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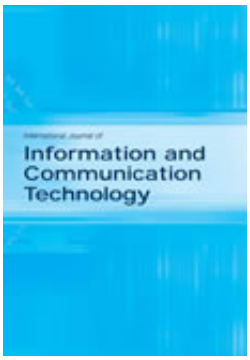

International Journal of Information and Communication Technology

ISSN online: 1741-8070 - ISSN print: 1466-6642
https://www.inderscience.com/ijict

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Article History:

Received:	29 July 2024
Last revised:	28 August 2024
Accepted:	08 September 2024
Published online:	10 October 2024

Optimisation of news propagation path in media convergence era under interactive digital media technology

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Abstract: With the development of digital media technology, data sharing has become the main theme of the new media era of big data, so the news industry is facing new opportunities and challenges. As a new form of data news, the transmission path of data news is very important to its transmission effect. By the news propagation path as the research object, from the theoretical level discusses the communication content, the influence of the platform and digital news propagation path the main body, on the basis of social network analysis and the theory of the virus, analyses the related data of representative, studied three kinds of the difference of the path, find the data of news communication path mainly includes three types: the communication effect is affected by communication platform, communication node, news nature, external interference factors and so on. In the production and dissemination of data news using various operating platforms, attention should be paid to strengthening technology construction, maintaining user relations and paying fees.

Keywords: adaptive recommendation system; multi-media information environment; data analysis.

Reference to this paper should be made as follows: Gong, Y. and Shi, Z. (2024) 'Optimisation of news propagation path in media convergence era under interactive digital media technology', *Int. J. Information and Communication Technology*, Vol. 25, No. 7, pp.25–36.

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1 Introduction

With the rapid development of digital media and social science, data journalism has emerged as a prominent form of news presentation. However, the current data news transmission path faces several challenges, including simple communication channels, limited interactivity, and a lack of diverse content. This study aims to provide a comprehensive analysis of the data news transmission path and propose solutions to optimise its effectiveness. By utilising adaptive recommendation algorithms in a multimedia multi-dimensional information environment, we aim to enhance the user experience, expand the reach of data news, and increase its overall impact. The research questions we address include:

- How does the communication platform influence the data news transmission path?
- What factors affect the content choice and presentation of data news?
- How can interactive design and visualisation technology optimise the transmission path?

The paper is organised as follows: Section 2 provides an overview of data journalism and its development; Section 3 discusses the influencing factors of the data news transmission path; Section 4 presents the methods and case studies used to analyse and optimise the transmission path; and Section 5 summarises the findings and outlines future research directions.

2 Overview of data journalism

2.1 The development of data journalism

The development of information technology has prompted the birth of data journalism. Data journalism is a reporting method that utilises data analysis techniques to present news content, enhancing the readability and dissemination of information through visualisation and other means. In the early stage of the development of data journalism, it was characterised by a monotonous and unattractive form, usually using some simple infographics to deliver news content. With the gradual maturity of technology, data visualisation technology is applied in data news. For example, in 2013, Financial News launched Data Visualisation Lab, which uses intelligent charts to vividly express the

information contained in financial news. Data journalism research mainly focused on the case analysis of the problem of education forms, data, news, news data visualisation, data, news narrative form and the large amount of news because of its own data and data types are varied, news presentation of research in the form of case is better. For example, Zhan (2018) compared the visual reports of Xinhuanet and Sina.com in two dimensions of 'hard news' and 'soft news', and analysed the problems related to data news narrative. Shen et al. (2014) studied how to carry out journalism education by studying the evolution of news reporting methods. Through in-depth research on data journalism, Lang and Yang (2014) analysed innovative methods of news communication under the background of big data, such as news narrative and interactivity. Taking *The New York Times* as the research object, Meng (2016) found that data journalism is characterised by visualisation, mobility and interactivity, and the key to data journalism is to tell the story behind the data.

2.2 Data news transmission path

The dissemination path of data news refers to the distance and way of the dissemination of data news from publishers to other audiences (Ge, 2023). At present, the research on the transmission path of data news is in the initial stage, and the research focus is on the analysis of the transmission path of data news, which provides a new research direction for the dissemination of online public opinion information, in order to strengthen the supervision of online public opinion. This paper analyses the characteristics and existing problems of data news, combined with the background of big data era, and studies the multi-way interactive transmission path of data news.

