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Issue Attention and Semantic Overlap in Vaccination Coverage Within Switzerland's Hybrid Media System

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Abstract

Despite broad scientific support, vaccination is traditionally a contested issue among the public. During the Covid-19 pandemic, the issue of vaccination received widespread attention in news media and on social media. Although we know that public debates on such disputed issues evolve over time in hybrid media systems, there is still little knowledge about the extent to which news media and social media align or differ in their issue attention dynamics and semantics. Furthermore, empirical studies, particularly on social media data, tend to focus on periods of high issue attention, often missing relevant reference points before or after such phases. Focusing on the issue of vaccination in Switzerland, we examine 77,798 news articles by 20 Swiss online newspapers and 929,431 posts by 22,672 Swiss Twitter (now X) users to investigate the similarities and differences between the two spheres through a time series analysis between April 1, 2019, and June 30, 2022. The findings show how vaccination gained vastly in issue attention—measured as the share of total coverage and tweet volume, respectively—during the Covid-19 pandemic. Twitter and news media were closely aligned during the crisis in terms of issue attention and semantics, but less so before and after the pandemic. These findings substantiate previous works on issue agendas in hybrid media systems that converge toward a dominant issue in times of crisis.

Keywords

Covid-19; crisis communication; issue attention; journalism; news media; public sphere; social media; vaccination

1. Introduction

During large-scale societal crises, such as the Covid-19-pandemic, as people experience a strong need for orientation (Matthes, 2006; McCombs & Weaver, 1973), they turn to various kinds of media to learn about the events, debates, and policies regarding the crisis (Althaus, 2002; Van Aelst et al., 2021; Westlund & Ghersetti, 2015). The emergence of digital media channels has resulted in modern hybrid media systems (Chadwick, 2017) in which the number of available information sources and the number of producers of information have increased. In these high-choice media environments, users can access a wide array of sources that can both facilitate and complicate information acquisition. A defining feature of hybrid media systems is not the replacement of traditional media by digital channels but their coexistence and interaction. While new sources have emerged and gained influence, traditional media continue to play an important role (Djerf-Pierre & Shehata, 2017). This is mirrored by the large number of different sources people used for information during the Covid-19 pandemic (Friemel et al., 2020; Ilic et al., 2022). The increased demand by audiences for journalism, coupled with high news values, led to a vast amount of news coverage focused on the pandemic on the supply side (Eisenegger et al., 2021; Ort et al., 2023). Not least because of the strong dependence on mediated communication during public lockdowns, debates related to the pandemic were also highly salient on social media such as Twitter (now X; Rauchfleisch et al., 2023). Although social media were not necessarily among the most used sources for information during the pandemic in Switzerland (Friemel et al., 2020), Twitter specifically has been shown to play an important role in the agenda-setting process, as journalists source the platform for information about current (political) events (Metag & Rauchfleisch, 2017). Therefore, news media and Twitter are shown to have a complex, mutual influence on each other's agendas (Gilardi et al., 2022; Su & Borah, 2019). Due to the high demand for information by the public and the pronounced salience of the pandemic, news media coverage and communication on social media also played an important role in how people perceived the pandemic, and the key issues related to it (Ahmed et al., 2022; Geber et al., 2024). Notably, Twitter was rebranded as X in July 2023, after its acquisition by Elon Musk in October 2022. Throughout this manuscript we use the term "Twitter" to refer specifically to the platform as it existed during the study period (April 2019 to June 2022).

Crises typically lead to a narrowing of the issue agenda—that is, a reduced set of issues and increased attention to issues related to the crisis across different arenas (Imhof, 2011). One of the most salient issues regarding the pandemic was the debate on vaccination, particularly once a vaccine became available (Ort et al., 2023). Therefore, the issue of vaccination is a compelling case to study the relationship between legacy news media and online platforms, such as Twitter, in hybrid media systems. Understanding the alignment and distinctions in vaccination coverage between news media and social media is important, as media representations of vaccination shape public willingness to get vaccinated (Allington et al., 2021; Chadwick et al., 2021; Lin & Lagoe, 2013; Motta & Stecula, 2023). Despite much research on debates on the Covid-19 vaccination in news media (Motta & Stecula, 2023; Ort et al., 2023; Zeid & Tang, 2022) *or* on social media (Bonnevie et al., 2021; Jiang et al., 2021; Johnson et al., 2020), little is known about the similarities and differences between the public debates on this issue in hybrid media systems. Furthermore, most studies on the Covid-19 vaccination have focused on periods of high issue attention, often missing relevant reference points before or after such phases. As a result, there is little research comparing phases of high issue attention for vaccination in the media with phases of little issue attention (for an exception, see Bonnevie et al., 2021).

In this study, we address these two research gaps. Using extensive news and Twitter datasets covering the period from April 1, 2019, to June 30, 2022, we investigate the issue attention and semantic overlap of the vaccination debate in Swiss news media and in the Swiss Twittersphere before, during, and in the aftermath of the Covid-19 pandemic. Thus, the study shows how the Covid-19 pandemic, as a public health crisis, affected the debate on vaccination in the news and on Twitter and in two language regions of Switzerland.

2. Conceptual Framework

Over the past three decades, digitization has led to increasingly complex information ecosystems characterized by new communication channels and media logics (Carlson, 2020). Social media, in particular, have emerged as significant channels for disseminating information and facilitating public discussions. The communication environment within such hybrid media systems (Chadwick, 2017) poses challenges to some traditional functions of journalism in society, such as gatekeeping and agenda setting. While journalism continues to serve as a central authority in assigning publicity to issues and actors (Langer & Gruber, 2021), it now competes and interacts with newer media, algorithms, and diverse actors (Wallace, 2018).

In his seminal work, Chadwick (2017) underscored that in hybrid media systems, (political) communication is increasingly shaped by interactions between older and newer media logics. As a result, the construction of the public issue agenda has become more complex, influenced by a wide array of actors utilizing digital communication tools, algorithms, and alternative media (Wallace, 2018). In this process, newer and older media observe, compete with, influence, and interact with one another (Langer & Gruber, 2021). This dynamic has even raised questions about whether a unified public agenda still exists or, at least temporarily, can be established, or if the communication patterns within hybrid media systems have led to the fragmentation of the public, with separate agendas and differing issue priorities (Bruns, 2023). Consequently, we can expect temporal variations in issue attention and semantics when examining debates on the same issue across different communication arenas, such as social media and legacy news media.

