



Cognitive Gap and Differentiated Interpretation: A Comparative Study of Mainstream Media Frames in Belt and Road Initiative Co-construction Countries Based on Big Data

Yuanyuan Sun*

Department of Communication Art, Chongqing University of Posts and Telecommunications, Chongqing, China

*Corresponding author: 2499520532@qq.com

Abstract. Differences in internal perceptions among Belt and Road Initiative (BRI) participating countries are key variables influencing targeted communication and high-quality development, yet existing research largely treats these countries as a homogeneous whole. Drawing on cognitive divide theory, this study extends its unit of analysis from individual knowledge stratification to state actors, integrating framing theory with computational communication methods. Using sentiment analysis and keyword clustering, it systematically examines 1,695 English-language reports (2021–2025) from Indonesia’s Antara News, Russia’s The Moscow Times, and Greece’s Kathimerini. The findings reveal that participating countries do not constitute a monolithic ‘friendly camp’ but exhibit cognitive gradients shaped by geo-strategic autonomy, cooperation depth, and institutional embeddedness. Specifically, three cognitive structures emerge: ‘positive attachment’ (Indonesia), ‘strategic collaboration-confrontation’ (Russia), and ‘cautious acceptance and reflection’ (Greece). This study extends cognitive divide theory to state-level transnational public opinion analysis, offering theoretical and empirical foundations for understanding cognitive heterogeneity within BRI partner nations, as well as practical insights for targeted BRI communication strategies.

Keywords: The Belt and Road Initiative; Cognitive Gap; Framework Theory; Computational Communication; Sentiment Analysis.

1 Introduction

As the Belt and Road Initiative enters a new decade of high-quality development, its global narrative and international public opinion landscape have become critical for sustainability. Existing research provides an important foundation, but two tendencies prevail: first, a focus on narrative competition framed by a binary opposition between the West and China; second, treating over a hundred participating countries as a homogeneous whole. These perspectives obscure cognitive divisions within participating

countries arising from historical origins, geopolitical strategies, economic development stages, and cultural identity. These internal differences directly influence the public support base and cooperation effectiveness across regions.

The theory of the cognitive divide offers a crucial perspective for analysing this complexity. Traditionally used to explain knowledge stratification within societies, this study extends it to international communication to elucidate systematic differences in how national actors receive, interpret, and reconstruct the BRI narrative. These differences are embedded in media topic selection, source preferences, narrative logic, and framing strategies, collectively mapping the cognitive landscape of BRI international communication.

This study focuses on mainstream media of BRI partner countries, employing big-data-driven computational communication methods to systematically analyse representative media from 2021 to 2025. It aims to answer three questions: First, do micro-level cognitive divides exist within partner countries masked by macro-level narratives of friendship? Second, how do these gaps manifest in framing types and emotional structures? Third, what are the underlying driving mechanisms? By providing empirical answers, this study seeks to achieve a paradigm shift from a holistic perspective to a theory of internal cognitive structures, thereby offering theoretical and data support for more targeted BRI external communication strategies.

2 Literature Review

Existing research has revealed the complex landscape of international communication regarding the Belt and Road Initiative (BRI) from multiple perspectives: structural marginalisation within Twitter networks^[5], competition and cooperation between media and think tanks^[1], mainstream media's communication practices and performance enhancement^[3], mainstream media constructing a “communication community” through mediatisation practices^[4], and visualisation analysis showing interdisciplinary convergence^[15]. Most findings indicate that global perceptions of the BRI are not entirely uniform. However, while deconstructing the “East-West binary”, these studies often treat the numerous participating countries as a homogeneous “friendly camp”, overlooking internal cognitive divisions arising from historical traditions, geo-strategic interests, development stages, and cultural-geographical characteristics. These micro-level differences, masked by macro-level narratives of friendship, are key variables influencing regional implementation. To analyse such cognitive structures, this study expands the cognitive divide theory from individual knowledge stratification to systemic interpretative differences among state actors.