2.2.1 The problem with data journalism

There are a series of problems in the development process of data journalism, including too single communication path, similar types of reports, imperfect interactive experience and simple pursuit of visualisation, which affect the expansion of data journalism communication path in a sense.

2.2.1.1 The propagation path is too simple

In the transmission path of data news, the transmission effect is often affected because the transmission path is too simple. In the early development of data news, taking China's Xinhuanet as an example, most of the websites were presented in the form of 'text and text combination'. Although it could be shared to other websites, the number of users was small. Although data news in China originates from websites, the participation rate of mobile users is far higher than that of PC web users. Most news web pages have problems such as simple form and backward feedback mechanism in the process of interaction with the public. Users can only express their opinions through traditional ways such as likes, shares and comments, which lack interaction and make it difficult to obtain effective experience information of users and weaken the dissemination effect of news.

2.2.1.2 Similar types of reports

The development of data journalism is limited by talent, technology, capital, etc., and it focuses on some fields where data can be easily obtained, such as finance and economics, sports, entertainment, etc. Forward-looking news reporting is rare. Due to the lack of innovation consciousness, many media lead to the same topics, cannot attract the attention of the audience, is not conducive to the depth and breadth of news dissemination. Avoid homogenisation to focus on the theme, broaden the field of communication, expand the group, so as to improve the transmission.

2.2.1.3 The interactive experience is imperfect

Traditional news interaction mainly focuses on likes, comments and sharing, which cannot give full play to the advantages of data news. Due to the weak technical ability of computer and other related technologies, the interactive experience of data news is not perfect. It can cultivate the technical ability of journalists, learn R language, Python, API functions, etc., and give full play to the interactive advantages of data news, so as to optimise the communication effect and realise the network expansion of the communication path.

2.2.1.4 Simple pursuit of visualisation

There is a problem of excessive pursuit of visualisation in the dissemination of data news. Some media attract users through technical means, but still use a large number of texts in news narration, lacking of interpretation of data. Focusing solely on the 'graphical' processing of data will lead to a rigid result in data journalism and reduce users' interest in the media.

3 The influencing factors and modes of news transmission path

3.1 Influencing factors of data news transmission path

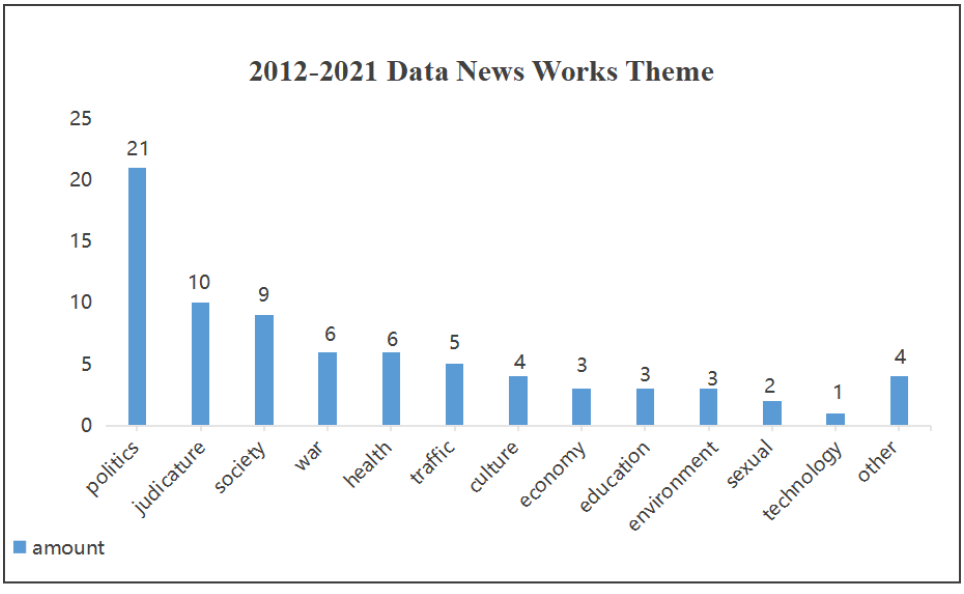
The transmission path of data news was born in the internet big data era and is affected by multiple factors. Based on the news source, the way of communication and the easy recipient of news in the news communication theory, this paper discusses the influence factors of the news communication path into three aspects: the content of communication, the platform of communication and the traditional subject.