The relevance and salience of issues in the public evolve over time. Pressing societal issues, such as public health, migration, or climate change, have been shown to continuously compete for attention in the public (Geiß, 2011). Downs (1972) introduced the concept of issue-attention cycles to describe the rise and fall of the salience of issues in the public. According to Downs (1972, p. 38), "public attention rarely remains sharply focused upon any one domestic issue for very long." Following a triggering event, issues will receive increased public attention for some time before gradually fading from the center of attention again (Downs, 1972). The concept of issue-attention cycles has been used to describe and empirically analyze the dynamics of health-related issues, such as vaccination (Arendt & Scherr, 2019) and epidemics (Shih et al., 2008), and other issues, such as the environment (Djerf-Pierre, 2013) and migration (Greussing & Boomgaarden, 2017). The concept of issue-attention cycles has also been applied to debates on social media, such as Twitter (Wang & Guo, 2018).

Crises are often tipping points for issue attention, leading to greater uniformity in the public agenda. During major societal crises, a few key issues tend to dominate public discourse (Imhof, 2011; Rauchfleisch et al., 2021, 2023). The range of topics discussed narrows, converging into those directly related to the crisis, with certain issues perceived as particularly urgent and gaining attention (Imhof, 2011). The Covid-19 pandemic, perhaps the most prototypical example, dominated the public agenda for months. Issues related to the crisis

gained prominence, often overshadowing other important issues such as the climate crisis (Rauchfleisch et al., 2023). Therefore, it is of interest whether events that affect large segments of the population, such as the pandemic, lead to a temporarily unified public sphere characterized by heightened attention to one or a few topics across different channels or arenas.

However, why do crises receive so much attention in the news media and on social media? Crises and related events often represent key events that reshape public debates, influencing factors such as an issue's salience in the news or on social media (Jang & Pasek, 2015; Kepplinger & Habermeier, 1995). Key events can also cause certain issues to be displaced by others (Geiß, 2011). For example, Rauchfleisch et al. (2023) showed that the announcement of the outbreak of the Covid-19 pandemic in Switzerland not only increased media coverage of the pandemic itself but also led to the displacement of the climate issue on Twitter and in the news. Such effects of real-world key events on issue attention are often amplified by journalistic working routines and audience needs. For news media, crises are times when the demands of audiences and the interests of news media align. Crises are events with high newsworthiness, and they promise high reach among news audiences (Vasterman & Ruigrok, 2013). Especially when an issue is explicitly linked to a crisis, it usually gains salience. An example is the issue of migration, which gained attention after the so-called "migration crisis" in 2015 (Greussing & Boomgaarden, 2017). Waldherr (2014) identified several factors that increased the news media's attention to an issue over time: characteristics of the issue itself, such as perceived threat, proximity, or novel information, which lead to high news value, and amplification by working routines in journalism, such as increased reporting as journalists observe and follow their colleagues' reporting. The increased reporting on crises meets the demands of audiences for reliable and trustworthy information related to the crisis. Most importantly, audience studies have shown that negativity, which is inherent in issues related to crises, drives online news consumption (Robertson et al., 2023) and the spread of content on Twitter (Schöne et al., 2021).

2.1. Issue Attention for Vaccination in News Media and on Social Media

Vaccination was one of the most central issues during the Covid-19 pandemic. In an inductive automated analysis of news coverage of the pandemic in Switzerland, Ort et al. (2023) identified vaccination as one of eight distinct overarching issues. They also showed that the start of the vaccine campaign in January 2021 altered the issue structure of pandemic-related news, with the issue of vaccination peaking around the start of the vaccination rollout. Vaccinations are a great medical achievement and have led to the elimination or containment of various infectious diseases (Rodrigues & Plotkin, 2020). Nevertheless, there have long been groups of vaccination opponents that deny the effectiveness of vaccines (Blume, 2006; Bonnevie et al., 2021). These groups are typically highly outspoken, and with social media, they have new avenues of dissemination for their beliefs (Gruzd et al., 2023; Milani et al., 2020). Thus, vaccine opposition has been found to rise on Twitter (Bonnevie et al., 2021), Facebook (Johnson et al., 2020), and YouTube (Kaiser et al., 2021). Due to its relevance as one of the main measures against the pandemic and opposition by certain population groups, the issue of vaccination gained significant attention and was discussed controversially by the public. The Covid-19 pandemic was undoubtedly a critical moment that changed the public debate about vaccination. Therefore, we ask the following question:

> RQ1: How does issue attention for vaccination evolve in the Swiss news media and in the Swiss Twittersphere over time?

2.2. Relationship Between News Media and Twitter

News production does not occur in isolation. Journalists often monitor their peers and pick up on relevant stories and topics covered by others. Research on intermedia agenda setting has explored how different journalistic media "emulate and adopt each other's stories" (Vliegenthart & Walgrave, 2008, p. 860; see also Boyle, 2001). In hybrid media systems, in which channels have multiplied, the question of how different types of media influence one another becomes increasingly important. Therefore, the concept of intermedia agenda setting has been used to examine the interaction between traditional news media and social media platforms, such as Twitter.