2.1 The Extension and Application of the Cognitive Divide Theory in International Communication

Cognitive divide theory, since Tichenor, has focused on knowledge gaps within societies from disparities in education, income and media exposure. With globalisation, re-

searchers recognise that cognitive divides also exist between nations due to asymmetrical information flows, unequal international status, and cultural filters. Xuan Changchun et al.^[2] quantitatively showed significant differences in sentiment and framing between BRI-participating and non-participating countries regarding political, economic and cultural issues, reflecting deep-seated international cognitive divergences. However, current research remains largely confined to binary “participating vs. non-participating” frameworks, failing to investigate whether more nuanced cognitive gradients exist within the partner group.

In the digital media era, the cognitive divide takes new forms. Wei Lu et al.^[17] point out that AI technology drives international cultural communication but also brings risks such as the “intelligence divide”, disinformation and political bias; the global cultural order is shifting towards “transcultural communication”. This insight provides crucial inspiration for extending cognitive divide theory from individual knowledge stratification to state actors: in the intelligent communication era, cognitive disparities between nations stem not only from unequal information access but also from technological power structures, platform rules and algorithmic bias.

2.2 Framing Theory and Narrative Competition in International Communication Regarding the Belt and Road Initiative

Framing theory holds that media construct social reality and shape public perception through selection, emphasis, and exclusion. In BRI international communication, framing competition lies at the core of global opinion struggles. Existing research shows that mainstream Western media (e.g., US, Europe) tend to activate negative frames such as “geopolitical competition”, “debt traps”, and “rule export”, while media in co-construction countries predominantly employ positive frames like “development cooperation”, “interconnectivity”, and “mutual benefit”^{[6][9]}. Similar patterns exist in Indian vs. Pakistani media^[13].

However, most existing studies rely on small-scale qualitative case analyses, lacking macro-level, longitudinal, and cross-national comparative perspectives. They struggle to capture the dynamic evolution of media frames across participating countries or to quantitatively compare the degree of frame consistency and heterogeneity among different nations.

2.3 Research Progress and Unresolved Issues Driven by Computational Communication Studies

Computational communication methods—such as natural language processing, topic modeling, and sentiment analysis—enable systematic mining of large-scale cross-national media texts. Recent studies have used LDA, Granger causality, K-means clustering, and exponential random graph models to reveal diverse BRI interaction patterns, echo chamber effects, and emotional communities on social media^{[1][11][14]}. These advances demonstrate the potential of computational approaches.

Nevertheless, existing computational studies generally treat BRI partner countries or the “Global South” as a homogeneous analytical unit. They fail to examine whether

cognitive clusters exist within partner countries based on geographic location, depth of cooperation with China, or institutional embeddedness. These structured cognitive differences remain unexplored, leaving a clear gap for this study to address.

3 Research Methodology

This study aims to quantitatively reveal the cognitive gaps and framing differences within the participating countries of the Belt and Road Initiative by systematically collecting and analysing news reports from their mainstream media. The research design follows the standard procedures of computational communication studies, comprising three stages: data collection, pre-processing, and multi-dimensional computational analysis.

3.1 Data Collection and Pre-processing

To overcome the limitations of previous studies that treated participating countries as a homogeneous whole, this study adopts a typological comparative design. A sample selection framework is constructed based on three constructional dimensions—geographical location, depth of cooperation with China, and level of economic development—to ensure that the selected countries exhibit structural differences and comparative significance within the group of participating nations. The specific dimensions are as follows: Firstly, geographical location: covering key nodes along the Maritime Silk Road and the Land-based Silk Road Economic Belt, whilst taking into account the three continents of Asia, Europe and Africa to ensure geographical diversity; secondly, depth of cooperation with China: based on indicators such as the implementation of Belt and Road projects, the timing of cooperation agreements and bilateral trade volumes, distinguishing between varying degrees of participation to reflect the influence of different stages of development on perceptions of the Belt and Road Initiative.

Media Selection.

Based on the above framework, this study has identified the following three countries and their representative English-language media outlets as the analytical units for multidimensional comparison, as detailed in Table 1.