3.2 The propagation content affects the propagation path

The most basic function of news is to deliver information to users, so it is very important to choose the dissemination content of news. For example, the similarity and importance of traditional news are also applicable in data news. The essence of data journalism is to dig deep into the surface information of news and reflect the deep problems of society. Such content is more valuable.

Data is one of the effective ways to draw conclusions. Based on this, data news can find social problems and provide some reference for relevant departments to make decisions. Figure 1 shows the theme statistics of the ten prise-winning data journalism works from 2012 to 2021. The themes of the prise-winning news works mainly focus on politics, justice, war, culture, economy, health and other events closely related to human life. It is because these reports truly reflect the issues closely related to the audience who watch the news, and visualised them through high-tech means, so as to expand the scope of news dissemination, extend the transmission chain, and improve the transmission power of data news.

Figure 1 2012–2021 data news works theme (see online version for colours)



3.3 The communication platform influences the way of communication

Because of the lack of interactivity, traditional news is generally one-way dissemination, and the dissemination effect of news is greatly limited. With the support of internet technology, data news is widely concerned by users through interactive news, dynamic news and other new situations, and has advantages that traditional news cannot match.

China's four major platforms (Sohu, Tencent, Netease and Sina) are the first to establish data news programs, which have achieved good communication effects. Xinhuanet and People's Daily also followed suit and opened WeChat public accounts of various websites, gradually forming their own news Windows from print media to WeChat and microblog.

China Advanced Laboratory of Financial and Economic News was awarded the best team of data news in 2018. They spread news to users through interactive websites, 3D animations, news asking games and other ways. This kind of news with a sense of fun and technology is more suitable for display on PC or mobile terminal.

Therefore, it can be seen that the data news display is affected by the communication platform, and the main problems are whether the news communication platform can present the complete news content. Users of different communication platforms have different interactivity and attention, thus affecting the development of news communication path.

3.4 The transmission subject influences the transmission route

The communication subject is indispensable to the news communication path. As an integral part of the communication path, it plays a key role in the development of the communication path. In particular, as the main influencing factor of the communication, opinion leaders influence the communication and expansion of the communication path. In social networks, the dissemination and influence intensity of information are in direct proportion to the proportion of informed people in a group (Merton, 1968).

According to the Matthew effect (Azoulay et al., 2012; Jiao, 2023; McMahon, 2004), under the influence of psychological effect, users' opinions will be automatically strengthened in information dissemination activities, and the main opinions will become important as the popularity of information dissemination increases. The first reason is that the activity of opinion leaders is higher than that of other ordinary people. The second reason is that the greater the influence of information disseminators, the faster the transmission speed, and their views are easier to be recognised by netizens.

3.5 Data news transmission path model

Compared with traditional news, data news has a more perfect algorithm recommendation mechanism, social chat mechanism, forwarding comment mechanism, etc., and its communication ability is significantly improved. The communication path mode is also more complex, and it is no longer simple one-to-one or one-to-many communication.

On the basis of consulting relevant literature (Han, 2022; Pan and Liu, 2023; Liao, 2024; Cheng, 2023), this paper divides the data news transmission path into three modes: central mode, multi-stage point mode and multi-dimensional chain mode. By observing and analysing the transmission path of specific news cases, it verifies and explains.

3.6 Central communication

One of the most common dissemination modes of data news is central dissemination, which includes key nodes and common nodes. Key nodes, also known as central nodes, refer to the nodes directly connected to a large number of nodes in the network. Data news signal source is generally the central node, the common node refers to the network does not contain other nodes other than the central node. Specifically, the central communication is the information interaction between many common nodes around a key node. The interaction type can be either one-way interaction or two-way interaction.

