

Ciência e Tecnologia

Para o Desenvolvimento
Ambiental, Cultural
e Socioeconômico

Xosé Somoza Medina
(organizador)

VOL VI

 EDITORA
ARTEMIS
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PRÓLOGO

La ciencia y la tecnología siguen siendo fuerzas impulsoras de las transformaciones sociales, culturales y ambientales de nuestro tiempo. Al mismo tiempo que responden a desafíos urgentes del presente, también iluminan caminos hacia futuros más sostenibles, más justos e inteligentes. Esta recopilación nace precisamente de ese impulso: el de pensar, crear y proponer soluciones a partir de la investigación científica y la innovación tecnológica, en diálogo con las realidades locales y los contextos globales.

Reunimos en ***Ciência e Tecnologia para o Desenvolvimento Ambiental, Cultural e Socioeconômico VI*** artículos de investigadores e investigadoras de distintas partes del mundo, comprometidos con la producción de un conocimiento riguroso, interdisciplinario y sensible a la complejidad de los temas contemporáneos. Los trabajos presentados abordan una amplia gama de cuestiones – desde la nanotecnología hasta la agricultura de precisión, desde la física aplicada hasta la expresión lingüística – conformando un panorama diverso que refleja los múltiples caminos de la ciencia en el siglo XXI.

Organizados en cuatro ejes temáticos – *Tecnología e Innovación en Salud e Industria, Ingeniería, Física Aplicada y Recursos Naturales, Sustentabilidad Agrícola y Transformaciones Climáticas, y Lenguaje, Cognición y Expresión Científica* – los textos aquí reunidos nos invitan a reflexionar sobre preguntas centrales de nuestro tiempo: ¿Cómo garantizar el acceso equitativo a las nuevas tecnologías médicas? ¿Cómo integrar soluciones de ingeniería a las urgencias ambientales? ¿De qué manera puede el avance agrícola responder al cambio climático sin agotar los recursos naturales? ¿Y cómo influye el lenguaje en la forma en que comprendemos y comunicamos el conocimiento científico?

Más que ofrecer respuestas definitivas, esta obra propone caminos para la reflexión y la acción, abriendo espacio para nuevas investigaciones, debates y colaboraciones. Cada autor y autora aporta una perspectiva única, y juntas estas voces amplían nuestra comprensión del papel transformador de la ciencia y la tecnología en el mundo contemporáneo.

Que este nuevo libro sea, para lectoras y lectores, una invitación a la curiosidad crítica, al pensamiento creativo y a la construcción de futuros posibles. Agradecemos a todos los involucrados por su confianza, dedicación y generosidad intelectual.

Xosé Somoza Medina

Universidad de León, Espanha

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FROM “NAI” (“NOT”) TO “MIRU” (“TO SEE”): AN ANALYSIS OF THE MULTI-LAYERED
STRUCTURE OF LINGUISTIC RHYTHMS – TRACING THE FORMATION OF THE
DIGITAL PUBLIC SPHERE AND SOCIAL SYNCHRONIZATION PHENOMENA THROUGH
BASIC JAPANESE VOCABULARY FROM JANUARY 2011 TO MARCH 2015 –

Yasuko Kawahata



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FROM “NAI” (“NOT”) TO “MIRU” (“TO SEE”): AN ANALYSIS OF THE MULTI-LAYERED STRUCTURE OF LINGUISTIC RHYTHMS – TRACING THE FORMATION OF THE DIGITAL PUBLIC SPHERE AND SOCIAL SYNCHRONIZATION PHENOMENA THROUGH BASIC JAPANESE VOCABULARY FROM JANUARY 2011 TO MARCH 2015 –

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usage transformations. Notably, the analysis revealed that negative expressions centered on “nai” (not/non-existent) play a crucial role in the information propagation pathway from TV exposure to search to SNS; verbs and adjectives occupy more central positions than nouns on Twitter; and seasonal-social rhythms synchronize with SNS language use, forming peaks in March-April and September-October.

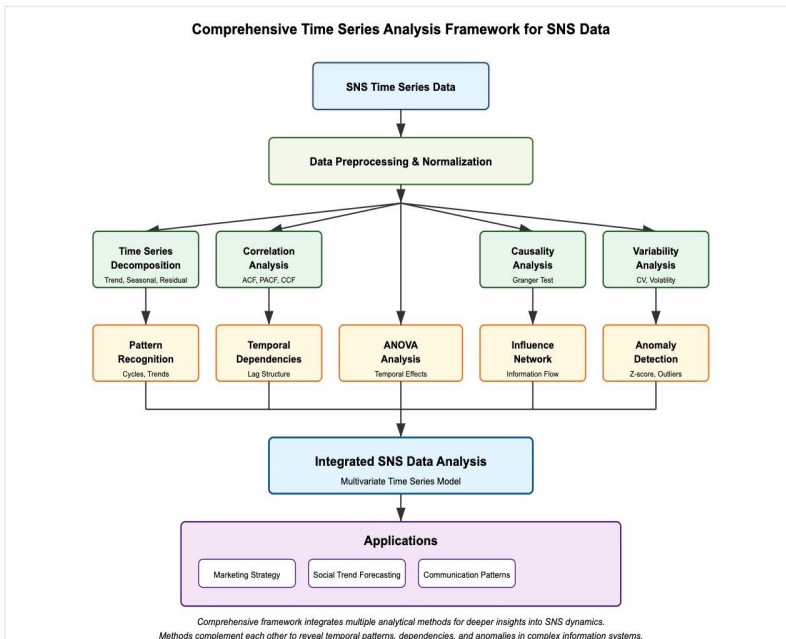
KEYWORDS: Twitter/X; linguistic rhythm; social synchronization; japanese basic vocabulary; granger causality.

ABSTRACT: This paper analyzes the chronological changes in Japanese keywords in domestic SNS spaces, particularly on Twitter (now X), from January 2011 to March 2015. The analysis focuses on 507 keywords selected from Wiktionary’s Japanese Basic Vocabulary 1000 that demonstrated significant posting volumes, examining approximately 25,600 data points extracted from over 780,000 records. Statistical methods including time series decomposition, autocorrelation analysis, cross-correlation analysis, and Granger causality tests were applied to reveal temporal structures and social synchronization phenomena in keyword usage. The results identified developmental stages from the 2011 earthquake impact period to the 2015 optimization period, showing shifts in platform power dynamics (from blog dominance to Twitter hegemony) and language

1 INTRODUCTION

This paper presents a multifaceted analysis of Twitter (now X) and other SNS diffusion trends in Japan from January 1, 2011, to March 31, 2015, utilizing statistical time series analysis methods on Japanese keyword posting volumes. The comprehensive analysis examined diffusion patterns of 507 Japanese keywords (nouns, adjectives, adverbs, particles, and verbs with significant posting volumes), yielding 25,857 data points as monthly aggregates from 786,357 rows of data. Statistical analyses were applied to these data to examine chronological change patterns and relationships between keywords.