The selection of these three countries forms a multidimensional comparative framework designed to reveal internal cognitive structures within participating nations. Geographically, the sample covers Asia (Indonesia, Russia) and Europe (Greece), encompassing key nodes along both the Land and Maritime Silk Roads. Economically, it includes high-income (Russia, Greece) and upper-middle-income (Indonesia) countries. Regarding cooperation depth with China, it includes deep strategic collaboration (Russia) and above-average cooperation (Indonesia's Jakarta–Bandung High-Speed Railway; Greece's Port of Piraeus). Although limited to three countries, this design maximises structural differences in geography, development stage, and cooperation model, possessing theoretical explanatory power to facilitate a paradigm shift from a 'holistic' approach to a 'theory of internal cognitive structures'.

Specifically, this design addresses whether micro-level cognitive divides exist within BRI partner countries that are obscured by macro-level narratives of friendship, thereby probing cognitive gradients and narrative fragmentation shaped by historical origins and geopolitical strategies.

Table 1. Sample selection framework and media profiles of three BRI co-construction countries

Country	Geographical location	The extent of cooperation with China	Media	Media Profile
Indonesia	Southeast Asia (a key hub on the Maritime Silk Road)	Above-average cooperation (flagship projects such as the Jakarta–Bandung High-Speed Railway)	<i>Antara News</i>	The Indonesian National News Agency, which has a strong official slant, provides nationwide coverage and reflects the Indonesian government’s official stance and mainstream public opinion on the Belt and Road Initiative.
Russia	Eurasia (a key partner on the Land Silk Road)	Strategic partner (alignment of the Eurasian Economic Union with the Belt and Road Initiative)	<i>The Moscow Times</i>	Mainstream English-language media in Russia: Narratives on the Belt and Road Initiative from the perspective of a strategic partner.
Greece	Southern Europe (the European gateway to the Maritime Silk Road)	Above-average cooperation (the Port of Piraeus project)	<i>Kathimerini</i> (English Edition)	Greece’s most influential English-language media outlet, reflecting the southern gateway nation’s acceptance of and reflections on the Belt and Road Initiative.

Data Collection Methodology.

The data collection period for this study spans from 1 January 2021 to 31 December 2025. The year 2021 was chosen as the starting point because on 19 November 2021, President Xi Jinping delivered an important speech at the Third Symposium on the Belt and Road Initiative, emphasising the need to “promote the high-quality development of the Belt and Road Initiative and achieve continuous new results”. This speech marked the official entry of the Belt and Road Initiative into a new phase of high-quality development. The year 2025 was set as the cut-off date for the study, covering the critical period from the deepening of the initiative’s development to its strategic adjustment. Furthermore, the retrievable data from the selected media outlets fully covers this timeframe, ensuring the consistency and comparability of the data.

Data collection utilised a web crawler written in Python, combined with the search functions on each media outlet’s official website, to automatically extract data from the official websites of the three media outlets mentioned above. The search keywords were constructed around the ‘Belt and Road’ initiative and related expressions, and were divided into two categories: core keywords and supplementary keywords: Core keywords: Belt and Road Initiative, Silk Road, etc.; To ensure comprehensiveness, “CPEC” and its full name were specifically added for the Pakistan case study to fully capture reports related to the China-Pakistan Economic Corridor. All keywords were applied to searches of headlines and body text using Boolean logic (OR operators). The

fields collected included: headline, publication date, body text, article link, and author/source (where available). The raw data was stored in a structured format to construct the initial corpus.

Data Cleaning and Pre-processing.

The following cleaning steps were applied to the raw data: deduplication was performed to remove completely duplicate reports based on their headlines; non-news text (such as advertisements, statements and notices) was filtered out; reports unrelated to the 'Belt and Road' theme were filtered out based on the frequency of keywords in the body text and their context; and text encoding formats were standardised, with HTML tags and garbled characters removed. A total of 1,695 valid articles were ultimately obtained, with the distribution of media samples across countries as follows: 882 from Indonesia's Antara News, 317 from Russia's The Moscow Times, and 496 from Greece's Kathimerini (English Edition).

