact intensity framework, lexical borrowing may occur without deeper structural transfer when bilingualism remains domain-restricted[3].

The stability of this equilibrium can also be interpreted through ecological metaphors. Enfield's concept of linguistic epidemiology emphasizes that linguistic features spread through networks of interaction rather than across homogeneous populations[5]. In Hainan, interaction networks were overlapping but not fully integrated. Coastal trade networks facilitated lexical exchange, while ritual and land-based practices reinforced Li continuity. The result was a layered system in which multilingual competence was widespread but structurally compartmentalized. Maritime trade further reinforced this equilibrium: Hainanese, as a Min variety, functioned within South China Sea trade circuits[1], facilitating exchange between inland Li communities and external markets without necessitating language replacement.

This historically layered equilibrium is therefore characterized by three structural properties: spatial differentiation limiting full linguistic assimilation, domain specialization distributing communicative authority across languages, and bilingual competence operating functionally rather than structurally. Crucially, this equilibrium was not static but dynamically maintained—minor lexical exchange and phonological accommodation occurred without destabilizing the broader ecological configuration. This pre-digital baseline is essential for measuring what follows: if historical multilingualism was sustained through domain-based differentiation, then any shift away from this organizing principle signals structural transformation.

3. Digital Mediation as Structural Reordering

If Hainan's historical multilingual system was organized through domain-based differentiation, digitalization introduces a fundamentally different organizing principle. Unlike traditional domains, which are socially negotiated and spatially distributed, digital platforms operate through infrastructural centralization. Language visibility in digital environments is determined less by community interaction and more by platform architecture, algorithmic design, and technical standardization.

In classical sociolinguistic models, domains such as family, trade, religion, and administration structure language use

through patterned social expectations[4]. Digital platforms, however, are technologically engineered environments governed by code, interface defaults, and algorithmic ranking systems. As van Dijck argues, platforms constitute infrastructural ecosystems that shape communication flows rather than merely hosting them[7]. The key structural transformation lies in the shift from domain authority to platform authority: in pre-digital Hainan, Li retained authority in land-based and ritual domains because these domains were socially regulated. Digital platforms redistribute communicative authority through technical affordances instead.

This transformation can be understood through Blommaert's concept of sociolinguistic scaling[6]. In digitally mediated environments, language practices are re-evaluated according to new scales of legitimacy and accessibility. Languages integrated into standardized encoding systems and supported by institutional infrastructures gain translocal mobility; those lacking such integration become restricted to low-visibility spaces. Digital visibility thus becomes a function of infrastructural compatibility rather than purely demographic presence.

Four structural mechanisms underlie this shift. First, interface language defaults influence user behavior: major digital platforms operating in China default to Mandarin, rendering Li structurally absent. As Deumert notes, interface absence produces implicit hierarchization[8]. Second, algorithmic amplification privileges content in languages with large corpora and high engagement metrics; Mandarin benefits from national-scale content production, while Li lacks the digital volume required for algorithmic prominence[9]. Third, technological standardization affects input and encoding: while Mandarin is supported by extensive input technologies, Li lacks widely disseminated input systems, reinforcing infrastructural inequality. Fourth, institutional digital governance—particularly within Hainan's Free Trade Port development—centralizes public communication in Mandarin, reducing the functional domains historically available to other languages.

These mechanisms collectively produce platform-induced hierarchical reordering. Unlike historical asymmetry, which was domain-bound and spatially segmented, digital asymmetry is infrastructural and pervasive, operating simultaneously across communication, governance, education, and commerce. Digital mediation does not necessarily eliminate minority languages from offline domains; rather, it redefines the conditions under which languages achieve relevance in high-mobility communicative spaces. If traditional multilingual equilibrium was maintained through domain specialization, digital environments dissolve those boundaries by consolidating communicative interaction within platform architectures, shifting multilingualism from functional distribution to algorithmic stratification.

4. Structural Constraints on Hlai in Digital Space

The structural mechanisms described above manifest as cumulative, mutually reinforcing constraints for Hlai specifically. Historically, Hlai maintained robust vitality within rural and mountainous regions of central and southern Hainan. Intergenerational transmission persisted in domestic and ritual contexts, and domain specialization preserved functional authority. According to UNESCO's language vitality framework, such domains constitute a critical indicator of sustainability[10]. However, the framework's emphasis on intergenerational transmission and institutional recognition does not fully account for digital infrastructural integration.

The first constraint concerns orthographic standardization. Unlike Mandarin, which possesses a fully standardized writing system supported by national education policy, Hlai lacks a widely accepted and consistently implemented orthography. Although linguistic research has proposed Romanized or phonetic transcription systems, these remain largely academic and have not achieved widespread community adoption. Orthographic instability inhibits digital circulation because platform systems rely on consistent encoding for searchability and algorithmic processing.

The second constraint involves input method integration. Mandarin benefits from highly optimized input systems across mobile and desktop environments. Hlai, by contrast, lacks mainstream input integration. Even if Unicode encoding theoretically supports Hlai phonetic representation, the absence of convenient input tools restricts spontaneous digital usage. In digitally mediated communication, friction in text production significantly reduces language presence.

Third, as Blommaert describes as "scale reordering," linguistic forms gain or lose mobility based on infrastructural

embedding rather than intrinsic communicative value[6]. Hlai content, even when produced, circulates within limited networks and receives minimal algorithmic reinforcement—a direct consequence of limited orthographic production and low corpus density feeding into recommendation systems on short-video platforms, social media, and search engines.