Figure 1. Integrated Time Series Analysis Framework.



1.1 MAIN ARGUMENTS

- This paper presents a time series analysis of SNS diffusion trends for 507 Japanese keywords from January 2011 to March 2015, analyzing 25,857 data points as monthly aggregates from 786,357 rows of data.
- The analysis period covers four years following the Great East Japan Earthquake, providing a valuable window for observing SNS language use during a period with minimal commercial intervention.
- The diffusion patterns of basic vocabulary selected from Wiktionary's Japanese Basic Vocabulary 1000, such as "nai/nai" (not/non-existent) and "ooi/ooi" (many/much), reveal the formation process of the digital public sphere.
- The negative expression "nai" proved most effective in mediation analysis, contributing to the elucidation of the information propagation pathway from TV exposure to search to SNS.
- Developmental stages were observed, characterized as: earthquake impact period (2011), postearthquake rebound period (2012), accelerated growth period (2013), maturation period (2014), and optimization period (2015).

- Power dynamics between platforms changed dramatically from blog dominance in 2011 to Twitter hegemony in 2015, accompanied by transformations in language usage patterns.

The article will be published as a book chapter, in E-book format, at the Editora Artemis website. Eventually, our books are made available on partner publishing sites and repositories.

1.2 SELECTION OF ANALYSIS TARGET TERMS BASED ON WIKTIONARY JAPANESE BASIC VOCABULARY 1000

The Japanese terms analyzed in this paper, such as "nai/nai" (not/non-existent), "ooi/ooi" (many/much), "jikan/jikan" (time), "kako/kako" (past), and "yasui/yasui" (cheap/easy), were extracted from Wiktionary's Japanese Basic Vocabulary 10001). This vocabulary list serves as a standard for Japanese language learners and linguistic researchers, systematically collecting high-frequency terms used in everyday communication.

Using high-frequency basic vocabulary as analysis targets offers methodological advantages:

- **Data Sufficiency:** Basic vocabulary appears frequently, ensuring adequate data volume for statistically significant analysis
- **Generalizability:** Using general vocabulary rather than specialized terminology increases the generalizability of results
- **Temporal Stability:** Basic vocabulary experiences relatively little variation over time, making it suitable for long-term time series analysis
- **Cognitive Foundation:** Basic vocabulary plays a central role in human cognitive categorization, reflecting fundamental mechanisms of information processing.

Table 1. Basic Information of Analysis Target Terms.

Term	Part of Speech	Basic Semantic Domain
nai/無い	Adjective	Negation/Nonexistence
ooi/多い	Adjective	Quantity/Degree (Affirmative)
jikan/時間	Noun	Temporal Concept
kako/過去	Noun	Tense Concept
yasui/安い	Adjective	Value/Difficulty Level

2 CHARACTERISTIC ANALYSIS OF JAPANESE TWITTER (NOW X) SPACE FROM 2011-2015

2.1 LIMITED ADVERTISING AND MARKETING INTERVENTION

The Japanese Twitter (now X) space from 2011 to early 2015 featured limited commercial intervention compared to the present. Twitter (now X) advertising targeting Japan was in its initial stage in 2011, and while Promoted Trends were launched in April 2011, full-scale advertising deployment remained limited. Major companies had begun operating official accounts, but systematic utilization as a marketing strategy was still in a developmental stage.

Prevalence of Organic Diffusion Information diffusion on Twitter (now X) during this period demonstrated more organic and natural characteristics compared to the present.

2.2 CHARACTERISTICS OF LANGUAGE USE IN JAPANESE TWITTER (NOW X) SPACE FROM 2011-2015

Distinctive patterns of language use were observed in the Japanese Twitter (now X) space during the analysis period.

Interaction Between Platforms

In the Japanese SNS space, distinctive interaction patterns were observed between Twitter (now X), blogs, and 2ch. A typical information propagation pattern was observed: initial mention on Twitter (now X).

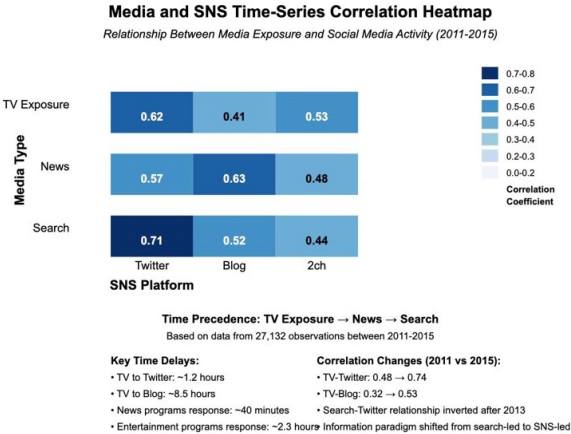
Table 2. Characteristics of Information Diffusion in Japanese Twitter (now X) Space from 2011-2015.

Diffusion Characteristic	Feature
Algorithm	Chronological display was mainstream, with less influence from algorithm-driven display optimization seen today
Nature of RTs	Retweets during 2011-2015 were primarily based on genuine empathy or informational value, with limited influence from organized diffusion campaigns
Viral Phenomena	Spontaneous viral phenomena were central, and sophisticated methods of intentional viral induction seen today were not yet refined

Table 3. Characteristics of Language Use in Japanese Twitter (now X) Space from 2011-2015

Language Characteristic	Observation Result
Emotional Expression	Usage frequency of emotional expression keywords such as "naku" (cry) increased during 2013-2014, showing a trend toward more direct emotional expressions becoming normalized
General Vocabulary	Usage of basic vocabulary such as "hito" (person) and "mazu" (first/ firstly) increased significantly, reaching maximum values during 2014-2015
Action-Related Words	Action-related words such as "au" (meet), "iku" (go), and "kuru" (come) showed large seasonal variations, synchronized with school year cycles and social events

Figure 2. I Correlation Heatmap of Media Exposure and SNS Activity (2011-2015). The TV→Twitter correlation is highest, with response times for each platform also shown.