Figure 2 The diagram of central propagation path (see online version for colours)

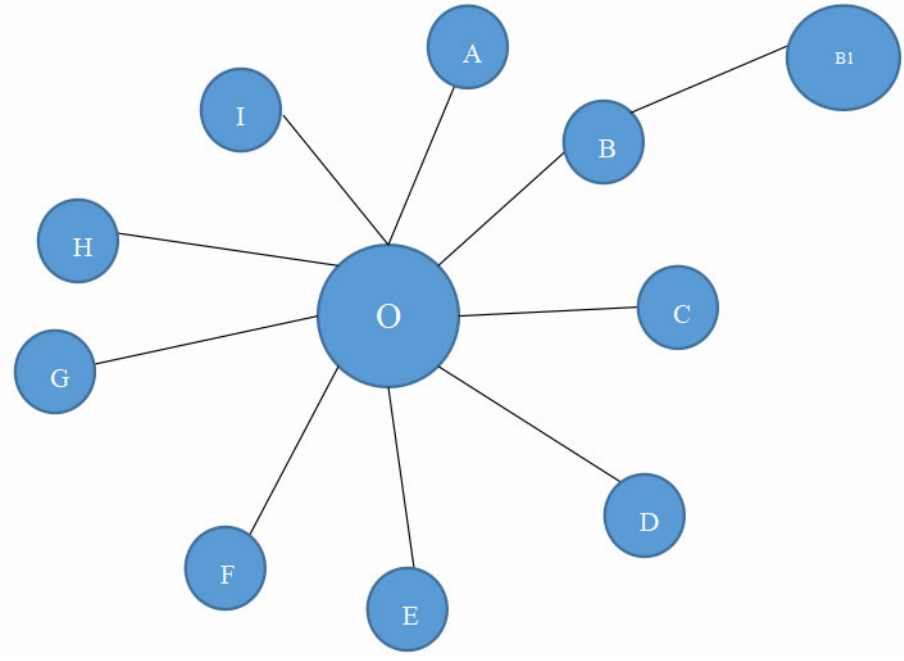


Figure 2 is a diagram of the central propagation path. The topology is divergent. O is the central node, that is, the key node. As shown in O-B-B1, the range of central propagation is limited, but many small nodes can be formed. The dissemination process of general information is as follows: the central node realises the dissemination of information to the ordinary node by virtue of its appeal and appeal. However, sometimes chain transmission occurs, in which central node passes information to B, and B node passes information to B1, thus increasing the path of information transmission. The central node is generally the source of information, celebrities, official media, etc., with many fans or followers, the information can be quickly forwarded and spread rapidly, and the spread range is wide through secondary or repeated transmission.

3.7 Multistage point propagation

The multi-level point propagation mode usually has multiple key nodes exchanging information on the common bridge node, and the bridge node is closely related to each central node, forming an information hub. The specific mode of multi-level point communication is as follows: after information is transmitted from information source to outside, multiple levels are formed after it reaches several key nodes. Due to the influence of these central nodes, fans are driven to forward and spread, so as to increase the depth and breadth of information transmission.

Figure 3 The diagram of multistage point news transmission path (see online version for colours)