However, we still know little about the extent to which these debates on highly contested issues, such as vaccination, are aligned or independent between news media and social media. While intermedia agenda setting is an often-used theory to explain how content is transferred between the news media and social media (Conway et al., 2015; Gilardi et al., 2022; Harder et al., 2017), the literature is at odds when it comes to the question of which sphere can set the agenda of the other sphere. Some studies have shown that, at least for specific issues, actors using social media can influence the agenda of the news media (e.g., Gilardi et al., 2022), while other studies have shown that the news media can set the agenda on social media (Harder et al., 2017). Most of these studies present results of mutual influence (Conway et al., 2015; Gilardi et al., 2022; Su & Borah, 2019; van Heijkant et al., 2019). For Switzerland, Gilardi et al. (2022) determined the salience of four political issues using a trained classifier that analyzed news media coverage, tweets by politicians, and tweets by party accounts. Using vector autoregression, they found that the salience of issues in the news media and the Swiss political Twittersphere are strongly related to each other, with no clear direction of influence. This finding aligns with previous research indicating that in Switzerland, Twitter is used by journalists to source political news (Metag & Rauchfleisch, 2017) and by politicians to communicate with journalists (Rauchfleisch & Metag, 2016). Therefore, it can be inferred that similar responses to the Covid-19 pandemic outbreak are apparent in the two spheres. However, the spheres are also characterized by different fields of communicators and communication logics (Chen et al., 2023). The coverage of news media is produced by a few communicators selecting newsworthy events and presenting them in a professional manner (Wallace, 2018). On social media (i.e., Twitter), the field of actors is much broader and includes professional and non-professional communicators (Rauchfleisch et al., 2021). Interestingly, Su and Borah (2019) showed that intermedia agenda-setting dynamics could be influenced by key events, implying that the effects are issue- and time-dependent. They analyzed eight newspapers from five countries, combined with the corresponding Twitter data, across four waves. The researchers manually coded subtopics within the climate change coverage, used rank-order analyses to compare issue saliency, and employed cross-lagged correlations to predict intermedia agenda-setting effects between news media and the Twittersphere.

The investigation of intermedia agenda setting in hybrid media systems presents significant methodological challenges. Many of the mentioned studies relied on measures based on *daily* volumes of social media content or news coverage. While such approaches yield valuable insights, modern hybrid media systems can involve much faster interactions in which journalists can pick up social media content and publish a story within hours, while social media users react, comment, and share news articles within minutes of publication (Lee, 2015; Peters, 2012). This greatly complicates the determination of causality or the direction of reciprocal influences. Therefore, in this study, which is also based on daily data, we do not aim to identify the causality

or directionality of reciprocal influence. Instead, we examine the strength of their correlation—that is, whether and how strongly the two time series (social media and news media) move in unison or independently of each other. Focusing on the case of vaccination issue salience before, during, and after the Covid-19 pandemic, we therefore ask the following:

> RQ2: How aligned is issue attention for vaccination in the Swiss news media and in the Swiss Twittersphere?

2.3. Semantic Overlap Between News Media and Twitter

The relation of salience of issues is only one aspect of intermedia agenda setting. To obtain an estimate of how news media or social media users emulate and adopt content from other sources (Vliegenthart & Walgrave, 2008), examining the nature of the content is also important. Particularly for major issues, it is not only a matter of whether an issue is covered but also how it is covered. Journalists have to decide what aspects of the issues they cover and which topics they leave out. In the news coverage of the Covid-19 vaccination, different subtopics have been identified, such as side effects, economic aspects, and the administration process (Bai & Lee, 2024; Ort et al., 2023; Wilson & McKee, 2024). Similarly, on social media, users discuss different aspects of an issue and have different opinions and evaluations of the issue. In their analysis of hashtags in Covid-related tweets, Rauchfleisch et al. (2021) demonstrated that the debate evolved over time, with the salience of subtopics shifting. A study by Milani et al. (2020) related to vaccines showed that anti-vaccination content and users were more prevalent on Twitter than pro-vaccine content and users. To capture these subtopics in vaccine-related discussions, we examine the similarity between the content of tweets and news articles within each week. As our analysis begins before the outbreak of the pandemic, the data initially includes news articles and tweets about vaccination in general or related to other diseases. It is only during the pandemic that the focus of the vaccination discourse eventually shifts to Covid-19. We expect that news coverage and social media content will have a higher semantic overlap during times of crisis. Therefore, we ask the following question:

> RQ3: How semantically aligned is the coverage on vaccination in the Swiss news media and in the Swiss Twittersphere?

2.4. Differences Between German- and French-Speaking Switzerland

Switzerland has a linguistically segmented media market with four language regions. Although there are frequent interactions between the regions in news media reporting and social media communication, they are also shown to have separate journalistic cultures and distinct social media user communities on Twitter (Rauchfleisch et al., 2021). Related to the Covid-19 pandemic, differences and similarities in news media reporting and social media communication have been identified between the French- and German-speaking regions. In the news and on social media, the salience of the issue and the subtopics discussed within the issue were similar, while the set of experts and actors was very different (Ort et al., 2023; Rauchfleisch et al., 2021). Therefore, we are also interested in whether there are any discernible differences between the two largest language regions, German- and French-speaking, regarding the vaccination issue:

> RQ4: Are there any differences between German- and French-speaking regions?

3. Methods

We investigated our RQs through an automated content analysis of the Swiss news media coverage of vaccination and posts about vaccination by Swiss Twitter users. We analyzed all news articles with reference to vaccination published between April 1, 2019, and June 30, 2022, in 20 online news media outlets from the German- and French-speaking regions of Switzerland (n = 77,798 news articles). Similarly, we used all tweets with reference to vaccination in the same period (n = 929,431 posts by 22,672 unique users). We only included posts in the German and French languages. News articles and tweets were retrieved using the same search query in both spheres (impf* OR vacc* OR vakzin*).

The news articles were accessed through the Swiss Media Database, which is maintained by Swiss publishers and contains full-text articles from the most relevant Swiss news media outlets. We selected online news outlets because they are the most widely used source of information in Switzerland. From three types of online media, namely subscription-based, mass market, and public service, we chose the outlets with the highest reach in the two language regions (Udris et al., 2024). A complete list of the selected outlets is provided in Table 1.

Table 1. Overview of news media outlets in the dataset (n = 77,798).