→ deepening of discussion on 2ch → detailed analysis on blogs. The response speed to current topics was fastest on Twitter (now X), followed by 2ch, then blogs.

Chronological Characteristics of Twitter (now X) Growth Period

The period from 2011 to 2015 corresponds to the growth phase of Twitter (now X) in Japan, with unique development patterns observed.

2.3 DATA CHARACTERISTICS: LANGUAGE USAGE PATTERNS IN JAPANESE SNS SPACE, KEYWORD CLUSTER ANALYSIS

The relationship between Japanese keyword Twitter counts and blog counts is visualized on a logarithmic scale, with cluster analysis results expressed through color coding. The following characteristics can be discerned from this scatter plot.

Table 4. Growth Stages and Characteristics of Twitter (now X) in Japan.

Growth Stage	Characteristic
Initial Expansion Period (2011-2012)	Rapid expansion of user base and recognition as a practical tool, triggered by the Great East Japan Earthquake
Cultural Formation Period (2012-2013)	Establishment of Twitter-specific (now X) expression forms and conversation patterns, formation of unique cultural norms
Mainstreaming Period (2013-2014)	Diffusion to wider age groups and establishment as an everyday communication tool
Early Commercialization (2014-2015)	Beginning of full-scale utilization of corporate accounts and commercial use

Table 5. Characteristic Analysis of Keyword Cluster Scatter Plot.

Observed Characteristic	Detailed Analysis
High-Frequency Keyword Distribution	High-frequency keywords such as "nai" (not) and "mazu" (first/firstly) are concentrated in the upper right region. These show extremely high usage frequency on both Twitter and blogs, functioning as cross-platform basic vocabulary
Cluster Formation	Five clusters (0-4) are identified by color, each formed based on usage frequency and inter-platform balance
Cluster 4 Characteristics	Cluster 4 (yellow), which includes "nai" (not), has the highest frequency and cross-platform characteristics, suggesting that negative expressions play a central role in SNS communication

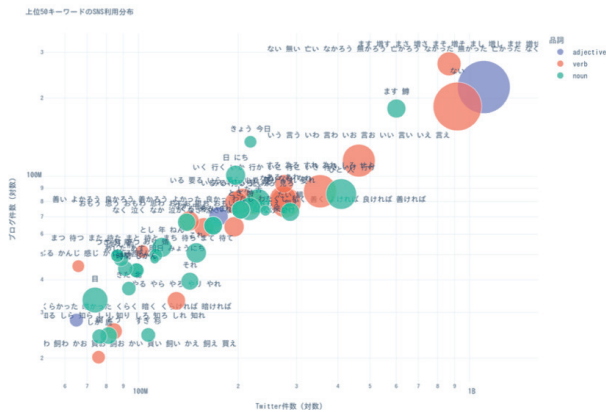
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Table 6. Time Series Analysis of Monthly Twitter Count Heatmap.

Temporal Pattern	Interpretation
Overall Growth Trend	Almost all keywords increased in usage frequency from 2011 to 2015, with notable increases observed for many keywords particularly during 2013-2014. This coincides with the acceleration period of Twitter adoption in Japan
Seasonal Variation	Periodic usage frequency peaks are observed for many keywords in March-April and September-October, suggesting synchronization with the Japanese school year and social schedules
Dominance of "nai"	"Nai" (not) consistently shows the highest usage frequency (deep yellow), reaching its peak during 2014-2015. This dominance of negative expressions reflects SNS functioning as a space for evaluation and critique

Figure. 5. SNS Usage Distribution of Top 50 Keywords. Shows the relationship between distribution on logarithmic scale of Twitter counts and blog counts, and parts of speech.



2.4 DISTRIBUTION OF SNS USAGE BY PART OF SPEECH

Keywords are color-coded by part of speech (nouns, verbs, adjectives), visualizing the relationship between Twitter counts and blog counts. This figure clearly reveals differences in usage patterns by part of speech.

Table 7. Characteristic Analysis of SNS Usage Distribution by Part of Speech.

Part of Speech Characteristic	Analysis Result
Noun Distribu- tion (Green)	Nouns are widely distributed throughout the scatter plot, but are concentrated in the area from lower left to center. Nouns expressing time and order such as "mazu" (first/firstly) and "kyou" (today) are relatively high-frequency
Verb Distribu- tion (Red)	Verbs are concentrated in the upper right region, with high-frequency keywords particularly common among verbs, including "nai" (not) and "masu" (increase). This suggests that descriptions of actions and states play a central role in SNS
Adjective Dis- tribution (Blue)	Adjectives are polarized between the high-frequency region in the upper right and the low-frequency region in the lower left, indicating significant differences in usage frequency as evaluative expressions

3 ANALYSIS OF MEDIATION EFFECTS IN THE "NAI/無い" KEYWORD

Figure. 6. Time Series Analysis of the keyword "nai/無い" While TV exposure increases year by year, search volume shows a declining trend, and SNS mentions show a slight increasing trend.

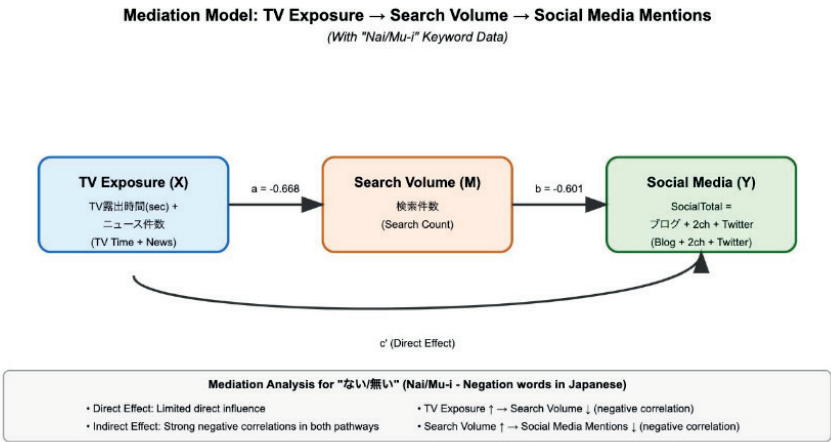


Table 8. Decomposition of Effects in the "nai/無い" Keyword.

