

Evaluation of Historical Journalism Data for Decision-Support System Gray-Zone Models

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ABSTRACT

A significant problem we face today is increasingly volatile, uncertain, and complex political-military strategic environments, where pacing, peer adversaries employ gray-zone tactics to hold our national resources, instruments of power (i.e., Diplomatic, Information, Military, Economic (DIME)), and emerging technologies at risk. Many of these tactics and “soft-power” capabilities are non-physics-based, conceptual, fuzzy-logic models which have been cost-prohibitive to produce or lack data to inform. Furthermore, our adversaries act in locations where journalists are our only situational awareness mechanism to inform assessments or decisions. Journalism could offer unique perspectives to inform statistical insight into world events through an alternate-path recognition of routine DIME patterns of behavior/life across multiple domains over time. This data can assist in distinguishing pattern anomalies (e.g., behaviors the world press identifies as coercive) to provide timely event detection, identification, classification, and alerting to inform decision-makers’ understanding of interdependencies across Political, Military, Economic, Social, Information, Infrastructure, Physical environment, and Time (PMESII-PT) aspects. Here, we present a follow-on to our “Evaluation of Open-Source Data for Gray-zone Operations Decision-Systems” paper (Ducharme et al., 2023). Specifically, our objective is to examine feeding the results of GDELT newsfeeds into 5-dimensional statistical DIME space + time as a basis for cost-benefit-risk calculations in the gray-zone arena. There are four facets to this proposed approach. First, the creation of more topic models and training them against eight-plus years of historical data. Second, further expansion of our thematic ruleset for both coercive behaviors as well as some expansion to normal international relations for analytical context. Thirdly, analysis of the eight-plus year timeline for identification of the most significant behavioral patterns journalists have identified and their consistency over time. Finally, we will discuss how our created framework and topical modeling, expanding to a larger historical sample, applies to feeding decision-support systems (e.g., operations; planning; wargames; etc.).

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INTRODUCTION

A significant problem we face today are increasingly volatile, uncertain, and complex political-military strategic environments, where pacing, peer adversaries—or antagonists to international peace and stability—employ gray-zone tactics to hold our national resources, instruments of power (i.e., Diplomatic, Information, Military, Economic (DIME)), and emerging technologies at risk. “Gray-zone activities are behaviors and/or actions potentially leading to, but below the threshold of armed conflict; The actor purposely behaves contrary to widely accepted or ratified—on a global stage—responsible norms and behaviors” (Ducharme et al., 2023). Also, we continue in belief that to maneuver in the gray-zone and not trigger armed conflict, “an actor has knowledge on how its opponent may perceive its actions, albeit lacking in full or ‘perfect’ understanding” (Ducharme et al., 2023). While the deeper gray-zone debates are beyond the scope of this paper, it is important to note there are split thoughts among ‘students of gray-zone’ as to whether to classify it as hybrid-warfare or not; We align to the latter category, offering that solely placing gray-zone tactics under the hybrid-warfare classification is limiting. Pointedly, gray-zone actions occur throughout the continuums of competition and conflict, with or with-out employing the military instrument of national power.

While gray-zone strategies and tactics are not new to the 21st century, there has been an increased requisite to allot more attention to gray-zone activities and long-term consequences to successfully manage the evolving strategic landscape. For brevity, we offer examples from Australia (AU), United Kingdom (UK), and the United States (US) (AUKUS). AU’s 2020 Defence Strategic Update states “Grey-zone activities are being integrated into statecraft and applied in ways which challenge sovereignty, shared interests and habits of cooperation. This includes challenges to long-established and mutually beneficial security partnerships Australia has with many countries, including in the Indo-Pacific ... Defence must be better prepared to respond to these activities, including by working more closely with other elements of Australia’s national power.” In 2021, the UK Ministry of Defence presented its “Defence in a Competitive Age” paper which states the “... need to take on new tasks and adapt the way we do traditional tasks given the changing strategic context and the emerging threats we observe. We will develop new doctrine, new operating methods, new capabilities and new partners to deter and constrain our adversaries in the grey-zone between peace and conflict.” Also, the UK Parliament opened an inquiry in 2023 to “examine how the grey zone interacts with more conventional military activities, and what lessons can be drawn from Russia’s invasion of Ukraine ...” and include a look across “... the rest of Government’s grey zone capabilities within this context and scrutinize the Government’s ability to work cross-departmentally.” Finally, the U.S. National Defense Strategy (NDS) 2022, the Joint Concept for Competing, and the Joint Warfighting Concept highlight our peer-pacing adversaries and other threat actors are increasingly employing gray-zone reversible and non-reversible multi-domain Non-Kinetic/Non-Lethal Effects (NKE/NLE), pre-antebellum, across all domains—especially in space and cyber—and instruments of national power. For example, the NDS 2022 states “competitors now commonly seek adverse changes in the status quo using gray zone methods—coercive approaches that may fall below perceived thresholds for U.S. military action and across areas of responsibility of different parts of the U.S. Government. The [People’s Republic of China] employs state-controlled forces, cyber and space operations, and economic coercion against the [US] and its Allies and partners. Russia employs disinformation, cyber, and space operations against the [US] and our Allies and partners, and irregular proxy forces in multiple countries.” These threat actors to international rules, norms, and

"Analyzing any adversary’s way of war is instructive. As former CJCS General Joseph F. Dunford recognized, “We think of being at peace or war...our adversaries don’t think that way.” They believe they are in a long-term “conflict without combat” to alter the current international system, advance their national interests, gain strategic advantage and influence, and limit U.S. and allied options. ... Strategic competition is thus an enduring condition to be managed, not a problem to be solved.”
— **Joint Concept for Competing, 2023**

standards increasingly turned-to gray-zone tactics to apply a subtle, tactical implementation of a 'chaos theory,' or 'deterministic chaos,' methodology to create a 'butterfly effect' (Ducharme et al., 2023); They intend to methodically prepare the strategic environment by shrewdly imposing increased cost and risk to their opponents center(s) of gravity (COG), including eroding their opponents legitimacy in the 'court of global opinion' and will to compete.