3.2 Analytical Methods

This study integrates the analytical perspective of framing theory and employs a computational text analysis method combining sentiment analysis with keyword clustering to systematically identify and compare the cognitive structures of media in co-constructing nations. In recent years, methods combining manual framing analysis with automated content analysis (such as sentiment analysis and keyword clustering) have been shown to effectively reveal complex framing structures within media discourse^[10].

Sentiment Analysis.

For dictionary-based sentiment analysis, the VADER (Valence Aware Dictionary and sEntiment Reasoner) tool was employed. Although this tool was originally designed for social media texts, it is equally well-suited for news texts. Given the specific context of the 'Belt and Road' initiative, this study has adapted the VADER default dictionary for the domain: positive sentiment terms such as 'prosperity', 'interconnectivity', 'mutual benefit and win-win outcomes', and 'sustainable development' were manually added, alongside negative sentiment terms such as 'debt trap', 'colonial expansion', 'hegemony', and 'exploitation', to enhance the accuracy of sentiment classification. Sentiment polarity (positive, neutral, negative) was assessed for the headlines and body text of each news report, and sentiment intensity scores were calculated. By calculating the average sentiment score and sentiment distribution ratio for samples from each country's mainstream media, this study reveals their macro-level sentiment tendencies and structural differences.

Keyword Cluster Analysis.

To explore in depth the differences in narrative frameworks within 'Belt and Road' coverage across mainstream media in various countries, this study employs a part-of-speech combination clustering method. This method identifies patterns of part-of-

ture development”, “energy transition”, and “supply chain”, highlighting a development-oriented, project-driven framework. A study of *The Jakarta Post* and *The Jakarta Globe* also found economic cooperation as the dominant narrative, though the South China Sea issue occasionally disrupts this, leading to a generally cautious tone^[16].



Fig. 1. Sentiment distribution of Antara News coverage on the Belt and Road Initiative (2021–2025)

Russia: A Cognitive Structure of Strategic Cooperation and Confrontation.

Of the 317 reports from Russia's *The Moscow Times*, 79 were positive (24.9%), 79 negative (24.9%), and 159 neutral (50.2%), presenting a “positive-negative confrontation” pattern (see Fig. 2). This reflects a “strategic cooperation-confrontation” cognitive framework. Russia, as the leading nation of the Eurasian Economic Union, actively aligns with the BRI while harbouring anxiety over potential loss of geopolitical influence. Kristiina ^[7]notes that Russia's Asian connectivity policy has shifted from cooperation to coercion, and Yang Rong ^[12]also finds positive and negative reports roughly equal in Russian media.

Keyword cluster analysis shows high-frequency subjects include ‘official’, ‘expert’, ‘president’, and ‘minister’, paired with verbs such as ‘say’, ‘sign’, and ‘face’. In noun-noun clusters, China, Russia, the US, and the UK appear together, placing the BRI within a multipolar geopolitical framework. Positive sentiment pairs like ‘agreement sign’ contrast with negative ones like ‘corruption fight’, revealing a dual-track structure of external strategic cooperation and internal oversight.



Fig. 2. Sentiment distribution of The Moscow Times coverage on the Belt and Road Initiative (2021–2025)

revealing whether there are cognitive divides within participating countries that are obscured by a macro-level narrative of friendship. Firstly, the participating countries do not constitute a monolithic ‘friendly bloc’; rather, there exists a cognitive gradient and narrative divergence shaped by structural factors such as geopolitical strategic autonomy, the depth of cooperation with China, and institutional embeddedness. Secondly, this differentiation manifests specifically in three distinct types of cognitive structures: the ‘positive attachment type’ represented by Indonesia, the ‘strategic collaboration-confrontation type’ represented by Russia, and the ‘cautious acceptance and reflection type’ represented by Greece. Thirdly, the formation of these three cognitive structures is closely linked to the structural positions of these countries as recipients of flagship projects, regional powers, and EU member states, respectively, reflecting how media reporting frameworks and emotional orientations are jointly shaped by national interest positioning and external institutional constraints.