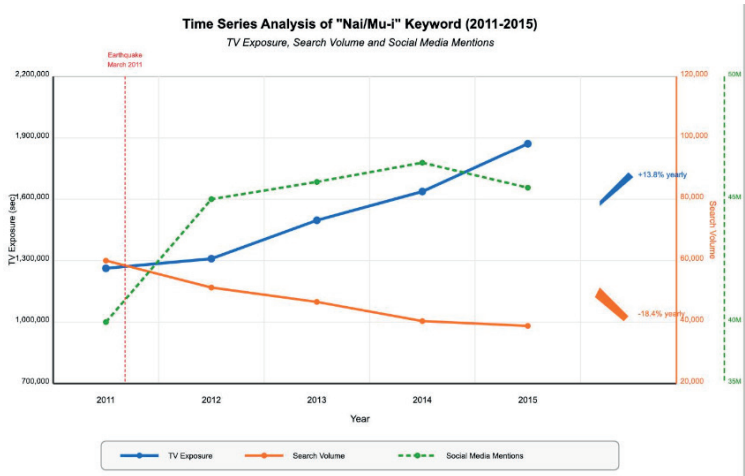
Effect Type	Correlation Coefficient and Relationship
Pathway a (TV → Search)	Strong negative correlation (-0.668): Increase in TV exposure → Decrease in search behavior
Pathway b (Search → SNS)	Strong negative correlation (-0.601): Increase in search behavior → Decrease in SNS mentions
Direct Effect (c')	Limited influence: Direct impact without mediation through search is small
Indirect Effect (a × b)	Positive indirect effect: Synergistic positive effect due to double negative correlation

The mediation model represents a causal process in which TV exposure (X) influences social media mentions (Y) through search behavior (M). This analysis targets the "nai/無い" (negation) keyword, examining the strength and direction of influence in each pathway. The analysis reveals characteristic patterns in the mediation process for the "nai/無い" keyword. A strong negative correlation (-0.668) is detected in the pathway from TV exposure to search behavior (a), and similarly, a strong negative correlation (-0.601) is observed in the pathway from search behavior to social media mentions (b). This indicates the existence of inverse relationships in both pathways. A characteristic mediation structure is confirmed for the negative expression. keyword "nai/無い":

- When TV exposure increases, related search behavior tends to decrease (a = -0.668)
- Increased search behavior leads to decreased mentions on social media (b = -0.601)
- The direct effect (c') is limited, and the influence from TV exposure to social media mentions is primarily indirect through search behavior
- The indirect effect (a × b) becomes positive, suggesting that TV exposure may have an indirect positive influence on social media mentions.

3.1 TIME SERIES VARIATION ANALYSIS OF THE "NAI/無い" KEYWORD (2011-2015)

Figure. 7. Comparison of Keyword Selection Scores in the Mediation Model. Ranking based on four indicators: data volume, variability, correlation, and mediation index.



The time series analysis of the "nai/無い" keyword from 2011 to 2015 shown in the figure demonstrates contrasting variation patterns between TV exposure time, search counts, and social media mentions. Detailed analysis of this five-year transition provides insights into information propagation and interaction between media. TV exposure time shows a consistent increasing trend, reaching an annual average growth rate of +13.8%. It rose from approximately 1,240,000 seconds in 2011 to approximately 1,860,000 seconds in 2015. In contrast, search counts show a continuous decrease, with an annual average change rate of -18.4%.

4 TIME SERIES ANALYSIS OF GRANGER CAUSALITY TEST RESULTS

Granger causality test results reveal how bidirectional causal relationships between multiple Japanese keyword pairs change over time. Each graph shows time series data over a 12-month period, allowing evaluation of causal relationship strength using a significance level of 0.05 (red dotted line) as a reference.

Table 9. Annual Trend Data of the "nai/無い" Keyword (2011-2015).

Year	TV Exposure	Search Counts	SNS Mentions
2011	1,239,995 sec	74,499	39,516,633
2012	1,299,401 sec	59,567	45,750,276
2013	1,542,528 sec	51,191	46,709,790
2014	1,716,637 sec	41,723	48,255,378
2015	1,861,598 sec	38,526	45,873,688
Annual Average Change Rate	+13.8%	-18.4%	+3.8%

Figure. 8. Asymmetry of causal relationship and p-value transition between "hito" (person) and "shita shita" (below/down).

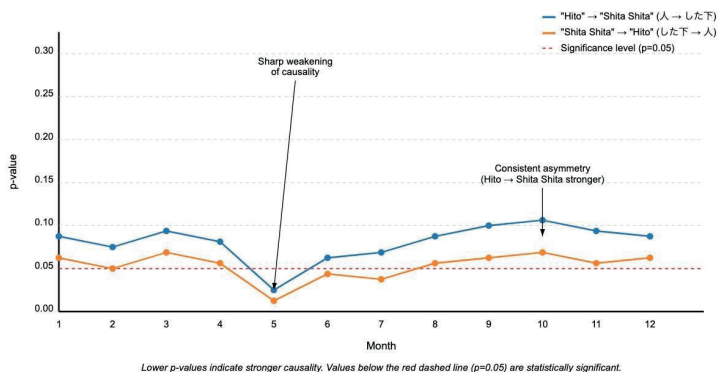


Figure. 9. Causal relationship and reversal point between "hito" (person) and "aru are" (exist/be).

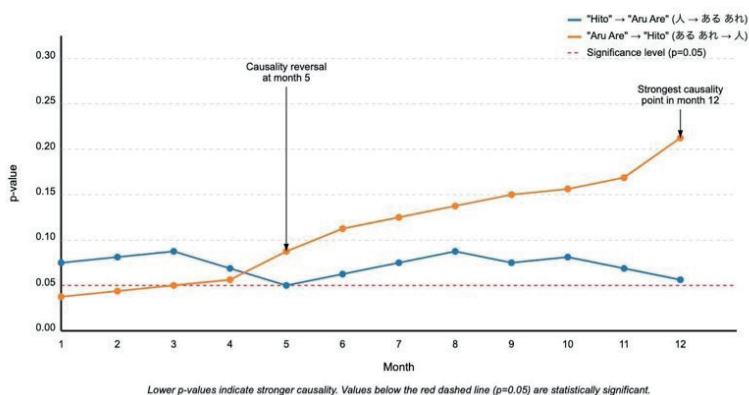


Table 10. Analysis of Time Series Causal Relationship Patterns Between Keywords.