On this note, the US Joint Publication (JP) 5.0 reads "In identifying COGs it is important to remember that irregular warfare focuses on legitimacy and influence over a population ... to force a change in an enemy's government or battlespace." While not solely, legitimacy and influence are often fought in the news and social media, especially with today's voracious reliance on these platforms. Thus, journalism can offer unique perspectives and inform statistical insight into world events, such as a substantial recognition of routine DIME patterns of behavior/life (PoB/PoL) across multiple domains over time. While journalism does not bear complete information and can introduce bias, it is important to consider antagonistic actors often act in locations where journalists are the only forward presence and data source (i.e., sensor) for situational awareness of unfolding events and related effects. Also, journalists tend to operate closer to the population, influencers, and/or governments who significantly sway popular legitimacy view. Thus, journalists and other news sources can provide data as events unfold (consideration of real-time developments) alongside historical data for contextual comparison. One data store for news sources is the Global Database of Events, Language and Tone (GDELT) database—a free and open resource which uses "massive computing power to see the world through others' eyes ..." (gdeltproject.org). While journalistic data, alone, cannot wholly inform trade-space analysis, it can: provide context, tones, and sentiments of what is occurring in the world; assist in distinguishing pattern anomalies (e.g., behaviors the world press identifies as coercive); provide meaningful understandings of human behavior and beliefs in terms of global relation interdependencies. As Admiral Scott Swift (2018) stated, "We need to continue to develop ways to use computing power to process data, turn it into information, and allow a commander to use it to increase knowledge. We must not only rediscover the art of [command and control (C2)], but also master it by harnessing science and technology." This paper will examine harnessing the data of GDELT—through topic model training—and computing power of Google Big Query to feed historical and current newsfeeds into 5-dimensional statistical DIME space + time as a basis for risk-cost-benefit and enable decision space analysis in the gray-zone arena.

BACKGROUND

Today's Struggle of GZ-Analysis and Modeling

Today's decision space analysis and planning solutions lack algorithms which apply search and statistical techniques to make full use of journalism data contrasted with historical context, emerging media, and arising global societal-scale behavior to inform strategic decision-making. As such, these solutions struggle to facilitate decision-makers' and strategists' ability to investigate gray-zone operations to: effectively and quickly organize ideas, explore issues, identify unknowns; analyze implications across multiple-domains, -actors, -geographies, -languages, -cultures, and -human sentiment. Much of this difficulty can be attributed to the modeling required is not physics-based and requiring 'fuzzy logic' because of: (1) the subjective nature of Political, Military, Economic, Social, Information, Infrastructure, Physical environment, and Time (PMESII-PT) effects; (2) the conceptual modeling required to inform decisions and consequences of DIME actions (many of which are 'soft power' actions); (3) the amount of data to process to build a common understanding to construct topic models to characterize DIME actions; etc. As well, these subjective models derived by experts tend to frequently be called into question because there is little-to-no quantitative foundation. In other words, the struggle between tacit knowledge (art) and confidence weighting (science)—and the desire for perfection, which can lead to analysis paralysis. "Better a diamond with a flaw than a pebble without one (Confucius)."

"Although the art of warfare is of primary importance, it is proper to recognize the critical role that science and technology can play in the service of that art. ... The promising science of augmenting human decision making should be used to transform large quantities of complex data bombarding commanders into readily understood, multidimensional displays designed to help them guide our forces to victory—not in a way that reimagines or replaces the art of C2, but in a manner that empowers it." —Admiral Scott Swift

A Framework to Address the Complexities of Modern DIME Strategic Environments

Our project's long-term research and development (R&D) purpose "... is to investigate [news sources, databases, and social media] to provide insight for creating models for a future solution to feed decision-support systems to aid decision-makers' examination of gray-zone tactics in terms of strategic campaigns and effects" (Ducharme et al., 2023). Figure 1 illustrates our long-term projects intent. Based on positive interest and feedback from our initial paper,

Evaluation of Open-Source Data for Gray-Zone Operations Decision-Systems (Ducharme et al., 2023), we present this paper as the next iteration, expanding our data pull to cover an eight-year period. In 2023, extracting data over just a four-month period, we derived our initial ‘Gray-Zone Data Pipeline and Offline Training System’ framework which provided a metric (e.g.,