Media outlet	Media type	Language region	Articles
nzz.ch	Subscription	German	6,054
letemps.ch	Subscription	French	5,480
blick.ch	Mass market	German	5,246
tagblatt.ch	Subscription	German	4,808
srf.ch	Public broadcaster	German	4,767
bluewin.ch	Mass market	German	4,199
20minutes.ch	Mass market	French	4,180
20minuten.ch	Mass market	German	4,158
aargauerzeitung.ch	Subscription	German	4,085
tagesanzeiger.ch	Subscription	German	3,974
baslerzeitung.ch	Subscription	German	3,794
bernerzeitung.ch	Subscription	German	3,738
lematin.ch	Mass market	French	3,675
luzernerzeitung.ch	Subscription	German	3,568
24heures.ch	Subscription	French	3,093
watson.ch	Mass market	German	2,749
suedostschweiz.ch	Subscription	German	2,728
lenouvelliste.ch	Subscription	French	2,624
rts.ch	Public broadcaster	French	2,546
tdg.ch	Subscription	French	2,332

To analyze Twitter, we used a tracking instrument (Rauchfleisch et al., 2021) that continuously collected the posts of all Swiss Twitter users (n = 296,841 unique users) through the Twitter API. All tweets written by the tracked users were downloaded to a server on a daily basis, resulting in a total dataset of 51,077,295 tweets

from 101,648 active unique users for our period of investigation. The method was developed to track the complete Swiss Twittersphere. Swiss users were identified using an iterative, semi-automated process based on information from the user biography and network analysis. The Swiss Twittersphere was defined as all accounts that mention Switzerland, Swiss nationality, or a Swiss city in their biography or, where applicable, as the location in their Twitter profile description. We included these keywords in all four official languages of Switzerland (i.e., German, French, Italian, and Romansh) and English. As a starting point, we used large, comprehensive datasets on Swiss Twitter debates that we had tracked for previous studies. We then filtered users by applying our set of keywords and downloaded all their followers. This filtering process was repeated in three rounds. The final round yielded only a small number of new followers referencing Switzerland, indicating saturation. Subsequently, we constructed a follower network using the Infomap algorithm (Rosvall & Bergstrom, 2008). We then manually validated the resulting communities and excluded some that were incorrectly identified as Swiss. For example, a group of users based in New Bern (a city in North Carolina, USA) was mistakenly included because the name "Bern" is the same as that of the Swiss capital. We also manually validated individual accounts. Among others, we validated highly active users to exclude automated accounts and checked whether well-known Swiss accounts were included in the dataset (e.g., journalists and news media, politicians, athletes, and companies). Overall, manual validation led to the exclusion of 6,113 accounts (2% of the initial sample). Although it is difficult to precisely assess how representative this dataset is, manual validation and comparison with the datasets collected using the tracker suggest that the results are highly plausible. This user-based approach to defining the Swiss Twittersphere has a key advantage: Due to the shared language with much larger neighboring countries, such as Germany and France, samples solely based on language can hardly be identified as Swiss. The sample presented here provides a more accurate representation of the Swiss Twitter debate, making it particularly well suited for a valid analysis of its relationship with a clearly defined sample of Swiss news media.

In Switzerland, as in most other countries, the Covid-19 pandemic caused major upheavals in society at the beginning of 2020. The first Covid-19 case in Switzerland was registered on February 25, 2020. On March 16, 2020, the government announced wide-ranging measures against the spread of the virus, including a public lockdown that lasted several weeks. Two years of cyclical tightening and loosening of measures followed to prevent the collapse of the health infrastructure. On November 9, 2020, Pfizer and BioNTech announced that their Covid-19 vaccine had demonstrated very promising results; other pharmaceutical companies followed. On December 23, 2020, the first vaccine dose was administered in Switzerland. Several rounds of vaccination were facilitated in the following months. In view of the increasing immunity of the population, in early 2022, the national government decided on far-reaching loosening of the measures, which have not been reintroduced since. Based on this chronology of events, we distinguish four phases in the analysis: a pre-pandemic phase from the first day of data collection to the first confirmed Covid-19 case in Switzerland (April 1, 2019–February 24, 2020); a pre-vaccine phase before the first viable vaccine option was within reach (February 25, 2020–November 8, 2020); a vaccine phase after the first vaccine was developed and rolled out (November 9, 2020–January 12, 2022); and a phase in which the measures against the spread of Covid-19 were slowly being "phased out" (January 13, 2022–June 30, 2022). We used an analysis of variance (ANOVA) to test for significant differences in issue attention and semantic overlap across the four time phases. Pairwise independent t-tests with Bonferroni correction were applied between all phase pairs for issue attention and semantic overlap. We used Spearman's correlation coefficient to examine the relationship between issue attention in two time series, namely Twitter and news media, each differenced by one day to control for autocorrelation.

To make valid comparisons between news media and Twitter, we measured the daily share of vaccination-related news coverage and Twitter communication. We calculated this by dividing the number of news articles or tweets referencing vaccination per day by the total number of news articles or tweets published on the corresponding day. This procedure was applied in other studies to measure issue attention (e.g., Gilardi et al., 2022; Schäfer et al., 2014) and allowed us to make valid comparisons between news media and Twitter (with more content providers and unrestricted space) and between the larger German-speaking region (with more news media outlets and more Twitter users) and the smaller French-speaking region. The total number of news articles published per day by the 20 analyzed outlets was obtained from the Swiss Media Database. As the Twitter tracker captured all posts from all Swiss users rather than just those containing specific hashtags or keywords, the total number of tweets published per day was also available.

To measure the semantic overlap between news media coverage and Twitter communication about vaccination, we identified the most frequently used words per week in both spheres. To account for the differing lengths of news articles and tweets and to minimize coincidental overlaps, we used only the first 40 words of each news article. This corresponded approximately to the average length of the title and lead section of news articles in our sample and was based on the assumption that the most important aspects of an article are stated at the beginning of most articles. First, the news articles and tweets were cleaned by removing punctuation, numbers, and stop words. Subsequently, common collocations (i.e., words that frequently appear together, such as “covid crisis”) were automatically identified in the data and merged for the analysis (to form “covid_crisis”). The frequency of all remaining words in news articles and tweets was aggregated per week for the two language regions. This process produced a list of the 100 most frequent words per week and language region for both news coverage and tweets about vaccination. These lists served as the basis for analyzing the weekly overlap between the key terms in each sphere (separately for each language region). This overlap was assessed as a percentage: the number of overlapping terms in both lists (news media and Twitter) divided by the number of terms in each list. We used this measure of semantic overlap as an approximation of the content similarity between the two platforms. The two metrics, issue attention and semantic overlap, allowed us to assess how aligned news media and Twitter were across the different phases before, during, and after the pandemic.