In terms of theoretical contributions, this study extends the analytical scope of the cognitive divide theory from traditional individual or intra-societal knowledge stratification to the realm of transnational public opinion differentiation at the level of state actors. The research demonstrates that the cognitive divide theory is applicable not only to explaining knowledge gaps resulting from unequal access to information, but also to analysing transnational media cognitive differences arising from structural factors such as geopolitics, economic interests and institutional norms. This extension provides a new analytical framework for the application of the theory within international communication studies.

In terms of practical contributions, the findings of this study offer data-driven decision-making references for the targeted communication of the Belt and Road Initiative. The research reveals that within participating countries, there is not a unified audience for narratives, but rather differentiated cognitive types. Consequently, external communication strategies should abandon a ‘one-size-fits-all’ narrative approach. Instead, they should formulate differentiated communication strategies and discourse designs tailored to distinct cognitive structures to enhance the public support base and cooperative efficacy of the initiative’s implementation across different regions.

This study also has certain limitations. Firstly, due to constraints on data availability, the study selected only three representative countries and their English-language media as the analytical sample, failing to cover the unique narratives of more participating countries and their media in local languages. Secondly, whilst sentiment analysis methods can effectively identify the emotional polarity of large-scale texts, they remain limited in recognising complex rhetorical devices such as irony and metaphor, which may affect the accuracy of sentiment interpretation. Future research could expand the sample of countries and media types, and combine quantitative methods with qualitative approaches such as in-depth interviews or discourse analysis, to further uncover the deep-seated socio-cultural roots underlying these cognitive divides, thereby providing a more comprehensive understanding of the complex landscape of international communication regarding the Belt and Road Initiative.

Overall, this study, through big data-driven computational communication methods, has achieved a paradigm shift from the ‘holistic theory of participating countries’ to the ‘internal cognitive structure theory’, revealing systematic cognitive differences in Belt

and Road coverage across the mainstream media of Indonesia, Russia and Greece. The findings not only validate the applicability of the cognitive gap theory in transnational public opinion analysis but also provide theoretical grounds and empirical support for promoting the high-quality development of the Belt and Road Initiative and its targeted international communication.

References

1. Xuan Changchun, Wu Junhao, Lin Jing. Competition and Cooperation in Agenda-Setting and Public Opinion Synergy Regarding the 'Belt and Road' Initiative in Global Media and Think Tanks from a Complex Systems Perspective (2014–2024) [J]. *International Journalism*, 2025, 47(06): 80–96. DOI: 10.13495/j.cnki.cjjc.2025.06.004.
2. Xuan Changchun, Wu Junhao. Does Distance Make the Heart Grow Fonder? A Computational Analysis of Mainstream Overseas Media Coverage of Traditional Chinese Medicine from a Spatio-Temporal Perspective (2010–2023) [J]. *Journalism*, 2024, (02): 86–96. DOI: 10.15897/j.cnki.cn51-1046/g2.20240226.004.
3. Hu Zhengrong, Guo Haiwei. Communication Practices and Performance Enhancement of Mainstream Media in the Context of Jointly Building the 'Belt and Road' [J]. *Television Studies*, 2023, (11): 20–24. Available at: <https://navi.cnki.net/knavi/JournalDetail?pcode=CJFD&pykm=DSYI> (search by year/issue)
4. Shi Anbin, Zhu Hongyu. International Communication by Mainstream Media and the Mediatization of the Concept of Building a Community with a Shared Future for Mankind in the Context of the Belt and Road Initiative [J]. *Television Studies*, 2023, (11): 25–29. Available at: <https://navi.cnki.net/knavi/JournalDetail?pcode=CJFD&pykm=DSYI> (search by year/issue)
5. Zhou Xiang, Wu Qian. Analysis and Reflection on the Structural Characteristics of the Belt and Road Twitter Communication Network from a Field Perspective [J]. *Journal of China University of Geosciences (Social Sciences Edition)*, 2019, 19(02): 109–125. DOI: 10.16493/j.cnki.42-1627/c.2019.02.010.
6. Che Nanlin, Li Zhaojing. Neglect, Attention, and Focus: A Decade of Evolution in US Media Coverage of the 'Belt and Road' Initiative [J]. *Journal of Xihua University (Philosophy and Social Sciences Edition)*, 2023, 42(6): 94–103. DOI: 10.12189/j.issn.1672-8505.2023.06.010.
7. Silvan, K., & Kaczmarek, M. Russia's approach to connectivity in Asia: From cooperation to coercion[J]. *East Asia*, 2023, 40: 317–334. DOI: 10.1007/s12140-023-09404-w.
8. Wu Yaming, He Yanran, Tang Tang. Analysis of Greek Media Coverage of China against the Background of the Belt and Road Initiative [J]. *Continental Bridge Perspectives*, 2023(4). Available at: <https://navi.cnki.net/knavi/JournalDetail?pcode=CJFD&pykm=DLQY> (search by year/issue)
9. Zhang, J., Bin Jabar, M. A., & Binti Mohd Jalis, F. M. "A decade on, the journey continues": Discourse analysis of ASEAN media representations of the Belt and Road Initiative[J]. *International Journal of English Literature*, 2025, 15(5): 34–48. DOI: 10.5539/ijel.v15n5p34.
10. Zai, F., Rohrbach, T., & Hänggli Fricker, R. Voices and media frames in the public debate on artificial intelligence: Comparing results from manual and automated content analysis[J]. *Frontiers in Communication*, 2025, 10: 1599854. DOI: 10.3389/fcomm.2025.1599854.