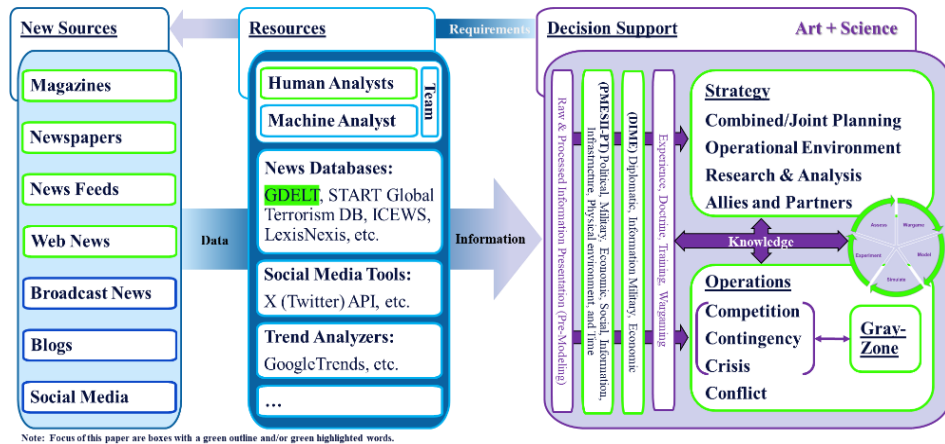


Figure 1. News Sources to Decision Support Framework

mentions) across DIME in terms of a relative importance to ‘the court of public opinion’ on global events. “[Mentions] provide a mathematical means of assigning value to what economists call intangibles; Thus, enabling them to be quantitatively integrated into risk-cost-benefit calculations as a plausible basis for decision support systems” (Ducharme et al., 2023). During this initial study, we recognized a greater sample of data over a longer period would be required to further flush out the feasibility of news source data to support decision analysis or support systems. This next gray-zone research iteration advances one of our objectives—Exploiting GDELT’s Event Database and Global Knowledge Graph (GKG) of news stories to evaluate journalism data’s feasibility to provide a source for: macro-level predictive analysis; gray-zone models; more expeditiously providing relevant and plausible story-board information for training or wargame events. As well, to assist in supporting “early identification and characterization of gray-zone campaigns as they unfold, and thus better position decision makers to counter such campaigns ...” (Ducharme et al, 2023).

Print and digital media news stories (i.e., newspapers; magazines; newsfeeds; web news) are unstructured data in terms of use for decision support. We found an opportunity for analysts to learn from best practices of other scientific fields that are similarly dependent on unstructured data such as psychology and sociology. For example, it is clear the use of thematic analysis (Braun & Clarke, 2006) in these fields is a common approach to coding the unstructured data into a more interpretable form. For optimum results though, it is necessary for researchers to collaborate and agree on the most useful themes to further the objectives of the field (e.g., DIME; PMESII-PT). This establishes the motivation for this paper to investigate a thematic analysis-based workflow as a potential starting point for a more systematic and collaborative based approach for investigators interested in this aspect of international relations towards improving outcomes. Our research attempts to integrate our scientific findings into statistical DIME space + time models.

Our intent is not to oversimplify intricate geopolitical matters, nor suggest thematic analysis of only journalistic data patterns and statistically derived information from GDELT as the gray-zone modeling panacea. To this end, it is also important to not overlook what GDELT can bring to refine and generate greater trust in ‘soft power’ research or models when coalesced with data from other sources, for example: Defense Common Ground System (DCGS); similar systems which extract newsfeeds (e.g., The Integrated Crisis Early Warning System (ICEWS); expert explicit and tacit knowledge; other social media tools; Google Trends; etc.) A deeper comparative study of these sources is beyond this paper’s scope. GDELT may appear to be a single-source; however, it is an embarkation point to a very diverse data corpus of new sources from over 100 different languages across every country in the world. Moreover, not every journalist has the same interpretation of world events or is ‘politically-pressured’ to bias, thus there will be a noteworthy number of diverse views and factual data. To note, Puhr and Kupfer (2023) offer a methodology to reduce inherent bias and increase confidence in the data using GDELT and Google Trends. Along these lines we offer:

- "GDELT may be used to research different units of analysis. It can analyze relationships (between themes and entities), a country, a given policy, issue or sector, and/or an event.” (Saz-Carranza, Maturana, and Quer, 2018).
- GDELT uses the CAMEO framework to “[monitor] the world’s broadcast, print, and web news...and identifies the people, locations, organizations, themes, sources, emotions, counts, quotes, images and events driving our global society every second of every day, creating a free open platform for computing on the entire world.” Its historical archive reaches back to January 1979, with the intention to include data dating back to the year 1800, and “...will be increasingly integrating social media into GDELT’s monitoring streams (gdeltproject.org).”

- Conflict and Mediation Event Observations (CAMEO) “framework is a new event data coding scheme optimized for the study of third-party mediation in international disputes” (Gerner et al., 2002). One approach to modeling the everchanging nature of global competition and conflict is examining the history of international relations encoded in multiple CAMEO open-source databases. CAMEO “was used extensively in the DARPA-funded Integrated Conflict Early Warning System (ICEWS) project and proved surprisingly robust ...” (Schrodt, 2012).

Data Pipeline and Offline Training System

Figure 2 illustrates the data pipeline we employed, and the evolution of our project to make a more qualitative sense of the results, via data presentation and a coalescence of qualitative and quantitative expressions. To generate results for this paper, we reused the same SQL query in Google Big Query as detailed in our previous paper (Figure 2 – ‘2023 Study (updated)’) to extract gray-zone specific content from the GDELT database of more general news information.