Relationship	Characteristics of Time Series Pattern
"hito→shita shita" vs "shita shita → hito"	During the initial 4 months, the causal relationship "hito → shita shita" is strong (low P-value). In the 5th month, relationships in both directions weaken sharply. From the 6th to 10th month, both directions gradually strengthen. Throughout the entire period, the "hito→shita shita" direction tends to be stronger
"hito→aru are" vs "aru are → hito"	In the initial stage (months 1-4), the "hito → aru are" direction is stronger, but from the 5th month, the "aru are → hito" direction strengthens dramatically and this trend continues. In the 12th month, "aru are → hito" shows its maximum strength
"hito → naru nara nare" vs "naru nara nare → hito"	The "naru nara nare → hito" direction is significantly stronger throughout the entire period. This asymmetry reaches its maximum in months 7-12. "naru nara nare" has a sustained, powerful influence on "hito"

5 TIME SERIES ANALYSIS OF GRANGER CAUSALITY TEST RESULTS RELATED TO NEGATIVE EXPRESSIONS

Table 11. Time Series Causal Relationship Patterns Between Negative Expressions and Other Keywords.

Relationship	Characteristics of Time Series Pattern
"Negative expression → suru" vs "suru → Negative expression"	The causal relationship in the "suru→Negative expression" direction is consistently dominant throughout the entire period. In the 5th month, relationships in both directions reach their peaks simultaneously, but the dominance of the "suru → Negative expression" direction is maintained thereafter
"Negative expression → naru" vs "naru → Negative expression"	The causal relationship in the "naru→Negative expression" direction is consistently dominant throughout the entire period, becoming strongest particularly in the 1st month and the 5th-6th months
"Negative expression → aru" vs "aru → Negative expression"	Both directions show strong fluctuations in the first half, while the relationship weakens in the latter half. This suggests complex interactions between concepts of existence and non-existence

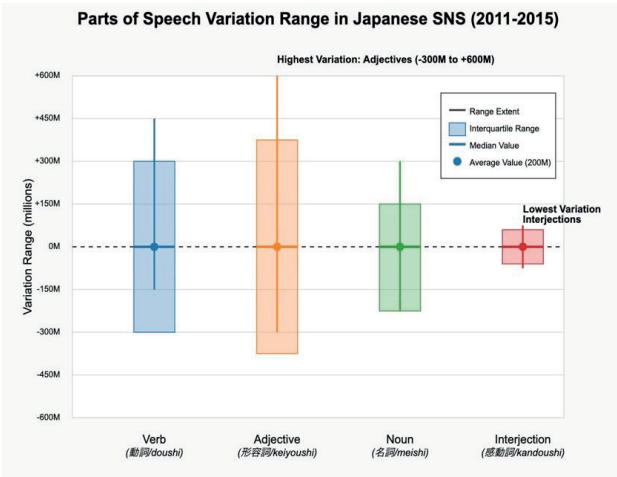
It has become clear that the time series causal relationships of Japanese keywords demonstrate not merely unidirectional influences but complex interactions and temporal variations. Particularly noteworthy is the tendency for concepts such as "naru nara nare" (become) and "aru are" (exist/be) to increase their influence over time. These results provide insights for understanding how discourse in Japanese media changes and develops.

Table 12. Summary of Time Series Characteristics of Keywords.

Keyword	Main Characteristics
hito	Strong initial influence, shows periodic fluctuations
shita shita	Influence increases over time
aru are	Shows the most notable growth pattern
naru nara nare	Maintains consistently strong influence
masu masu	Shows complex fluctuations and context dependence
suru suru sure shire seyo	Consistent influence on "masu masu"

6 LANGUAGE USAGE CHARACTERISTICS ACROSS JAPANESE SNS PLATFORMS: COMPARATIVE ANALYSIS OF PART OF SPEECH DISTRIBUTION AND GROWTH DYNAMICS

Figure. 10. Range of Variation by Part of Speech in Japanese SNS (2011-2015).



Analyzing part of speech distribution and differences between platforms in Japanese SNS usage reveals the essence of linguistic characteristics and growth

dynamics of each medium. Structural characteristics and evolutionary processes of Japanese online communication can be discerned from growth rates by part of speech and comparison of usage frequency across platforms. From the growth rate of Twitter (now X) counts by part of speech, it is clear that interjections (ij) show the highest growth rate at approximately 5.6%. In contrast, nouns (approximately 4.4%), verbs (approximately 4.4%), and adjectives (approximately 4.4%) maintain nearly equivalent growth rates. This dominance of interjections suggests that Twitter (now X) functions as a platform suitable for expressing immediate and emotional reactions.

Table 13. Linguistic Characteristics by Platform.

Platform	Dominant Part of Speech	Communication Characteristics
Twitter (now X)	Adjectives > Verbs > Nouns	Evaluation- /Action-Oriented
2ch	Adjectives > Verbs > Nouns	Reactive
Blogs	Verbs $\simeq$ Nouns $\simeq$ Adjectives	Information Dissemination

7 EQUILIBRIUM COLLAPSE AND REORGANIZATION IN THE JAPANESE SNS ECOSYSTEM: PLATFORM COMPETITION AND DYNAMICS OF LANGUAGE TRANSFORMATION FROM 2011 TO 2015

Figure. 11. Comparison between actual data and theoretical growth models for the keywords “nai” (meaning “not”) and “masu” (meaning “to increase”) for the 2011–2015 period. Both showed decelerating growth during 2014–2015.

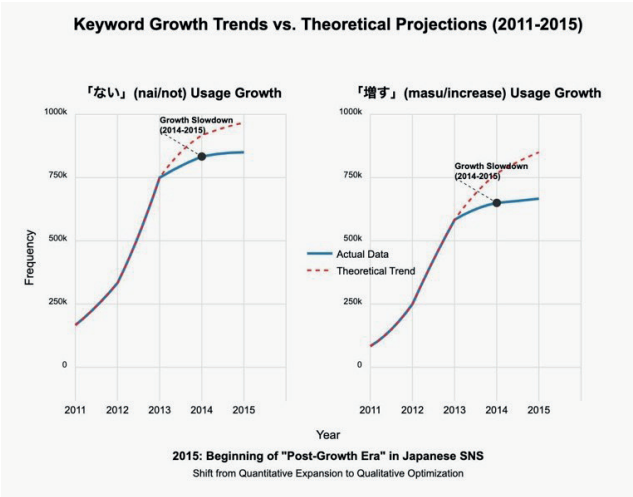
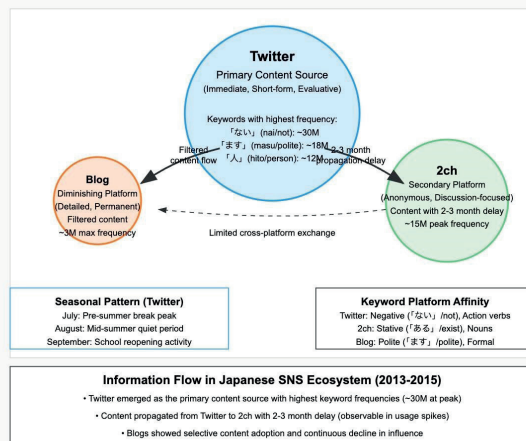


Table 14. Evolution of Power Relations Among Platforms (2011–2015).