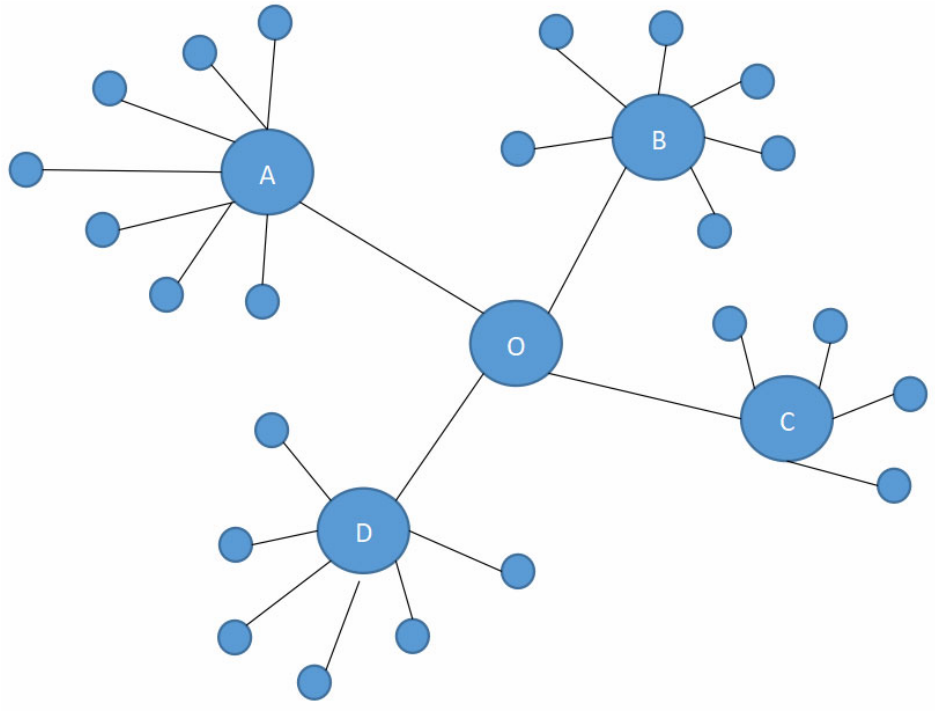


Figure 3 shows the specific process of multi-level point information transmission: signal source O reaches four key nodes A, B, C and D respectively in the transmission process. This kind of news transmission is characterised by a long transmission chain and a wide range of transmission. After the release of information, some media or personal portal websites will compile or re-decode the information, rearrange and process the information, attract the attention of the public and become the bridge point in the transmission chain. Therefore, paying attention to the key nodes is beneficial to optimise the transmission path of news.

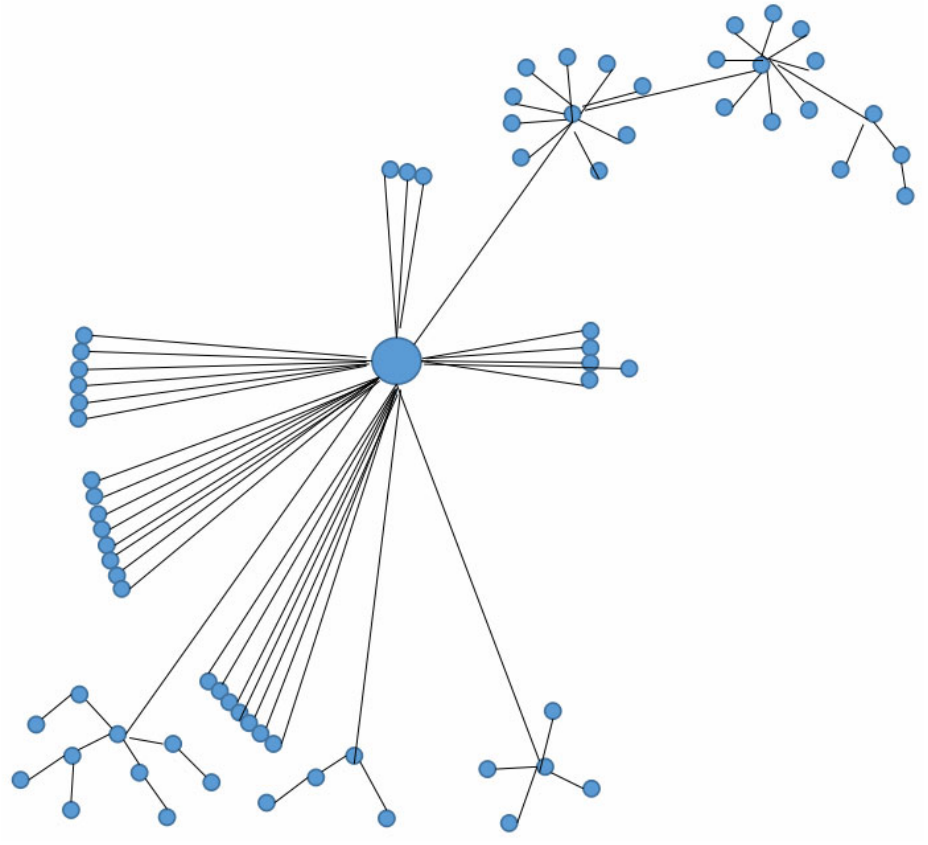
3.8 Multi-dimensional chain propagation

Combined with the characteristics of the two news communication modes, the central mode and the multi-stage point mode, a communication mode of minority is formed, namely, the multi-dimensional chain communication mode, which takes the signal source as the starting point, transmits information to another node, and then continues to spread downward, with a long transmission path.