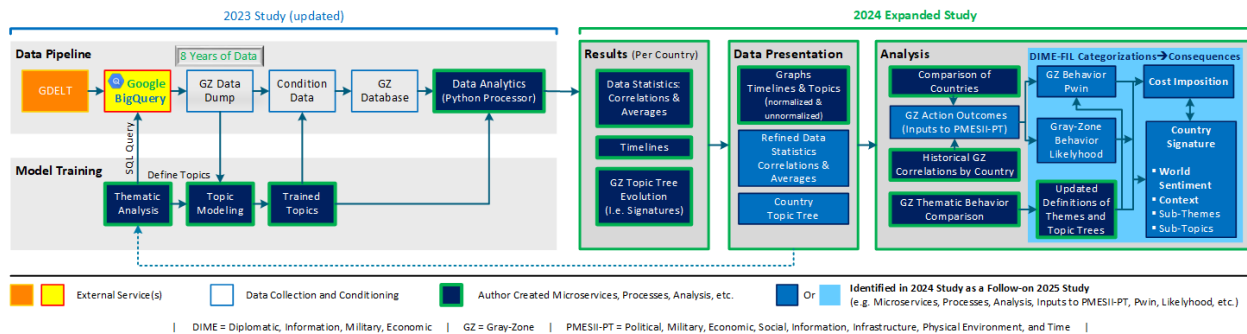


Figure 2. High-level Diagram of Gray Zone Data Pipeline and Offline Training System

We expanded our gray-zone data mining from just January through April 2023 to eight-plus years of continuous time-period, January 2016 through March 2024. This query produced 30 GB of data. To note, newsworthy events have multiple features which can be used to characterize them in the GDELT database including the date and time of first publication, the citing article, and a CAMEO code that classifies the nature of the event. GDELT further tracks all the subsequent mentions of the event across all news sources and a list of themes extracted for each of the citing articles to provide a succinct summary of the detailed information in each one. We employed the initial taxonomy we developed in 2023, tying GDELT themes to news topics and gray-zone campaigns. A key aspect of the process is the inclusion of a subject matter expert (SME) who created the initial ruleset to generate gray-zone themes through a Reflective Thematic Analysis (RTA). Notably, the ruleset had a dual role: (1) running the SQL query which extracted the gray-zone data; (2) transforming GDELT themes into gray-zone themes for each news article. Straightforward summation over the number of times each gray-zone theme can be associated with news event per instigating country per month then results in the formation of a trained statistical topic which summarizes the gray-zone behavior of a country in that month. This step is called topic modeling. The trained topics alongside the rest of the gray-zone data passed through a data conditioning step to create the conditioned gray-zone database for input into the data analytics step. Regarding the data conditioning step, we previously showed event mentions fall on a Pareto distribution (i.e., a small minority of events have large numbers of mentions while the vast majority get very few). This led to introducing a filter for excluding events with mentions per month falling below a threshold value N . We generated the current results using $N=100$. This follows a comparison of results for $N=10$ and $N=100$ in the 2023 study which presented only a modest impact on results; Thus, the choice of N is not a critical decision. The point of data analytics step in the data pipeline is to generate results useful for creating data presentations such as table and graphs in response to queries to a human analyst. This includes many basic data operations; For instance, joining tables, averaging and computation of correlation coefficients. We will highlight more detailed specifics in the results section.

Evolution of our Approach to Evaluate Historical Journalism Gray-Zone Data

Our initial research in 2023 explored ‘what’ data is available to support understanding gray-zone in both context (historical and current events), which led us to GDELT, among a few other databases. To wit, we were drawn to potential benefit of GDELT’s large data corpus and explored a means to filter and condition this data into a usable data feasible for decision support. Our answering of the questions of ‘what’ and ‘how’ naturally pivoted our research to answer the questions—‘so what’ (i.e., ‘why do I care’) and ‘how can I use it’—focusing on these guiding questions:

- ✦ How do we handle the new time dimension? Has data changed over time? What are the driving forces?
- ✦ How does the data correlation/ normalization help me identify a topic or news story of ‘interest?’
- ✦ Is there predictive power in the data? Can we determine behavior signatures and likelihood to inform models and to what level (e.g., operational; training; wargaming; etc; ‘all the above;’ none)?
- ✦ What else can this data provide, other than real-time newsfeeds?

Finally, Figure 2, the ‘2024 Expanded Study’ frame (see legend), also illustrates: (1) our executed roadmap (green outlined boxes) in exploring the our data pipeline results and presenting the data for deeper analysis; (2) two data presentation microservices we identified to further investigate in our next paper; (3) a very basic taxonomy to act as an intentional guide to be poised to transition gray-zone campaign data into action outcomes, effects models, and categorizations of consequences. We understand some may view this taxonomy as too simple; however, we submit when something is extremely complex, it is best to: provide a structure which directs forward motion; start at the basics in a way which establishes a solid foundation in which to refine and scale quickly. As Lam Thuy Vo well-states, “So while analyzing data takes a certain amount of technical know-how, it’s also a creative process that requires us to use our judgment in an intentional and informed way. In other words, data analysis is both science and art.”

RESULTS

This paper portrays our findings in three parts: (1) an overview of journalistic interpretation of sub-set of Chinese and Russian gray-zone actions; (2) Examination of if these countries exhibit predictable gray-zone PoB/PoL; (3) creating a portal to further distill and identify gray-zone behaviors and determine the consequences of these behaviors—in terms of the DIME + financial, intelligence and law-enforcement (DIME-FIL) instruments countries use to compete in international relations. Note: we added ‘-FIL’ to test the limits of what we can identify. Figure 3 illustrates the number of mentions to news events associated with specific gray-zone themes for China and Russia over the last eight years. Notably, the vertical scale of press coverage for Russia is four times higher than for China. Bearing this in mind,