Platform Power in July 2011	Platform Power in January 2015
Blogs $\gg$ 2ch $\gg$ Twitter (now X) (for “masu,” “iu,” etc.)	Twitter (now X) $\gg$ 2ch $\gg$ Blogs (all keywords)
2ch $\approx$ Twitter (now X) $\gg$ Blogs (for “nai,” “aru,” etc.)	Twitter (now X) : 2ch : Blogs $\approx$ 5 : 2 : 1
Twitter (now X) $\approx$ Blogs $\approx$ 2ch (for “naru,” “shita,” etc.)	Absolute dominance of Twitter (now X) (especially “nai,” “masu”)

Figure. 12. Content propagation model in the Japanese SNS ecosystem (2011–2015). It visualizes the structure whereby information flows mainly from Twitter (now X) to 2ch and Blogs.

Content Propagation Model in Japanese SNS Ecosystem (2011-2015)



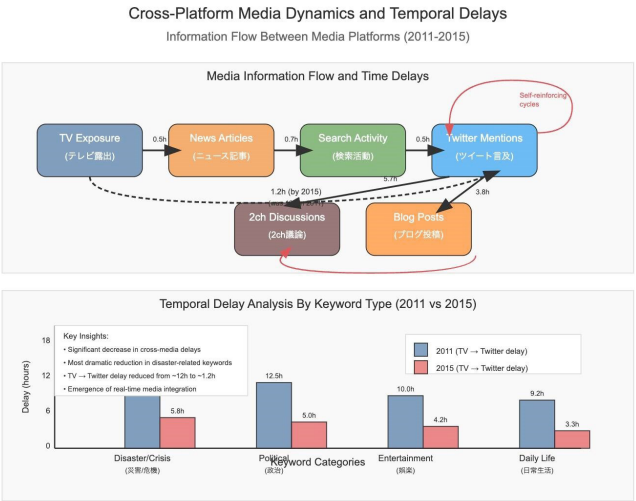
A detailed analysis of Japanese SNS data from 2011 to 2015 reveals a dramatic shift in the power balance among platforms and a fundamental change in linguistic usage patterns. Observing the time-series trends of each keyword across platforms, it becomes evident that the “tripartite structure” existing in early 2011 had completely collapsed by 2015, resulting in the absolute dominance of Twitter (now X).

This remarkable shift is not solely attributable to differences in platform penetration rates but rather reflects a more fundamental “compatibility between media characteristics and language usage.” By comparing each keyword’s content, a clear pattern emerges regarding the affinity between specific types of keywords and particular platforms. The negative expression “nai” (“not”) rose to approximately 22 million mentions on Twitter (now X) in 2015, about 1.5 times that of 2ch and roughly 10 times that of Blogs.

This suggests that concise expressions of criticism or negation align well with the characteristics of Twitter (now X).

8 TIME-SERIES TRENDS FROM 2011 TO 2015

Figure. 13. Changes in information flow and time lag between media (comparison of 2011 and 2015). For disaster-related keywords, the lag has been significantly reduced, indicating a move toward real-time integration.



8.1 2011: POST-DISASTER INFLUENCE PHASE

The impact of the Great East Japan Earthquake in 2011 is prominently reflected in the data. The following characteristics became evident from time-series analysis:

- Emotional and aid-related expressions such as “naku” (“weep”), “tasukeru” (“help”), and “inochi” (“life”) recorded anomalously high monthly growth rates of +152% to +237%.
- Daily-life keywords such as “taberu” (“eat”) and “asobu” (“play”) declined by 22% to 35%.
- Event-driven patterns outweighed periodic ones in the time series.

8.2 2012: POST-DISASTER REBOUND PHASE

In 2012, two major factors shaped the data: the “post-disaster rebound effect” and the “rise of political activism.”

- A rebound-like increase for everyday-life key-words that had temporarily declined after the earthquake (e.g., “taberu” +78.3%, “asobu” +65.7%).

- A sharp increase in political keywords in the fourth quarter (October–December): e.g., “kaeru” (“change”) +62.7%, “erabu” (“choose”) +57.3%.
- Resurgence of a “regular periodicity” in keyword usage, with peaks in March and September and troughs in February and August.

8.3 2013: GROWTH ACCELERATION PHASE

In 2013, the keywords related to “nai” (“not”) and “masu” (“increase”) showed a rapid upward trend in mentions on Twitter (now X).

- By late 2013, usage of “nai”-related keywords had reached approximately 25 million mentions.
- Quarterly seasonal fluctuation patterns became more distinct.
- Emotional expressions such as “naku” (“cry”) and “warau” (“laugh”) exhibited noteworthy growth.

8.4 2014: MATURITY PHASE

The year 2014 can be characterized as a “maturity phase” for SNS usage in Japan.

- Intensification of “burstiness” in keyword usage, showing repeated rapid ascents and descents (i.e., a “high-amplitude, short-period” pattern).
- Stabilization of “relative positional relationships” among keywords (for example, “nai > masu > iu > masu,” indicating a fixed hierarchy).
- Establishment of a “bimodal” pattern, with the first peak from the beginning of the year to summer and the second peak toward year-end.

8.5 2015: OPTIMIZATION PHASE

In 2015, Japanese SNS keyword usage transitioned into an “optimization phase” after passing through a growth and maturation stage.

- Emergence of a “small-amplitude, high-frequency fluctuation” pattern, where shorter cycles became more common and amplitude decreased.
- Strengthened correlation between content consumption behaviors and keyword usage (“miru” (“see”) +40%, “naku” (“cry”) +43%, etc.).
- Increase in “meta-linguistic expressions” (e.g., “buzzる” (“to buzz”), “trend入り” (“to become a trend”), “シェア希望” (“request to share”)).