4. Results

We consider issue attention for the vaccination issue in Swiss news media and the Swiss Twittersphere over time (RQ1). The trends on both platforms follow typical patterns of the issue-attention cycle (Downs, 1972). For both news media and Twitter, we can observe low salience in the pre-pandemic phase, followed by a moderate increase after the outbreak of the pandemic, as vaccines were discussed as a possible measure but were not available yet. This initial increase in issue attention is followed by a significant peak once a viable vaccine becomes available and then by a decline in the phase-out of measures against the pandemic (Figure 1).

Various subtopics shape news reporting and tweets on the issue of vaccination over time. Before the Covid-19 pandemic, Twitter and media coverage on vaccination were limited, mainly featuring terms such as measles, influenza, Ebola, and vaccine skepticism. During the pre-vaccine phase, discussions center on the new virus, mitigation measures, and the potential development of a vaccine. With the development of the first Covid vaccine and the launch of the national vaccination campaign, issue attention for vaccination and

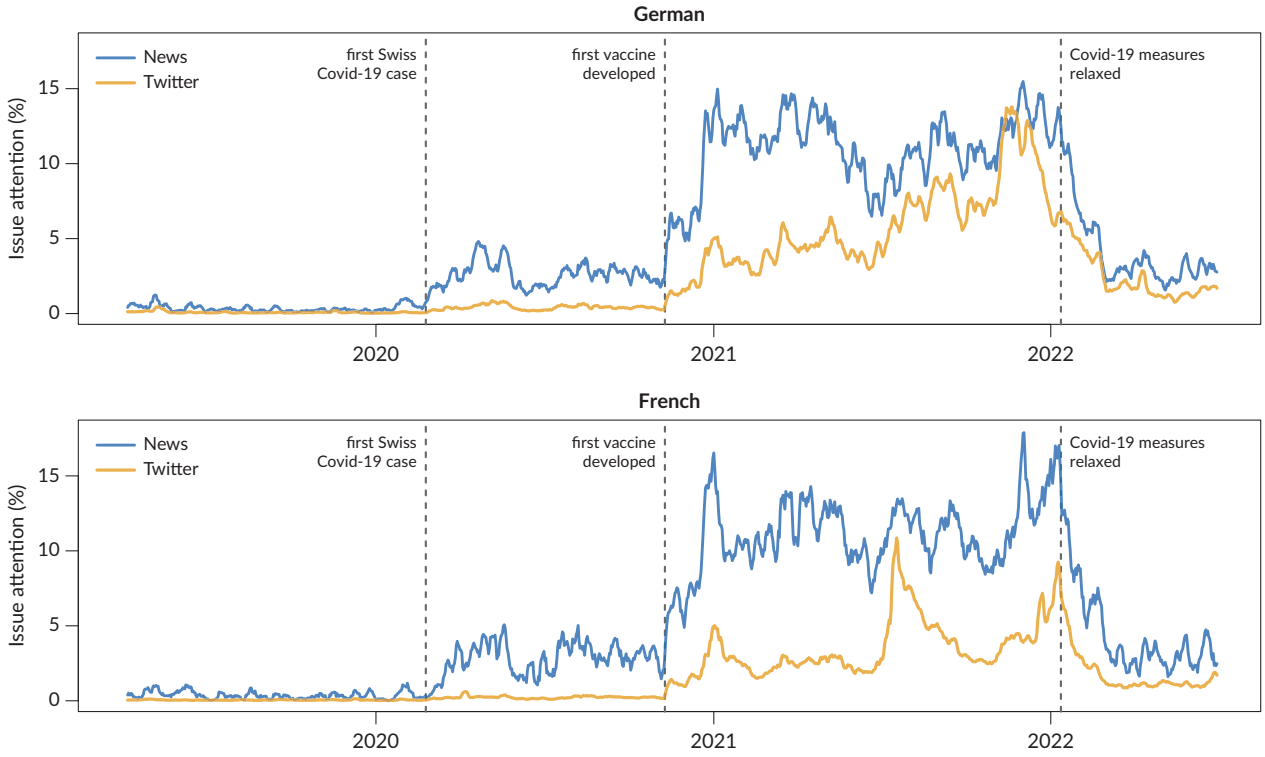

Figure 1. Issue attention for vaccination in news media (daily share of articles, blue) and on Twitter (daily share of tweets, yellow) in the German-speaking (top) and French-speaking (bottom) regions.

its related subtopics increases rapidly. The vaccine phase is marked by: debates such as the strategies, modalities, and progress of the national vaccination campaign; the procurement, efficacy, and side effects of the various vaccines available (with particularly unfavorable reports about the AstraZeneca vaccine); the comparisons with other countries (notably Israel, which achieved an exceptionally early vaccine rollout); and the vaccination rate disparities among certain population groups. Later subtopics include booster doses, Covid-19 vaccinations for children, vaccine certificates, restrictions on the unvaccinated (notably Novak Djokovic's Australian Open affair), and discussions on mandatory vaccination. With the gradual lifting of Covid-19 control measures during phase-out, the volume of discussion declines rapidly in both spheres and language regions. Case numbers (which continued to rise), vaccination rates, and comparisons with neighboring countries are still discussed but to a much lesser extent.

Issue attention for vaccination, measured as a share of the total news coverage or tweets, respectively, is higher in news media than on Twitter across all phases of the analysis (Table 2). Therefore, the vaccination issue is generally discussed more prominently in the news media than on Twitter. Furthermore, we observe similar levels of salience in news media across the German- and French-speaking regions (5.23% vs. 5.37%). However, salience on Twitter is higher in the German-speaking region (2.55%) than in the French-speaking region (1.57%).

Table 2. Average daily issue attention for vaccination, measured as the daily percentage of total news articles or tweets, for each phase and for both language regions.