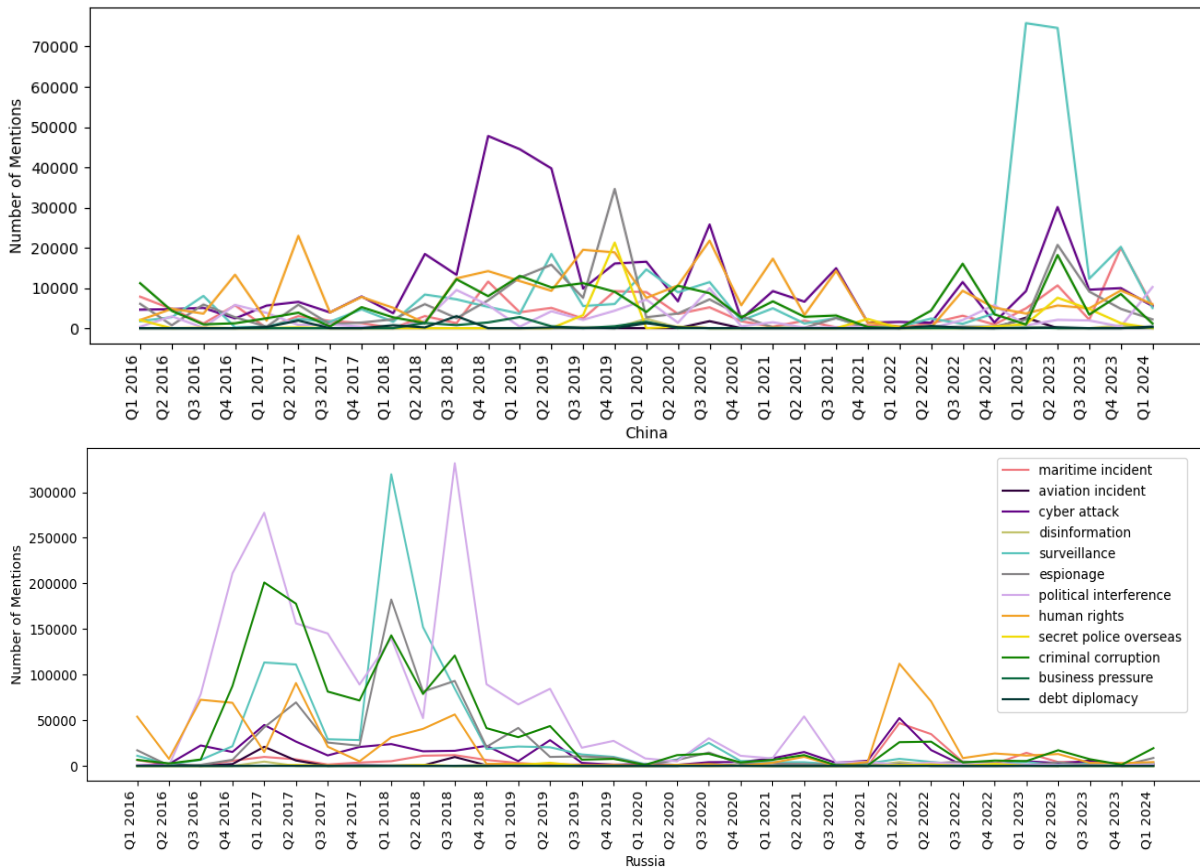


Figure 3. Mentions to News Events Associated with Specific Gray-Zone Themes for China and Russia

it is striking that one gray-zone news event stands out for both, towering over all other events, and running for an exceptionally long three-year period: Distinctively, stories regarding Russian interference in the 2016 US presidential election. This news cycle coverage started before the 2016 election, then continued at a reduced level beyond the release of the Mueller report in March 2019; This report had the effect of at least tamping down speculation of involvement of the sitting president of the United States in a criminal conspiracy. Other notable events appearing on than the gray-zone timeline include a human rights peak in 2022 owing to the onset of the Russian attack on Ukraine, as well as a high surveillance peak on the Chinese timeline in the first quarter of 2023 corresponding to the intrusion of a Chinese balloon equipped with surveillance equipment into US air space. When U.S. military action, shot this ‘spy balloon,’ reporting did taper off. Of course, there are several other significant peaks; Once each peak is identified, there is a need to more specifically query the peaks to learn more about it. We will return to this problem later.

Gray-zone topics are initially created for each month but can be added like vectors to create a representation of a countries gray-zone behavior which is applicable over more extended periods of time. Figure 4 illustrates this concept as the normalized thematic signatures of both Russia and China averaged over the past 8 years. It can be seen from visual inspection that China and Russia topics are dissimilar. Particularly, the top two Russian themes are election