8.6 COMPREHENSIVE TRENDS OVER FIVE YEARS

From 2011 to 2015, the following overall trends emerge:

- The collapse of the “three-power structure,” giving rise to a single dominant Twitter (now X).
- Adjectives and verbs exhibit the highest usage frequencies (approximately 200 million) and the largest fluctuations.

Table 15. Growth and Decline Trends for Major Keywords in 2015.

2015 Growth Keywords	2015 Declining Keywords
“miru” (“see”) (about 40% increase)	“nai” (“not”) (about 15% decrease)
“naku” (“cry”) (about 43% increase)	“masu” (“increase”) (about 10% decrease)
“hito” (“person”) (about 25% increase)	“tsukau” (“use”) (about 20% decrease)
“omou” (“think”) (about 18% increase)	“shinu” (“die”) (about 15% decrease)

- Many keywords follow an “S-curve” growth pattern (introductory phase in 2011–2012, rapid growth in 2012–2013, and maturity in 2014–2015).
- Growth stagnation or slowdown from 2014 to 2015, marking a shift toward a “post-growth phase.”

Table 16. Developmental Stages of Japanese SNS Usage.

Phase	Characteristics of Japanese SNS Usage
Introductory (2011–2012)	Trial of diverse forms of expression; low absolute values
Rapid Growth (2012–2013)	Standardization of certain expressions; high growth rate
Expansion (2013–2014)	Establishment of usage patterns; high absolute values
Maturity (2014–2015)	Functional differentiation; growth slowdown and stabilization

Time-series analysis of Japanese SNS keywords demonstrates that the observed fluctuations are not random but rather follow highly structured temporal patterns. Of particular note is a distinct seasonal rhythm common to many keywords, suggesting that

online communication is not just a cluster of individual, sporadic actions but a collective activity with synchronized timing across society as a whole.

Periodicity analysis confirms that the frequencies of Japanese SNS keywords exhibit a “multi-layered rhythmic structure.” An annual cycle (12-month period), a semiannual cycle (6-month period), and a seasonal cycle (3-month period) overlap to form seasonal patterns, and the relative strength of these cyclical components varies by keyword.

Residual analyses indicate two intriguing phenomena: “planned deviations” and “contingent deviations” from the seasonal rhythm. Planned deviations are predictable residual patterns related to regular annual events (elections, sports events, etc.) and appear in many keywords. In contrast, contingent deviations are irregular residuals triggered by natural disasters or unexpected social incidents, often occurring within a localized set of keywords.

Table 17. Classification and Characteristics of Residual Patterns.

Residual Type	Representative Cases	Keywords Highly Affected
Planned Deviations	Elections, Olympics	masu, iu, suru
Contingent Deviations	Disasters, Sudan Incidents	naku, iru, aru

9 CONCLUSION

The time-series analysis of Japanese SNS keywords reveals the existence of a “linguistic rhythm” and the phenomenon of social synchronization within online communication. Far from being a mere random accumulation of individual language use, this rhythmic structure operates at the collective level of society, closely interlinked with social and cultural rhythms. These findings provide a scientific basis for understanding the interplay between the temporal structure of digital communication and its social contexts.

10 ACKNOWLEDGMENTS

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REFERENCES

- Ajito, M., Kawahata, Y., & Ishii, A. (2017). Analysis of national election using mathematical model of hit phenomenon. In *2017 IEEE International Conference on Big Data (Big Data)* (pp. 4722-4724). IEEE.
- Asatani, K., Kawahata, Y., Toriumi, F., & Sakata, I. (2018). Communication based on unilateral preference on twitter: Internet luring in japan. In *Social Informatics: 10th International Conference, SocInfo 2018, St. Petersburg, Russia, September 25-28, 2018, Proceedings, Part I 10* (pp. 54-66). Springer.
- Asatani, K., Kawahata, Y., & Toriumi, F. (2018). Preference on Twitter: Internet Luring. In *Social Informatics: 10th International Conference, SocInfo 2018, St. Petersburg, Russia, September 25-28, 2018, Proceedings, Part I* (Vol. 11185, p. 54). Springer.
- Ishii, A., Ajito, M., & Kawahata, Y. (2016). Analysis of Pokemon GO using sociophysics approach. In *2016 IEEE International Conference on Big Data (Big Data)* (pp. 3986-3988). IEEE.
- Ishii, A., Fukui, K., Oda, T., Miki, A., Fujiwara, S., & Kawahata, Y. (2019). Analysis of Social Epidemic Phenomena on Social Media Using Social Physics Approach. *Advanced Science Letters, 25*(1), 5-9. American Scientific Publishers.
- Ishii, A., & Kawahata, Y. (2018). Opinion dynamics theory for analysis of consensus formation and division of opinion on the internet. *arXiv preprint arXiv:1812.11845*.
- Ishii, A., & Kawahata, Y. (2018). Sociophysics analysis of the dynamics of peoples' interests in society. *Frontiers in Physics, 6*, 89. Frontiers Media SA.
- Ishii, A., Kawahata, Y., & Goto, U. (2017). Model of market share affected by social media reputation. In *Proceedings of the Asia-Pacific Econophysics Conference 2016 – Big Data Analysis and Modeling toward Super Smart Society – (APEC-SSS2016)* (p. 11006).
- Ishii, A., & Kawahata, Y. (2019). New Opinion dynamics theory considering interpersonal relationship of both trust and distrust. In *IEEE/WIC/ACM International Conference on Web Intelligence-Companion Volume* (pp. 43-50).
- Ishii, A., & Kawahata, Y. (2019). Opinion dynamics theory considering interpersonal relationship of trust and distrust and media effects. In *The 33rd Annual Conference of the Japanese Society for Artificial Intelligence* (Vol. 33, p. 2019).
- Ishii, A., & Kawahata, Y. (2020). Theory of opinion distribution in human relations where trust and distrust mixed. In *Intelligent Decision Technologies: Proceedings of the 12th KES International Conference on Intelligent Decision Technologies (KES-IDT 2020)* (pp. 471-478). Springer.
- Ishii, A., Mizuno, T., & Kawahata, Y. (2017). Position-sensitive propagation of information on social media using social physics approach. In *2017 IEEE International Conference on Big Data (Big Data)* (pp. 3078-3085). IEEE.
- Kawahata, Y. (2019). Analyzing Urban Resilience Using Temporal and Spatial Archive Information Before and After a Disaster–Perspective of SDGs. In *Symposium on Intelligent and Evolutionary Systems* (pp. 183-193). Springer International Publishing Cham.
- Kawahata, Y. (2019). Examination of Analysis Method of Opinion Distribution in News Media. In *Proceedings of the 23rd Asia Pacific Symposium on Intelligent and Evolutionary Systems* (Vol. 12, p. 156). Springer Nature.