Language region	Medium	Pre-pandemic (n = 330)	Pre-vaccine (n = 258)	Vaccine (n = 430)	Phase-out (n = 169)	Overall (n = 1,187)
German	News	0.35%	2.61%	11.08%	3.86%	5.23%
	Twitter	0.08%	0.42%	5.82%	2.30%	2.55%
French	News	0.37%	2.86%	11.18%	4.18%	5.37%
	Twitter	0.05%	0.23%	3.54%	1.60%	1.57%

Note: The number of days in the analysis is attached to each phase in the header.

A one-way ANOVA was conducted to test the differences in issue attention for vaccination across the four phases. The results reveal that the phases differ significantly ($F(3, 4{,}744) = 2{,}002.43$, $p < 0.001$), with a large effect size ($\eta^2 = 0.56$). Pairwise post hoc comparisons (with Bonferroni correction) show that all phase pairs differ significantly in issue attention (Table 3). These results confirm the substantial shifts in the salience of vaccination across different phases, with the highest issue attention observed during the vaccine phase and the lowest during the pre-pandemic phase.

Table 3. Results of six post-hoc tests to assess the pairwise differences in issue attention between individual phases across all media types and language regions.

Phase A	Phase B	t-Statistic	Degrees of freedom
Pre-pandemic	Pre-vaccine	−25.63***	1,114.37
Pre-pandemic	Vaccine	−71.30***	1,749.23
Pre-vaccine	Vaccine	−53.80***	2,364.11
Phase-out	Pre-pandemic	29.99***	691.32
Phase-out	Pre-vaccine	13.93 ***	1,076.06
Phase-out	Vaccine	−34.83***	2,182.01

Notes: The issue attention for vaccination differs significantly between all phases; *** $p < 0.001$, ** $p < 0.01$; * $p < 0.05$.

To answer RQ2, we investigated whether issue attention for vaccination in news media and on Twitter is related. The plot of issue attention over time shows that the salience of debates on vaccination follows similar patterns in news media and on Twitter (Figure 1). Issue attention in the language regions shows some variance but still follows similar general trends.

We used correlations to statistically analyze how strongly related news coverage and Twitter activity are. Spearman's correlation coefficient between issue attention in news media and on Twitter is significant in the German data across all phases but one (Table 4). During the pre-pandemic phase, a moderately positive correlation between tweets and news reports is observed for the German data ($r = 0.19$), while the correlation for the French data ($r = 0.10$) is positive but not significant. As the pandemic advanced to the pre-vaccine stage, the correlation strengthens to a high level for the German data ($r = 0.27$), while the correlation for the French data ($r = 0.09$) remains not significant. In the vaccine phase, both German ($r = 0.31$) and French ($r = 0.30$) correlations reach their highest levels. No significant correlation is found during the phase-out period in either the German data ($r = 0.04$) or the French data ($r = 0.08$). Across all phases, the correlation is strong for the German ($r = 0.24$) and French ($r = 0.21$) data, indicating a robust alignment in issue attention between news media and Twitter over time, particularly in the German-speaking region.

Table 4. Spearman correlation between the daily issue attention for vaccination in news articles and tweets, shown per language region and time phase.

Language region	Pre-pandemic (n = 329)	Pre-vaccine (n = 258)	Vaccine (n = 430)	Phase-out (n = 169)	Overall (n = 1186)
German	0.19***	0.27***	0.31***	0.04	0.24***
French	0.10	0.09	0.30***	0.08	0.21***

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

To answer RQ3, we investigated the semantic overlap between news coverage and Twitter communication within the vaccination issue. Our examination of the most frequently used words each week shows that the semantic overlap between news media coverage and tweets increases as the pandemic progresses (Figure 2), peaking during the vaccine phase.

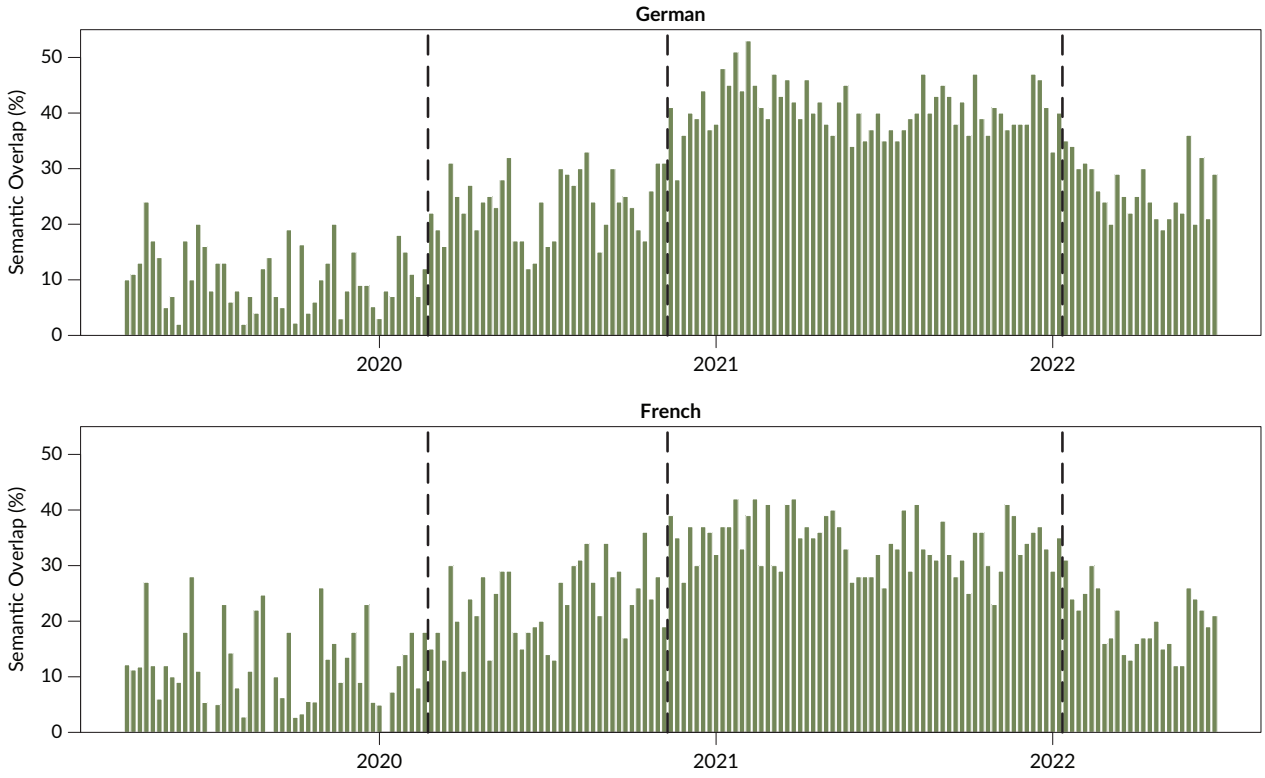

Figure 2. Weekly semantic overlap between Swiss Twitter and news media in the German-speaking (top) and French-speaking (bottom) regions.