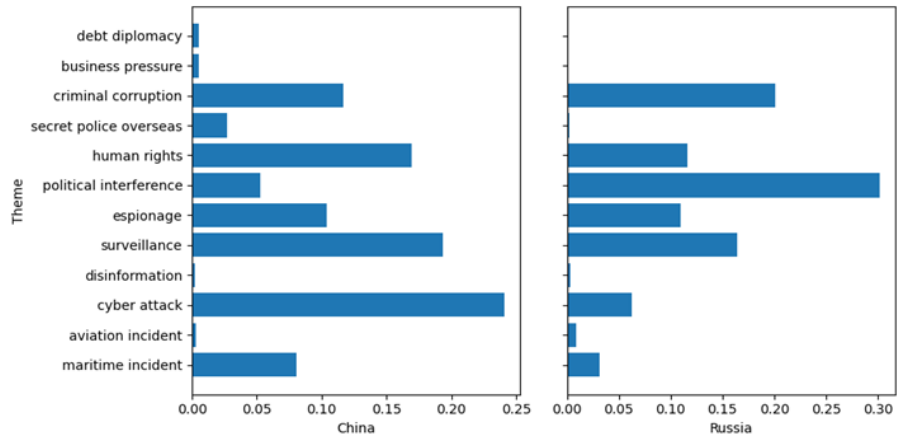


Figure 4. Normalized Thematic Signatures Averaged Over Eight-plus Years

interference and criminal corruption, whereas for China, it is cyber-attack and surveillance. In the previous study, Kullback-Liebler divergence was introduced as a mathematical measure of the degree of similarity between topics. In this paper, we use Pearson correlation instead which gives precise measure of linear correlation. It is generally good to work with multiple dependence measures in statistics since one may work better than the others depending on the nature of the correlation between the two datasets (Wijayatunga, 2016) which may not be foreknown. Pearson correlation is reported here gave interesting results. The Pearson correlation coefficient calculated between the 8-year China and Russia topics is 0.4 aligning with the expectation. From visual inspection, these datasets are quite dissimilar.

One question we could not answer definitively in our first study is whether gray-zone thematic signatures of countries are consistent from year-to-year, or do they evolve over time? Figure 5 shows the Pearson correlation coefficient comparing the Chinese and Russian thematic signatures over the 8-year timeline to their baseline behaviors illustrated in Figure 4. The left graph shows the results of generating annual thematic signatures for each calendar year; The right graph depicts the results of performing the averaging for each quarter. The annualized China signature is very well correlated to the baseline behavior for all 8 years showing much consistency in Chinese gray-zone operations over time.

The annualized Russian signature was consistent between 2016 and 2021; In 2022, it underwent a phase transition corresponding with the start of the war with Ukraine.

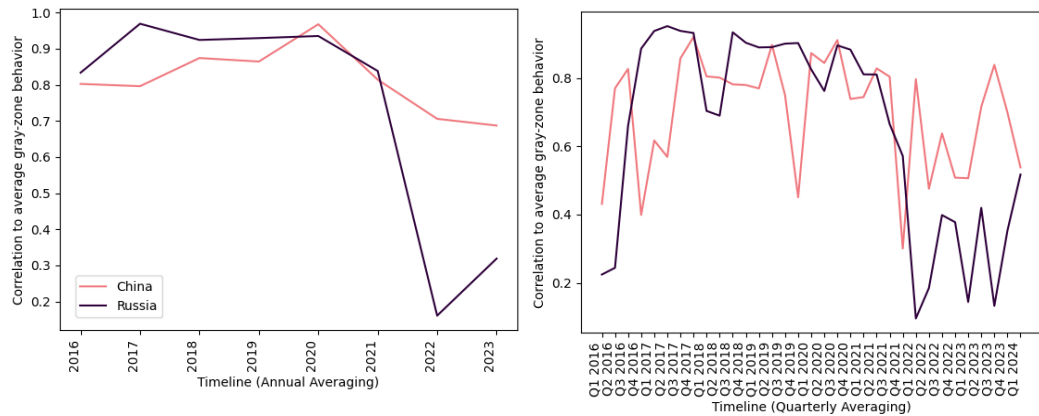


Figure 5. Correlation between Annual and Quarterly Gray-zone Topics to 8-year Average

Also, the right graph reveals quarterly thematic signatures are a lot noisier than annualized ones shown on the left graph. Pointedly, although most quarterly signatures correlate well to baseline behaviors, there are a significant number of quarters which do not for both countries. The utility of high-level data presented over long timelines is it can reveal peaks and transition periods to motivate or guide further inquiry. For this purpose, we have begun to develop a portal to facilitate and automate deeper lower-level queries based on the observations from the above timeline graphs.

Figure 6 is our portal’s input panel with a list of source URLs each query generates. Queries are applied against the 30 GB gray-zone dataset for the eight-plus year period we extracted from the much bigger GDELT database. The inputs are the date range down to 15 min increments (based the GDELT update rate), the country (actor) of interest, the minimum number of mentions required to the sourced event, and a descriptor for the gray-zone behavior and DIME-FIL outcome. Selecting a source URL in the list will open the article in a web browser and provide reporting on the associated event and all related theme counts. There are limitations.

