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Linguistic Landscapes, Digital Payment Discourse, and Urban Multilingualism: A Comparative Semiotic Analysis of Cashless Communication in Tokyo and Stockholm

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ABSTRACT

The rapid expansion of digital payment infrastructures has transformed urban communication, multilingual public signage, and semiotic organization within contemporary cities. This study comparatively investigates how cashless payment systems reshape linguistic landscapes and communicative practices in Tokyo and Stockholm as two technologically advanced but socio-culturally distinct urban environments. Drawing upon linguistic landscape studies, multimodal discourse analysis, and urban sociolinguistics, the article analyzes 14,600 photographed public signs, digital transaction interfaces, multilingual payment notices, and institutional communication materials collected between 2023 and 2025. The findings indicate that Tokyo's payment discourse environment prioritizes informational density, multilingual accommodation, and institutional politeness, whereas Stockholm's communicative system emphasizes minimalist design, procedural efficiency, and digital self-service ideology. The comparative evidence demonstrates that cashless communication systems function not merely as economic technologies but as socio-semiotic infrastructures organizing linguistic visibility, urban inclusion, and public interaction. AI-assisted translation, QR-code communication, app-based transaction systems, and platformized consumer interfaces increasingly shape multilingual accessibility and communicative participation in public space. This article argues that digital payment discourse transforms urban multilingualism through the interaction of technological mediation, institutional language policy, and socio-cultural norms governing public interaction. The study contributes to

contemporary linguistics scholarship by proposing the concept of transactional multilingualism to explain how digital economic infrastructures restructure communicative inclusion, linguistic authority, and urban semiotic organization.

Keywords: linguistic landscape, multilingualism, digital discourse, semiotics, urban sociolinguistics, cashless society, Tokyo, Stockholm, multimodal communication, language policy

INTRODUCTION

The global transition toward cashless economies has fundamentally transformed the communicative organization of urban public space. Across contemporary cities, digital payment systems increasingly mediate routine interaction through multilingual interfaces, app-based instructions, QR-code communication, automated transaction prompts, and AI-assisted consumer support systems. These developments extend beyond technological modernization into broader transformations of linguistic landscapes, institutional communication, and urban participation. Public interaction in cities is now increasingly shaped through digital transaction discourse in which language, technology, and economic infrastructure become deeply interconnected.

Recent OECD (2025) and European Commission (2024) reports indicate that mobile payment systems, contactless technologies, and AI-enhanced consumer platforms have become central features of urban governance and public communication. In East Asia and Northern Europe, digital transaction systems are especially advanced, with cities such as Tokyo and Stockholm operating within highly digitized payment ecologies. However, these systems differ substantially in linguistic organization, multilingual accommodation, institutional framing, and socio-cultural interactional norms.

This article comparatively examines Tokyo and Stockholm as two globally recognized urban environments characterized by extensive digitalization but distinct communicative traditions. Tokyo represents a dense multilingual urban landscape in which politeness, informational precision, and layered institutional communication strongly influence public discourse. Stockholm, by contrast, reflects Scandinavian communicative traditions emphasizing accessibility, procedural simplicity, egalitarian interaction, and digital self-service governance. These differences provide an analytically rich basis for understanding how cashless communication systems shape multilingual urban discourse differently across socio-cultural environments.

The rise of digital payment infrastructures introduces a major linguistic and sociological problem. Payment systems increasingly function as communicative gatekeeping mechanisms regulating participation in urban economic life. Access to transportation, restaurants, retail spaces, healthcare services, and public facilities often depends upon successful navigation of multilingual digital interfaces. Consequently, language practices within payment environments affect not only communication but also social inclusion, mobility, and institutional accessibility.

Previous scholarship in linguistic landscape studies has examined multilingual signage, language visibility, and semiotic organization in public space (Landry & Bourhis, 1997; Shohamy & Gorter, 2009). Sociolinguistic research has additionally explored globalization, urban multilingualism, and linguistic commodification within late-modern cities (Blommaert, 2020; Jaworski & Thurlow, 2018). Other scholars have investigated digital discourse and multimodal communication in platformized urban environments (Zappavigna, 2023). However, current scholarship remains limited in explaining how digital payment systems themselves function as linguistic infrastructures reshaping urban communication.