The semantic overlap between tweets and news articles on vaccination shows striking differences between phases (Table 5). For instance, in the German-speaking region, the overlap intensifies from 10.33% pre-pandemic to 40.64% during the vaccine phase, suggesting a convergence of messaging or themes between news media and social media as the pandemic evolves. Similarly, the French-speaking region exhibits an increase from 11.72% during the pre-pandemic period to 34% during the vaccine phase. Interestingly, both regions experience a decrease during the phase-out period, with the German semantic overlap decreasing to 26.25% and the French semantic overlap to 19.88%. Overall, along with issue attention, both regions show an increase in overlap during the vaccine phase, which indicates an alignment

of public discourse between social media and news reports. Thus, news media and Twitter feature similar debates around vaccination, the higher the salience of the issue.

Table 5. Weekly semantic overlap in news articles and tweets on the issue of vaccination, shown per phase and language region.

Language region	Pre-pandemic ($n = 47$)	Pre-vaccine ($n = 37$)	Vaccine ($n = 61$)	Phase-out ($n = 24$)	Overall ($n = 169$)
German	10.33%	23.32%	40.64%	26.25%	26.38%
French	11.72%	22.97%	34.00%	19.88%	23.38%

The results of the one-way ANOVA show that the time phases differ significantly in terms of semantic overlap ($F(3,334) = 332.04$, $p < 0.001$, $\eta^2 = 0.75$). This is also evident in the pairwise post hoc comparisons. Significant differences are found between all phase pairs, except one. The only non-significant result is between the phase-out and pre-vaccine periods, in which semantic overlap does not seem to differ substantially. The overlap of information between Twitter and news media increases significantly with the pandemic, with the largest difference observed during the transition from the pre-pandemic to the vaccine phase (Table 6).

Table 6. Results of six post-hoc tests to assess the pairwise differences in weekly semantic overlap between individual phases across language regions.

Phase A	Phase B	*t*-Statistic	Degrees of freedom
Pre-pandemic	Pre-vaccine	−12.28***	159.34
Pre-pandemic	Vaccine	−31.07***	186.78
Pre-vaccine	Vaccine	−15.88***	143.99
Phase-out	Pre-pandemic	10.83***	99.29
Phase-out	Pre-vaccine	−0.08	101.65
Phase-out	Vaccine	−13.87***	80.97

Notes: The semantic overlap of news media and tweets differs significantly between all phases except between the phase-out and pre-vaccine phases; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

RQ4 concerns the differences between the German- and French-speaking regions of Switzerland. As previously discussed in our findings, for the first three RQs, we do not observe major differences overall. The vaccination issue follows a similar pattern in both regions in terms of general issue attention and semantic overlap. However, the most notable difference is that, despite following the same trend, issue attention for vaccination is lower in the French-speaking Twittersphere than in its German-speaking counterpart.

5. Discussion and Conclusion

By analyzing 77,798 news articles and 929,431 tweets, we investigated how the issue attention and semantics of news media and Twitter content are related in a hybrid media system using the case of the vaccination issue in Switzerland. Our analysis shows that issue attention for vaccination follows similar patterns in news media and on Twitter, with some traction in the pre-vaccine phase and a particularly high increase in the vaccine phase before a rapid decline during the phase-out period. News media and Twitter are more strongly correlated in the pre-vaccine (for the German-speaking region) and vaccine phases than in the pre-pandemic

phase or phase-out. Before and after the pandemic, public debate on vaccination has more distinct dynamics in each sphere. We find typical patterns of issue-attention cycles (Downs, 1972) on Twitter and in news media for the issue of vaccination.

Regarding semantic overlap, similar to issue attention, keywords overlap the most during the vaccine phase. However, semantic overlap remains higher during phase-out than in the pre-pandemic phase. This finding shows that the news media and the Twittersphere feature similar debates around vaccination during crises. It is quite striking how issue attention and semantic overlap run parallel to one another, which highlights how closely news media and Twitter are aligned in the hybrid media system. This finding is consistent with earlier studies demonstrating the proximity between the two spheres (Gilardi et al., 2022; Metag & Rauchfleisch, 2017; Su & Borah, 2019).

The salience data show various peaks in issue attention, which can be traced back to key events—the first Covid-19 case in Switzerland, the first promising vaccine development, and the easing of pandemic measures—which we used to divide the four phases of the study. Other major and minor key events in the data include the start of the national vaccination campaign in December 2020, the introduction of a national certificate requirement (vaccinated, tested, or recovered) for many public spaces in September 2021, or the emergence of the Omicron variant in December 2021. Events abroad also repeatedly influenced the topics discussed in Switzerland, such as Israel's introduction of a health pass and the associated opening of many public spaces in Israel in February 2021 or the controversy over Novak Djokovic's deportation from Australia due to his lack of Covid-19 vaccination before the January 2022 Australian Open. Neighboring countries played a recurring role too, such as France's introduction of its version of a health pass in July 2021 and Austria's discussion of mandatory vaccination in November 2021.