Fourth, institutional digitalization reinforces hierarchy. As public services, education systems, and administrative procedures migrate online under Free Trade Port development, Mandarin serves as the exclusive medium of official digital interaction. Even when offline community interactions remain multilingual, online bureaucratic engagement becomes monolingual. This transition narrows the functional domains available to Hlai not through prohibition but through infrastructural exclusion.

These constraints operate cumulatively and self-reinforcingly: orthographic instability limits digital production; limited production reduces algorithmic amplification; reduced amplification decreases perceived relevance; decreased relevance discourages institutional investment. The result is a feedback loop that gradually marginalizes minority languages within digital space. Hlai may continue to function robustly in face-to-face interaction while simultaneously losing relevance in high-mobility digital contexts—what may be termed digital invisibility. This bifurcation carries long-term implications: if youth language practices increasingly develop within digitally mediated environments and Hlai remains absent from these spaces, its symbolic association may shift from everyday communicative resource to heritage marker. It is therefore insufficient to assess minority language vitality solely through intergenerational transmission metrics; digital infrastructural integration must be recognized as a distinct dimension of contemporary vitality.

5. The Digital Multilingual Ecological Shift Model

Building on the preceding analysis, this study proposes the Digital Multilingual Ecological Shift Model (DMESM) to conceptualize how historically layered multilingual equilibrium transitions into platform-induced hierarchy. The model identifies three structural transitions.

First, authority shifts from domain to infrastructure. In the pre-digital era, language choice was mediated by social function and interactional context. In digital environments, language visibility is mediated by platform design, encoding compatibility, and algorithmic ranking. Infrastructure becomes the primary determinant of linguistic mobility.

Second, asymmetry shifts from segmented to systemic. Historical asymmetry in Hainan was domain-bound: Li dominated ecological contexts, while Sinitic languages structured administrative domains. Digital asymmetry is infrastructural and pervasive. Platform ecosystems operate across commerce, education, governance, and entertainment simultaneously, making linguistic hierarchy vertically integrated rather than horizontally distributed.

Third, vitality shifts from transmission-based to integration-based criteria. Traditional vitality models emphasize intergenerational transmission and institutional recognition[10]. Under digital mediation, vitality increasingly depends on technological integration: standardized orthography, input accessibility, search indexing, and corpus availability. Without infrastructural embedding, even demographically stable languages risk digital marginalization.

The DMESM thus conceptualizes ecological transformation across three structural phases. Phase One: Layered Multilingual Equilibrium—language distribution governed by domain specialization and spatial differentiation. Phase Two: Digital Mediation Layer—platform architecture introduces infrastructural filtering mechanisms that reorganize visibility and participation. Phase Three: Platform-Induced Hierarchy—languages with high institutional and technological integration acquire hyper-visibility, while those lacking integration experience digital invisibility.

In Hainan's case, Mandarin benefits from national standardization, educational reinforcement, and full technological integration. English occupies symbolic global positioning within interface options and transnational commerce. Hainanese, although regionally robust, lacks formal institutional embedding in digital governance structures. Hlai, facing orthographic and infrastructural limitations, occupies the lowest tier in digital visibility. Importantly, the model does not predict immediate language loss but ecological reordering: Hlai may continue to function in localized offline domains while simultaneously losing participation in high-mobility digital networks, producing stratified invisibility rather than abrupt

displacement.

The theoretical contribution of DMESM lies in extending ecological multilingual theory into digitally mediated contexts. While earlier contact models focused on migration, trade, and institutional power[3], the present framework introduces infrastructural mediation as a distinct explanatory variable. Digital platforms operate as ecological transformers, reshaping the parameters under which linguistic equilibrium can be sustained. This reconceptualization carries broader implications: frontier multilingual regions globally may experience similar transitions as governance, commerce, and education migrate to digital platforms.

6. Conclusion

The Hainan case illustrates how digital marginalization may occur without explicit language suppression. Hlai continues to function in localized social contexts, yet its absence from high-mobility digital networks constrains its participation in contemporary communicative life. This bifurcation between offline vitality and online invisibility signals a shift from functional multilingualism to infrastructural stratification—operating through design architecture rather than overt policy exclusion.

Importantly, the model does not predict deterministic decline. Institutional interventions—such as orthographic standardization, digital corpus development, minority-language input systems, and inclusive interface design—can modify infrastructural hierarchies. However, such measures require recognition that digital integration constitutes a structural dimension of language vitality rather than a peripheral enhancement. From a theoretical standpoint, the study extends contact linguistics into the digital era by introducing infrastructural mediation as a core explanatory variable, where classical contact theory emphasizes migration, trade, and political dominance[3], contemporary multilingual ecologies must also account for algorithmic visibility and platform governance.

Future research should empirically test the DMESM through three directions. First, comparative analysis across frontier multilingual regions could determine whether infrastructural hierarchy consistently emerges under digitalization. Second, quantitative study of digital language presence—such as corpus frequency distribution and algorithmic ranking patterns—would allow measurement of digital visibility disparities. Third, longitudinal research could assess whether digital marginalization correlates with subsequent shifts in intergenerational transmission patterns.

In conclusion, Hainan's multilingual history demonstrates that stable linguistic coexistence can persist across centuries through domain-based differentiation. The rise of digitally mediated infrastructures, however, introduces a new structural condition that reorganizes multilingual equilibrium. Recognizing digitalization as ecological restructuring rather than communicative expansion is essential for understanding contemporary language inequality. The future of minority language vitality in digitally connected societies will depend not only on community transmission but on integration within platform ecosystems that now govern visibility, mobility, and participation.

Disclosure statement

The author declares no conflict of interest.

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