As shown in Figure 4, the propagation path of the multi-dimensional chain propagation is complex and the propagation range is wide. Due to the strong influence of the information source itself and the transmission of powerful nodes, the contents forwarded by this mode are generally hot topics or major emergencies, which are easy to receive wide attention from groups from all walks of life and attract strong interest of news users.

Through the introduction of the above three modes of communication, I have a preliminary understanding of the dissemination of news. In real life, the mode of propagation path changes with the evolution of events. It starts with 'central' or 'chain' transmission, develops into 'multi-level point' transmission, and finally, with the continuous escalation of events, it may develop into 'multi-level chain' transmission mode. The specific transmission path mode needs to analyse the news data that users are concerned about, explore the transmission mode and characteristics of data news, and release data news in a targeted way (Nie, 2024).

Figure 4 The diagram of multi-dimensional chain news transmission path (see online version for colours)



4 Optimisation of news transmission path

In order to specifically study how to optimise news transmission path by using interactive technology, this paper selects PC cases as data for specific analysis, so as to summarise the specific measures of news transmission path optimisation.

4.1 Case selection and analysis

With the maturity and development of computer technology, more and more group selection in the PC to watch the news, pay attention to current events, etc., related to the case, this article selects the Xinhua a data published on 19 June 2018 news 'threshold increases as case analysis', Xinhua by combination of the complex economic issues to show concise and clear out, compared with other news media coverage of the personal income tax issue received more attention.

The research data of this PC-end news comes from the analysis of the communication effect of the founder Changying media platform, which presents specific visual data on the reprint times, reprint channels and reprint trends, which is convenient for mastering the news feedback effect.

By grabbing the news from founder platform, it can be seen that there are 1,220 valid reposts, 491 reposts and 2 days, 21 hours and 49 minutes of reposting. PC forwarding can be forwarded by different platforms of the same media. Compared with Weibo, it is not easy to carry, resulting in a small number of users. It plays a basic role in spreading news and has less influence than Weibo.

4.2 Enhance interactive design to optimise the propagation path

Paying attention to the interactive design in the process of news transmission, especially the visual realisation of user interaction performance, can not only make the news intuitive image, more importantly, it can attract users' interest, give users a lot of independent choice, but also help users to participate in the topic of news. On the basis of ensuring the social significance of news, we should attach importance to the way of presentation and narrative of news, pay attention to interactive communication and visual presentation, and make users an indispensable part in the process of news production.

In the case of BBC's Best News of 2015, for example, news producers used D3 technology to design a very interactive button slide page and ring chart. Once users have completed the test, they can be shown the right sports for them to participate in, greatly increasing user engagement.

Therefore, focusing on the application of interactive technology and visualisation technology in news production and dissemination can effectively increase user experience and optimise news dissemination path.

5 Conclusions

This study analysed the characteristics and problems of data news transmission path in the context of the new media environment. We identified several influencing factors, including communication platform, content choice, and user interaction. Through case studies and data analysis, we proposed optimisation strategies using interactive design and visualisation technology. The results show that these strategies can effectively improve the quality and speed of news dissemination, increase user engagement, and expand the scope of news influence. For future work, we plan to further explore the potential of adaptive recommendation algorithms in the multimedia multi-dimensional information environment. Multimedia multi-dimensional information environment is a complex environment that includes multiple media forms (such as text, images, videos,

etc.) and information dimensions (such as time, space, relationships, etc.), used for the display and dissemination of information. And adaptive recommendation algorithm is an algorithm that can dynamically adjust recommended content based on users' historical behaviour, interest preferences, and contextual information to improve the accuracy of recommendations and user satisfaction. Specifically, we will investigate how to integrate user behaviour analysis, content semantics, and context information to provide more personalised and accurate news recommendations. Additionally, we will study the impact of emerging technologies, such as artificial intelligence and virtual reality, on the future of data journalism and news transmission.

Data availability

The data used to support the findings of this study are available from the corresponding author upon request.

Funding statement

This research study is sponsored by these projects: project one: the soft science project on the Construction of Science and Technology Communication Media Service System in Shaanxi Province, the project number is: 2019KRM176. Project two: 'Youth Top-notch Talents' Support project of Xianyang Normal University. Thank these projects for supporting this article!

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