This study set out to measure the extent to which issue attention and the semantics of the vaccination debate align between news media and social media in the different phases of a crisis, specifically the Covid-19 pandemic. The results show that the two spheres, news media and Twitter, are significantly more closely aligned in times of crisis. These findings substantiate previous works on issue agendas converging toward a dominant issue in times of crisis (Imhof, 2011; Rauchfleisch et al., 2023). Although the dissemination of information and the number of actors involved in today's hybrid media environment have clearly become much more complex (Chadwick, 2017; Wallace, 2018), traditional news media still seem to play a significant role in shaping public debate, especially in the earlier stages of a debate. Journalists seem to have adapted to the hybrid media environment in consolidating their former agenda-setting power. In a US context, journalists have been found to increasingly focus on algorithmic strategies and audience numbers while upholding fundamental journalistic values and attempting to regain control over content (Walters, 2022). This finding also corresponds with previous studies on intermedia agenda setting (Gilardi et al., 2022; Harder et al., 2017), particularly Su and Borah's conclusion (2019, p. 246), which established that "newspapers are more likely to influence Twitter in terms of ongoing discussions during non-breaking news periods, while Twitter is more likely to influence newspapers right after the occurrence of breaking news." In terms of the implications for vaccine information, news media and social media are relevant to the public debate on this important issue, especially at the height of the crisis. We assume that traditional news media will not only remain significant sources of information on vaccines but will also remain particularly important due to their higher credibility and trust (Piltch-Loeb et al., 2021; cf. Gehrau et al., 2021). Social media content tends to attract less attention to vaccine issues outside of crisis periods but can reach groups that traditional media may not reach directly (Chadwick et al., 2021).

The underlying data of this study enabled us to measure and compare tweets and news articles related to the issue of vaccination as shares of their respective total volume, which is often neglected in research. The advantage of the measurement as a share of total volume, or issue attention, is that it allows for a more accurate assessment of the dimension of a debate. As issue attention values are measured on a standardized scale (0% to 100%), this measurement makes the data suitable for comparisons, for example, between different platforms or language regions. In the case of the vaccination issue in Switzerland, we found similar overarching trends in the two language regions (German and French). In these regions, the salience of the issue is higher in news media than on Twitter. This difference is most likely an effect of the "unlimited" or "uncurated" space in Twittersphere compared with the somewhat limited and certainly stronger curated space in news media (cf. Jang & Pasek, 2015). When examining the development over time, we observed that issue attention was higher in news media than on Twitter during the first few months following the outbreak of the pandemic (pre-vaccine phase). This suggests that vaccination was already being discussed within the context of the pandemic before vaccines became available and were rolled out, while the debate on Twitter gained momentum only afterward. This challenges the common assumption that social media act as an early indicator of emerging public debates to be later picked up by traditional news media—that is, that social media set the agenda of journalism. Conversely, the data highlight the central role of (constructive) journalism: anticipating adverse events and exploring potential solutions (Hallin et al., 2023; Mast et al., 2019). Interestingly, we found only minor differences between language regions when focusing on the four main phases and disregarding short-term fluctuations. One notable exception is the significantly higher issue attention in the German-speaking Twittersphere at the end of the vaccination phase in autumn 2021, when case numbers increased in the wake of the Omicron variant, a national vote on the pandemic measures was held, and internationally, debates about vaccine mandates started to emerge. This is also the only period when issue attention on Twitter briefly exceeds that in news media.

These results invite further in-depth research. The question arises as to whether the alignment of issue attention and semantics means that perspectives and frames coincide or whether similar topics are discussed with different frames and evaluations. Moreover, the mechanisms behind this alignment can be further explored. For example, news media organizations and journalists' accounts on social media play a crucial role in intermedia agenda setting (Harder et al., 2017), and content from social media is often directly embedded in news articles (Oschatz et al., 2022).

Our method also has some limitations that should be taken into account when interpreting these results. We deliberately kept the analysis of issue attention relatively simple and intuitive, focusing on the strengths and patterns of the relationship between news media and Twitter rather than determining the direction or causality of these connections. We acknowledge that, similar to many previous studies, we analyzed daily data (for issue attention) and even weekly data (for semantics), despite underscoring the need for sub-daily analyses to capture the complex interplay between social media and news media. Therefore, although this study successfully identified patterns in issue attention and semantic overlap between news media and Twitter over time, it did not evaluate the directionality of this relationship. Employing additional time series analysis methods with a specific focus on measuring directionality and precise timing in future research would allow for a more detailed examination of whether news media activity precedes or influences Twitter discussions and to what extent (or vice versa). However, it should be noted that these effects can be challenging to isolate reliably, even with sub-daily media data. Newspapers often lag behind social media due to structural constraints, such as publishing bundled articles the next day. By contrast, interactions between online news and social media

unfold within minutes or hours, especially during breaking news. Thus, without tailored strategies, even data with minute-level precision may not reliably establish causality on their own.

Moreover, although many of the findings are consistent with previous research, the results of this single-country study should always be combined with findings from other contexts. Semantic analysis is also a relatively simple method of analysis, in which we used 100 terms per medium and week as an approximation of the content of the articles and tweets. This approach has the advantage of being relatively straightforward and consistent across languages with differing modalities. However, follow-up studies could analyze content in more depth, for example, by capturing topics, frames, or sentiments. Another limitation is that we considered Twitter a unified discursive space, thereby ignoring the diversity of actors involved in the debate on vaccination. Future studies could address this aspect by investigating how issue attention for vaccination and semantic focus in debates differ between user communities on Twitter and how these variables are related to news media coverage. It remains uncertain whether the results can be transferred to other social media platforms, especially as Twitter is used by many journalists and news media outlets to source and publish stories, a characteristic that may be less evident in other social networks. Notably, Twitter has changed substantially since Elon Musk's takeover in October 2022, including a name change to X (Claesson, 2024). Our analysis was not immediately affected by these circumstances, as the entire period under investigation was prior to Musk's operational control. Therefore, although the results may not be directly transferable to X, they still provide valuable insights into the alignment of issue attention and semantics between social media and news media in the age of hybrid media systems.

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Conflict of Interests

The authors declare no conflicts of interest.

Data Availability

Data on the number of articles or tweets per day can be provided upon reasonable request.

LLMs Disclosure

The authors used AI tools from DeepL and OpenAI to assist with translation and wording when preparing this manuscript.

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