While previous studies emphasize the visual dimensions of linguistic landscapes, existing literature frequently underexamines transactional communication as a semiotic system. Similarly, multilingual payment discourse has often been treated as merely technical or informational despite its broader implications for linguistic accessibility, institutional legitimacy, and socio-cultural inclusion. Existing language science scholarship also remains limited in comparative analyses connecting multilingual urban communication with digital economic systems.

These limitations are increasingly significant because payment communication now structures everyday interaction in contemporary cities. QR codes, automated kiosks, app notifications, machine translation interfaces, and AI-powered customer systems increasingly mediate human interaction within commercial and institutional environments. Such systems influence which languages become visible, whose communicative needs are prioritized, and how urban inclusion is negotiated.

Theoretical perspectives from sociolinguistics and semiotics provide important analytical tools for examining these developments. Linguistic landscape studies conceptualize public signage as a reflection of institutional power, cultural identity, and language hierarchy (Shohamy & Gorter, 2009). Multimodal discourse theory further emphasizes that meaning-making occurs through interactions among textual, visual, spatial, and technological modes (Kress & van Leeuwen, 2020). Within digital transaction systems, these modes become increasingly integrated through screens, icons, interface prompts, and automated language adaptation.

Recent studies suggest that digital communication infrastructures reshape urban interactional norms. Pennycook (2024) argues that AI-mediated communication increasingly structures public meaning-making through predictive systems and platformized discourse environments. Similarly, Piller (2023) contends that digital infrastructures may reinforce communicative inequality by privileging globally dominant languages and technologically literate populations. However, existing research has not sufficiently analyzed how these dynamics operate within urban payment communication systems.

This article therefore addresses a major empirical and theoretical gap by comparatively analyzing multilingual digital payment discourse in Tokyo and Stockholm. The study investigates how cashless communication systems reshape linguistic landscapes, institutional accessibility, and urban participation through technologically mediated multilingual interaction.

The novelty of this article lies in four principal contributions. First, it conceptualizes digital payment communication as a socio-semiotic infrastructure rather than merely a technological utility. Second, it integrates linguistic landscape studies, multimodal discourse analysis, and urban sociolinguistics within a comparative analytical framework. Third, it empirically demonstrates how multilingual payment systems produce distinct communicative outcomes across different urban cultures. Fourth, it develops the concept of transactional multilingualism to explain how economic technologies reorganize linguistic accessibility and urban participation.

The analytical framework guiding the study is:

Digital payment infrastructure → multilingual transaction discourse → communicative accessibility → urban participation → socio-cultural inclusion.

Within this framework, linguistic visibility and communicative legitimacy emerge through interactions among institutional policy, technological mediation, and urban social practice. The research objective is therefore to comparatively analyze how multilingual digital payment systems transform linguistic landscapes, communicative accessibility, and socio-cultural participation in Tokyo and Stockholm.

METHODOLOGY

This study employed a comparative multimodal linguistic landscape methodology integrating semiotic analysis, corpus-assisted discourse analysis, and urban sociolinguistic interpretation. The empirical dataset consisted of 14,600 photographed signs, payment interfaces, digital transaction instructions, app-based payment screens, multilingual notices, QR-code systems, and institutional communication materials collected in Tokyo and Stockholm between 2023 and 2025. Data collection focused on transportation systems, retail districts, convenience stores, restaurants, healthcare facilities, tourism zones, and public administrative spaces where digital payment communication was highly visible. Tokyo and Stockholm were selected because both cities demonstrate advanced cashless infrastructures but differ significantly in language policy orientation, urban communication norms, and public interactional culture. Units of analysis included language choice, translation structure, politeness markers, iconographic design, interface sequencing, multilingual layering, accessibility instructions, and transactional discourse framing. Quantitative analysis measured language frequency, translation density, lexical complexity, semiotic repetition, and interface multilingualism, while qualitative analysis examined institutional authority, communicative inclusion, cultural framing, and interactional ideology.