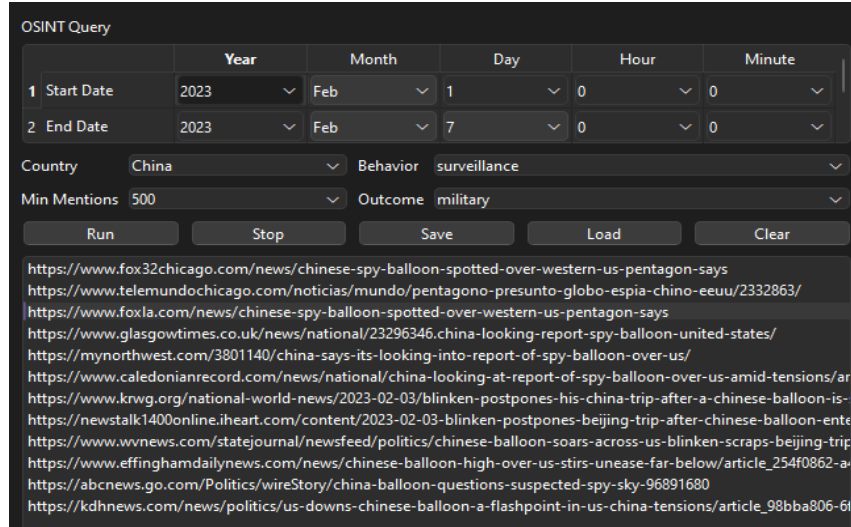


Figure 6. Portal to Explore GDELT Gray-zone and DIME-FIL Themes

Not all GDELT sources are web-based, so the source URL may not open a web page. To note, although GDELT uses its own translation tool, GDELT Translingual, to translate 65 languages into English to for query processing, only the source URL to the foreign language source is provided, not the translation, thereby requiring users to retranslate. Additionally, many older articles are simply unavailable since they have been deleted from the web servers of the news organizations that originated them. In these cases, much useful summary information about the article remains in the GDELT database. For instance, Figure 6 shows a surveillance query for China in the first week of February 2023 when a Chinese spy balloon overflew US air space. Here it can be seen a high minimum number of mentions (500) and headlines reveal the importance to journalist and the public of the events.

In addition to detecting gray-zone behaviors, we are interested in investigating the consequences of those behaviors using the DIME-FIL framework; This is possible with GDELT as journalists oft report holistically, assessing the impact of events and possible outcomes beyond simply reporting basic facts, including populace sentiments and tones. Thus, we make two basic assumptions: there is value in this reporting; this value is captured to some useful degree in the thousands of themes GDELT algorithms generate to summarize the information. Table 1 highlights a sampling of sub-strings found in GDELT themes to identify journalistic references to instruments of national power.

Table 1. Mapping between DIME-FIL Actions and GDELT Themes

DIME-FIL	Example Substrings in Common GDELT Themes
Diplomatic	'FNCACT_SECRETARY_OF_STATE', 'FNCACT_FOREIGN_MINISTER', 'FNCACT_AMBASSADOR', 'FNCACT_DIPLOMAT', 'FNCACT_OFFICIAL', 'NEGOTIATION', 'DISPUTE_RESOLUTION'
Informational	'SURVEILLANCE', 'FNCACT_SPY'
Military	'MILITARY', 'TROOPS'
Economic	'ECON_', 'EPU_ECONOMY'
Financial	'FINANCE', 'FINANCIAL'
Intelligence	'FNCACT_INTELLIGENCE_OFFICER'
Law-Enforcement	'POLICE', 'CRIME', 'JUSTICE', 'ARREST', 'TRIAL', 'CORRUPTION', 'TERROR'

The presence and weighting (number of mentions) of these themes in gray-zone news stories provides statistical linkages between specific gray-zone behaviors and particular DIME-FIL outcomes. For example, the Chinese spy-balloon story is strongly themed as a military, information, and diplomatic story, with weak economic theming. To note, the FIL component DIME-FIL does not appear to be of significance according to journalism.

DISCUSSION

GDEL T is a valuable data source to gather gray-zone environment open-source intelligence (OSINT). This said, many systems are overwhelmed when focused on pulling the entirety of GDEL T's 55 TB—and growing—data corpus directly into their decision dashboards; This may be tied to a trending unquenchable thirst to possess all available data, vice focusing on value-driven data pulls to meet stakeholder analytical requirements. We even found our focused data-pulls, yielding a more manageable 30 GB dataset required refinement of our taxonomy, paradoxically by both expanding our top-level themes while narrowing the focus of themes via sub-themes. Our framework and topic model training has streamlined our ability to automate and more quickly pull valuable, fit-for-purpose (i.e., meaningful; actionable) data, especially comparatively to individual web searches. In turn, as GDEL T updates their database every fifteen-minutes, these topic models more effectively and efficiently facilitate targeting what data to pull down directly to decision dashboards. We found applying thematic analysis—used predominantly in social sciences (especially psychology) and market research—with topic modeling provides a very suitable means to extract the purposeful data and derive meaning from this qualitative data (e.g., modeling the statistical PoB/PoL of countries (represented as topics)). Topics can be thought of as vectors in statistical DIME space, over time, with themes providing the basis set for the space. Results from our expanded eight-plus year average highlight: the number of quarterly mentions to each theme; thematic signatures depicting each country's time-averaged gray-zone behavior; graphs illustrating the Pearson correlation between yearly and quarterly average behaviors and thematic signatures. For China (Figure 5), we find yearly averages correlate well with the thematic signature, while quarterly averages are much noisier; Russia (Figure 5) follows a similar pattern seen in the Chinese graph until 2022 (a phase change in Russian gray-zone reporting which corresponds to the invasion of Ukraine; Continued analysis is required to reveal if this is a change in only reporting the highly visible aspects of war, Russia gray-zone tactics, or both. Our interest to better understand the timeline graphs revealed the need to construct an analysis portal to detect and/or investigate the context, tones, and outcomes of historical gray-zone behaviors through the implementation of (or threats thereof) instruments of national power using the DIME-FIL framework. The point being the statistical topic model linking gray-zone behaviors and DIME-FIL has been trained on the massive GDEL T database summarizing the collective knowledge of the world's journalists.