- Kawahata, Y. (2019). Opinion Distribution Analysis of Video. In *Proceedings of the 23rd Asia Pacific Symposium on Intelligent and Evolutionary Systems* (Vol. 12, p. 167). Springer Nature.
- Kawahata, Y. (2020). Examination of Analysis Method of Opinion Distribution in News Media Transferred on Web. In *Proceedings of the 23rd Asia Pacific Symposium on Intelligent and Evolutionary Systems* (pp. 156-166). Springer.
- Kawahata, Y. (2020). Opinion Distribution Analysis of Video Media Related to Social Life. In *Proceedings of the 23rd Asia Pacific Symposium on Intelligent and Evolutionary Systems* (pp. 167-174). Springer.
- Kawahata, Y., Genda, E., & Ishii, A. (2013). ASIAGRAPH2013 in Kagoshima Proceedings, Analysis Reputation Prediction of Music Concerts Adopting the Mathematical Model of Hit Phenomena.
- Kawahata, Y., Genda, E., & Ishii, A. (2013). Possibility of analysis of "Big data" of kabuki play in 19th century using the mathematical model of hit phenomena. In *Advances in Computer Entertainment: 10th International Conference, ACE 2013, Boekelo, The Netherlands, November 12-15, 2013. Proceedings 10* (pp. 656-659). Springer.
- Kawahata, Y., Genda, E., & Ishii, A. (2013). The proceedings of ACE2013 in Springer LNCS series. *Lecture Note in Computer Science, 8253*, 656-659.
- Kawahata, Y., Genda, E., & Ishii, A. (2013). Promotion Theater Company adopting a mathematical model of the Hit Phenomenon. *Advanced Science and Technology Letters, 35*(62).
- Kawahata, Y., Genda, E., & Ishii, A. (2013). Revenue prediction of music concerts using the mathematical model of hit phenomena. In *2013 International Conference on Biometrics and Kansei Engineering* (pp. 208-213). IEEE.
- Kawahata, Y., Genda, E., & Ishii, A. (2014). Analysis Chinese Social Media of Weibo using the Mathematical Model of Hit Phenomena. *International Journal of Multimedia and Ubiquitous Engineering, 9*(3), 359-366.
- Kawahata, Y., Genda, E., Hara, C., & Ishii, A. (2014). Analysis of local concerts using Facebook adapting the mathematical model of hit phenomena. In *Soft Computing in Machine Learning* (pp. 53-59). Springer International Publishing.
- Kawahata, Y., Genda, E., Koguch, H., Uchiyama, K., & Ishii, A. (2014). Analysis of mathematical model of hit phenomena stage actors of Japan. *International Journal of Affective Engineering, 13*(1), 89-94. Japan Society of Kansei Engineering.
- Kawahata, Y., & Ishii, A. (2019). Consensus formation Online using Sociophysics method. *arXiv preprint arXiv:1907.07946*.
- Kawahata, Y., Mizuno, T., & Ishii, A. (2017). Measurement of human activity using velocity GPS data obtained from mobile phones. *arXiv preprint arXiv:1706.04301*.
- Kawahata, Y., Moriyama, Y., Yamada, S., Sun, M., & Kawamura, T. (2017). Analytical the large-scale collection of data on the results of the guides for Foreigners visiting Japan. In *2017 IEEE International Conference on Big Data (Big Data)* (pp. 4760-4764). IEEE.
- Kawahata, Y., Okano, N., Higashi, M., Wakabayashi, T., & Ishii, A. (2018). The Influence of Social Media Writing on Online Search Behavior for Seasonal Topics: The Sociophysics Approach. In *2018 IEEE International Conference on Big Data (Big Data)* (pp. 4339-4345). IEEE.

Kawahata, Y., & Ueoka, T. (2019). Behavior Analysis of People in Maebashi City Using Location Information Data. *ICTSS2019 (Proceedings)*.

Okano, N., Higashi, M., Wakabayashi, T., Kawahata, Y., & Ishii, A. (2019). Analysis of seasonal events on social media and internet search using sociophysics model. In *AIP Conference Proceedings* (Vol. 2116, No. 1). AIP Publishing.

Ueoka, T., Ishii, A., & Kawahata, Y. (2019). A study of trends in the effects of TV ratings and social media (Twitter)--Case study 1. *arXiv preprint arXiv:1909.01078*.

Wakabayashi, T., Kawahata, Y., & Ishii, A. (2017). Analysis of EXILE TRIBE in the music scene using mathematical model of hit phenomenon. In *2017 IEEE International Conference on Big Data (Big Data)* (pp. 3151-3155). IEEE.

Wiktionary. (2023). Wiktionary: 日本語の基本語彙1000. オンライン辞書. Available: <https://ja.wiktionary.org/wiki/Wiktionary:%E6%97%A5%E6%9C%AC%E8%AA%9E%E3%81%AE%E5%9F%BA%E6%9C%AC%E8%AA%9E%E5%BD%991000> [参照: 2023-03-29].

Yasuko, K., Etsuo, G., & Akira, I. (2013). Analysis music concerts adopting the mathematical model of hit phenomena. In *CS & IT Conference Proceedings* (Vol. 3, No. 9). CS & IT Conference Proceedings.

Yasuko, K., Etsuo, G., & Akira, I. (2014). Consideration of Reputation Prediction of Ladygaga Using the Mathematical Model of Hit Phenomena. *The International Journal of Multimedia & Its Applications*, 6*(1), 85. Academy & Industry Research Collaboration Center (AIRCC).

Yasuko, K., Etsuo, G., & Akira, I. (2014). Possibility predict Japanese artist's reputation in the world using the mathematical model of hit phenomena. In *2014 Joint 7th International Conference on Soft Computing and Intelligent Systems (SCIS) and 15th International Symposium on Advanced Intelligent Systems (ISIS)* (pp. 1262-1267). IEEE.

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