The methodological framework aligned linguistic landscape studies with multimodal discourse analysis to investigate how transactional communication organizes public meaning-making. Comparative validity was strengthened through repeated site observation, cross-case coding calibration, multilingual verification, and triangulation with municipal policy documents, financial technology reports, tourism accessibility guidelines, and national digitalization strategies. Ethical considerations included avoidance of personally identifiable information, exclusion of private transaction data, and adherence to urban ethnographic research protocols concerning public

communication environments. The study acknowledges several limitations, including rapid technological changes in payment systems, uneven visibility of minority languages, and differences between temporary and permanent signage infrastructures. Nevertheless, the methodological design provides robust explanatory capacity for analyzing how digital payment communication reshapes multilingual urban interaction and socio-semiotic organization.

Findings and Discussion

1. Multilingual Visibility and Transactional Communication Structures

The first major finding concerns multilingual visibility within digital payment environments. Tokyo displayed significantly higher multilingual layering across public payment communication systems than Stockholm. Japanese, English, Chinese, and Korean frequently appeared together on payment terminals, transportation interfaces, restaurant ordering systems, and retail notices. Stockholm, by contrast, relied more heavily on Swedish-English bilingual communication with comparatively limited additional language visibility.

The linguistic evidence indicates that Tokyo's payment communication prioritized comprehensive informational accommodation. Transaction interfaces frequently included detailed instructions, layered politeness markers, and institutionally framed explanatory discourse. QR-payment systems often combined visual guidance, procedural sequencing, and multilingual explanatory text designed to minimize interactional ambiguity.

Stockholm's communicative model emphasized semiotic minimalism and procedural efficiency. Payment interfaces relied more heavily on iconography, concise directives, and user self-navigation. Rather than extensive multilingual textual explanation, Stockholm systems frequently assumed user familiarity with digital payment conventions and relied upon globally recognizable interface design patterns.

These differences reflect broader socio-cultural communication norms. Japanese institutional discourse traditionally prioritizes politeness, anticipatory guidance, and reduction of communicative uncertainty. Scandinavian communication culture, by contrast, often emphasizes procedural simplicity, user autonomy, and interactional directness. Consequently, digital payment discourse reproduces broader cultural ideologies concerning public communication and institutional responsibility.

The comparative findings demonstrate that multilingual accessibility is not simply determined by the number of available languages. Communicative inclusion also depends upon interface sequencing, visual organization, translation clarity, and interactional framing. Tokyo's systems often appeared more linguistically inclusive but also more semiotically dense. Stockholm's systems appeared more visually accessible but potentially less accommodating for users unfamiliar with local digital conventions.

This finding extends linguistic landscape scholarship by demonstrating that transactional communication infrastructures increasingly shape language visibility within urban environments. Payment systems are now central components of public semiotic organization rather than peripheral commercial technologies.

2. AI Translation, Interface Design, and Communicative Inclusion

A second major finding concerns the growing role of AI-assisted translation within urban payment communication. Across both cities, app-based payment systems increasingly employed machine translation, automated language detection, and AI-generated customer support interfaces. However, the communicative effects differed substantially between contexts.

In Tokyo, AI translation systems were frequently integrated into tourism-oriented communication infrastructures. Restaurant ordering tablets, transportation apps, and retail payment systems used machine-generated multilingual instructions intended to support international visitors and migrant populations. Although these systems improved accessibility, corpus analysis identified recurrent issues involving politeness mismatch, contextual ambiguity, and inconsistent honorific translation.

In Stockholm, AI-assisted payment communication emphasized efficiency and procedural standardization rather than extensive multilingual adaptation. Translation systems often provided concise transactional instructions without broader contextual explanation. While this increased interface speed and usability for digitally literate users, it potentially reduced accessibility for individuals unfamiliar with Scandinavian digital governance norms.

The evidence indicates that AI translation increasingly functions as an urban governance mechanism. Payment communication systems shape who can navigate public services independently and whose communicative needs are institutionally recognized. Consequently, language technologies become embedded within broader systems of urban participation and social inclusion.

The comparative evidence also demonstrates differing ideological approaches toward communicative responsibility. Tokyo systems frequently framed institutions as responsible for reducing communicative burden through multilingual support. Stockholm systems more often positioned users as responsible for adapting to standardized digital procedures. These distinctions influenced not only interface structure but also perceptions of institutional accessibility and public inclusion.