11. Shao, W., & Wang, Z. Community dynamics and echo chambers: A longitudinal study of the Belt and Road Initiative in the Twittersphere during COVID-19 pandemic[J]. *Humanities and Social Sciences Communications*, 2025, 12: 1421. DOI: 10.1038/s41599-025-05806-8.
12. Yang Rong. A Survey of Russian Media Coverage on the Tenth Anniversary of the Belt and Road Initiative [J]. *Journal of Western Studies*, 2024(2). Available at: <https://navi.cnki.net/knavi/JournalDetail?pcode=CJFD&pykm=XBSY> (search by year/issue)
13. Chu, J., Hassan, Z., & Sikandar, S. M. The framing of the Belt and Road Initiative in Indo-Pakistani media[J]. *Humanities and Social Sciences Communications*, 2025, 12: 21. DOI: 10.1057/s41599-024-03830-8.
14. Shi Wen, Huang Wenxin. Inter-media Interaction Mechanisms on the 'Belt and Road' Topic on X (Twitter): An Empirical Analysis Based on Exponential Random Graph Models [J]. *International Journalism*, 2025, 47(1): 155–176. DOI: 10.13495/j.cnki.cjjc.2025.01.008.
15. Liu Xiaoqin. A Visualisation Analysis of Domestic and International Research on News Coverage of the Belt and Road Initiative [J]. *News Tribune*, 2023(2). Available at: <https://navi.cnki.net/knavi/JournalDetail?pcode=CJFD&pykm=XWLT> (search by year/issue)
16. Ma Jinduo, Li Wen. Cooperation and Game: A Framing Analysis of 'Belt and Road' Reports in Indonesian English-Language Media — Case Studies of The Jakarta Post and The Jakarta Globe [J]. *Media Observer*, 2019(4). Available at: <https://navi.cnki.net/knavi/JournalDetail?pcode=CJFD&pykm=CMGC> (search by year/issue)
17. Wei Lu, Jin Qianyi. The Restructuring of Global Cultural Order in the Age of Artificial Intelligence [J]. *International Communication*, 2024(4). Available at: <https://navi.cnki.net/knavi/JournalDetail?pcode=CJFD&pykm=GJCB> (search by year/issue)

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 3.0 International License (<http://creativecommons.org/licenses/by-nc/3.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