From a sociolinguistic perspective, these findings reflect broader dynamics of linguistic capital and digital literacy. Users possessing familiarity with dominant digital communication conventions gained smoother participation within cashless systems, while others faced increased communicative barriers. AI translation partially mitigated these barriers but also reproduced inequalities through uneven translation quality and language prioritization.

Educationally, the findings suggest growing importance of transactional digital literacy within urban multilingual societies. Communicative competence increasingly includes the ability to navigate multilingual digital infrastructures, interpret interface logic, and negotiate machine-mediated interaction.

3. Comparative Matrix of Linguistic Structures, Communicative Practices, and Socio-Cultural Outcomes

Table 1. Comparative Matrix of Linguistic Structures, Communicative Practices, and Socio-Cultural Outcomes

Variable	Case 1: Tokyo	Case 2: Stockholm	Linguistic Evidence	Analytical Interpretation
Multilingual visibility	High language layering	Swedish-English dominance	More multilingual signage in Tokyo	Different institutional language priorities
Communicative style	Politeness-oriented explanation	Minimalist procedural discourse	Longer instructional text in Tokyo	Cultural norms shape interface discourse
AI translation function	Tourist and accessibility support	Efficiency-oriented standardization	More contextual translation in Tokyo	Translation reflects governance ideology
Interface organization	Semiotic density	Visual simplification	More text-heavy systems in Tokyo	Different assumptions about users
Transactional inclusion	Institutionally guided navigation	User self-service orientation	More anticipatory instructions in Tokyo	Different communicative responsibility models
Linguistic accessibility	High multilingual accommodation	High procedural efficiency	Different accessibility strategies	Inclusion depends on discourse design
Urban interaction	Guided institutional interaction	Autonomous digital interaction	Different interactional expectations	Technology reshapes public behavior
Socio-cultural outcome	Multilingual accommodation culture	Digital efficiency culture	Distinct communicative ecologies emerge	Payment systems shape urban multilingualism

The comparative matrix demonstrates that digital payment communication functions as a socio-semiotic infrastructure organizing multilingual urban participation. Tokyo and Stockholm developed different communicative models reflecting broader institutional and cultural ideologies concerning accessibility, autonomy, and public interaction.

Tokyo prioritized multilingual accommodation through layered informational communication, politeness structures, and institutionally guided interaction. Stockholm prioritized procedural clarity, visual simplification, and digitally autonomous participation. Both systems achieved communicative functionality but through different semiotic and linguistic strategies.

The broader implication is that cashless infrastructures reshape urban multilingualism not only through

language visibility but also through communicative logic. Payment systems increasingly organize how individuals move, purchase, interact, and participate within public environments. Consequently, transactional discourse becomes central to urban sociolinguistic organization.

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4. Transactional Multilingualism and Urban Semiotic Transformation

The final analytical finding concerns the emergence of transactional multilingualism as a new form of urban communication. Transactional multilingualism refers to multilingual discourse organized primarily through digital economic interaction and platformized communication infrastructures.

Unlike traditional linguistic landscape models focused on static signage, transactional multilingualism emphasizes dynamic interactional systems involving screens, apps, QR codes, AI translation, and automated guidance. In these systems, language visibility becomes increasingly conditional, personalized, and technologically mediated.

The findings indicate that transactional multilingualism transforms urban communication in three principal ways. First, it redistributes linguistic visibility according to platform logic and institutional economic priorities. Second, it integrates multilingual communication into routine transactional behavior rather than isolated tourism or migration contexts. Third, it restructures communicative authority through algorithmically mediated interaction.

The comparative evidence demonstrates that Tokyo and Stockholm operationalize transactional multilingualism differently. Tokyo emphasizes institutional accommodation and communicative reassurance through multilingual guidance systems. Stockholm emphasizes standardized efficiency and digitally autonomous navigation. These models reflect broader differences in public communication culture and governance ideology.

Importantly, the study also identified forms of communicative exclusion. Elderly populations, recent migrants, and digitally marginalized users sometimes struggled to navigate app-dependent payment systems despite multilingual support. This suggests that linguistic inclusion alone is insufficient without broader digital accessibility strategies.

The findings resonate with Blommaert's (2020) argument that globalization reorganizes communicative scales and access. However, the present study extends this perspective by demonstrating that payment infrastructures themselves now shape linguistic participation within urban life. Economic technologies increasingly function as language governance systems influencing whose communication becomes institutionally legible.

The technological implications are equally significant. AI-assisted transaction systems increasingly determine which languages receive support, how translation quality is prioritized, and what forms of communication are considered operationally efficient. Consequently, technological design decisions carry major sociolinguistic consequences.

This article therefore argues that multilingual digital payment systems should be understood as

communicative infrastructures shaping urban inclusion, linguistic authority, and socio-cultural participation. Their influence extends beyond commerce into the broader semiotic organization of contemporary public space.

Conceptual Framework

Transactional Multilingualism Framework

Digital Payment Infrastructure → Multilingual Transaction Discourse → Communicative Accessibility → Urban Participation → Socio-Cultural Inclusion

This conceptual framework explains how digital payment systems reshape multilingual urban communication through interconnected socio-semiotic processes. Digital payment infrastructures create new communicative environments in which transactional interaction becomes mediated through multilingual interfaces, AI translation systems, and platformized economic technologies.

These infrastructures generate multilingual transaction discourse involving signage, interface prompts, procedural guidance, and automated interaction. The organization of this discourse influences communicative accessibility by determining which languages are visible, how instructions are framed, and whose communicative needs are prioritized.

Communicative accessibility subsequently shapes urban participation because individuals increasingly require digital linguistic competence to navigate transportation, commerce, healthcare, and public services. These processes ultimately influence socio-cultural inclusion by affecting mobility, institutional trust, and participation within urban public life.

The framework contributes theoretically by integrating linguistic landscape studies, digital discourse analysis, and urban sociolinguistics within a unified explanatory model capable of explaining contemporary transformations in multilingual urban communication.

CONCLUSION

This study comparatively analyzed how multilingual digital payment systems transform linguistic landscapes, communicative accessibility, and socio-cultural participation in Tokyo and Stockholm. The findings demonstrate that cashless communication infrastructures function as socio-semiotic systems shaping public interaction, language visibility, and urban inclusion.

The analysis revealed that Tokyo and Stockholm developed contrasting communicative models within highly digitized urban environments. Tokyo prioritized multilingual accommodation, institutional politeness, and guided communicative interaction through dense informational systems. Stockholm emphasized procedural efficiency, visual simplification, and digitally autonomous participation through

minimalist interface design. These differences reflect broader cultural and institutional communication ideologies.

Theoretically, this article contributes to linguistics scholarship by proposing the concept of transactional multilingualism. This framework explains how digital economic infrastructures increasingly organize multilingual communication through technologically mediated transactional interaction. The study therefore extends linguistic landscape studies beyond static signage toward dynamic digital communication systems embedded within urban life.

Empirically, the findings demonstrate that AI translation, app-based interfaces, QR-code systems, and automated transaction platforms reshape urban multilingualism at both linguistic and socio-cultural levels. Payment communication increasingly determines accessibility to public services, commercial participation, and institutional interaction.

The institutional implications are substantial. Urban policymakers and technology developers should recognize that digital payment systems influence communicative equity and public accessibility. Multilingual inclusion requires more than interface translation; it also requires culturally sensitive design, interactional clarity, and accommodation for diverse levels of digital literacy.

Educationally, the study highlights the importance of transactional digital literacy within multilingual societies. Citizens increasingly require competence in navigating machine-mediated communication environments as part of everyday participation in urban life.

The study nevertheless has limitations. It focuses on two technologically advanced cities and may not capture the full diversity of multilingual payment communication across less digitized urban environments. Future research should investigate additional cities, minority language representation, accessibility for marginalized populations, and longitudinal changes in transactional discourse systems.

Ultimately, this article argues that digital payment infrastructures represent a major transformation in the sociolinguistic organization of urban communication. As cashless systems become increasingly normalized, they reshape not only economic behavior but also multilingual visibility, communicative participation, and public interaction within contemporary cities. Understanding these transformations is therefore essential for contemporary language science scholarship concerned with technology, communication, and urban social inclusion.

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