Topic Modeling Gray-Zone Action Can Produce Actionable Information to Enlighten 'Soft-Power' Modeling

GDEL T's potential to facilitate quantitative analysis attributes to the fact it is big data (i.e., data dating back to 1979 and progressing back to 1800). Saz-Carranza et al (2018) find based on timespan, coverage, and translation, "along with its constant content update and its gradual inclusion of non-Western newspapers, have earned GDEL T a positive degree of reliability among scholars." It is important to point out thematic analysis done haphazardly or without 'checksums' could further mask ground-truth by creating something which does not exist or missing what does exist. This said, as gray-zone actions are often to influence legitimacy, or push boundaries, we offer each time a journalist reports on an event it is more than a vote casted for the event's newsworthiness or what the public finds interesting. These votes also provide signatures and periodicity of similar actions, and a potential measure of legitimacy in terms of an actor's actions to influence 'the court of public opinion.' Similarly, each time journalists reference a DIME-FIL connection, they are voting to create a link between behaviors and consequences which may have been missed due to a 'butter-fly effect' or a swift-moving event. Furthermore, in GDEL T, these votes are mentions to events and to themes. Thus, it is possible to use mention data to train statistical models which capture both behaviors in noteworthy and actionable context. While this paper's attention is actions (e.g., DIME-FIL), it is important to note this data support other frameworks (e.g., PMESII-PT effects) for thematic integration. Additionally, GDEL T events are laid out on a timeline enabling extraction of both the temporal properties, as well as time-averaged data. Our findings illuminate peaks and transitions of data on timeline graphs, which provides an additional source of insightful information. The Pearson correlation provides some utility to idea of countries having a time-independent gray-zone thematic signature.

Feeding GDEL T Results into a Statistical DIME Space + Time

One of the end-state objectives of our project is to directly feed GDEL T data into DIME-FIL models. The motivation

here can be understood from an analogy between potential DIME-FIL modeling and finance modeling hedge fund managers (e.g., late mathematician James Simons (Zuckerman, 2019)) have famously applied to financial markets. Hedge fund companies build models to predict the response of markets to patterns world state data which have the potential to affect markets. For comparison, countries are interested to know

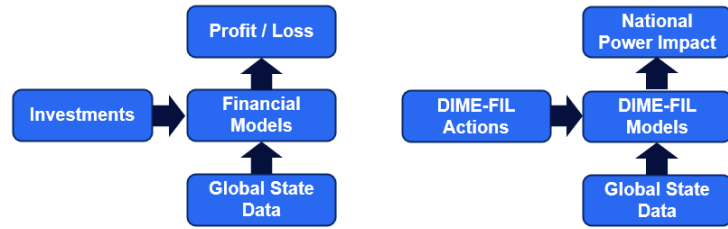


Figure 7. Analogy Between Financial and DIME-FIL Modelling

how their use of instruments of national power will affect their overall standing in the world; Financial markets determine if a particular investment leads to profit or loss for the investor. Similarly, it is the sequence of DIME-FIL actions of multiple countries in response to gray-zone behaviors that determine the net effect of the interaction on the international standing of each other. Figure 7 shows an analogy between financial and DIME-FIL modeling indicating instruments of national power are in some sense comparable to investments. In both cases, human actors are fundamentally competing for finite resources and trading commodities. In each case, the actor makes a move and the system produces a result. Analogously, a move can be an investment in financial markets or a DIME-FIL action in international relations. Also, actors may seek to improve outcomes by attempting to predict the most likely impact of their move based on global state data. If all actors are cooperative in following a clear set of rules, then their system may find a stable equilibrium. From a mathematical modeling perspective, gray-zone then emerges when actors cease to be fully cooperative (transactional), thus driving the system from the equilibrium state that might exist otherwise.

Departure from the equilibrium state of international relations is one challenge of gray-zone modeling. This is the motivation for isolating gray-zone news coverage from other kinds. The thought is using gray-zone data to build gray-zone models will be more effective than training models using more general DIME-FIL data. Another challenge is to build a practical system. To this end, we have progress on several fronts. Firstly, we have trained simple models and found correlation indicating past gray-zone behavior of a country is often predictive of what they will do in the future. Secondly, we have recently found journalistic data can be used to determine links between gray-zone actions and DIME-FIL consequences. The logical next step is to use this thematic linking concept to build more sophisticated models. For example, we are aware of the possibility to take our existing gray-zone behavior themes and break them down into sub-themes to glean more granular details. We could break down the surveillance theme, for example, into different categories of surveillance. Similarly, our current vague concept of DIME-FIL events could be further refined by colors representing country groups and levels indicating the seriousness of the response. Placing these elements on a timeline is expected to provide more detailed descriptions of past gray-zone campaigns in a thematic form, with the goal to be able to grade them on the outcomes they produced. For this we are interested in the continuing to investigate making full use of GDELT tools which capture news articles' tones and sentiments, through application programming interfaces, to directly feed operational decision ecosystems dashboards to streamline situational awareness.

Application to Decision-Analysis and Strategic Planning

Regarding current operations, we are intrigued by GDELT's tools (i.e., GDELT Event; GKG) to update in near-real time (15 minutes) breaking global events. This facilitates refining models and employing our framework to set alerts for current gray-zone news stories for situational awareness and forecasting departure from statistical expected behaviors or new maneuvers in the gray-zone. On another note, based on our research findings, we are continuing to dig deeper into our data pulls to better understand how swiftly GDELT can present actionable information for topics not modeled; Specifically, to establish how quickly an operations cell could pull actionable data on unmodeled topics to inform a short-turn 'go-no-go' decisions. Thereby, we find further investigation is required to: (1) answer the aforementioned question; (2) close the gap on maximizing data automation and modeling and simulation (M&S) in a fashion which minimizes human analysts' requirements. It is important to remember, decision-makers'/leaders' business is to manage chaos by balancing time, space and force against risk, and accept responsibilities of their choices (i.e., technology augments/enables or teams with, vice replaces human decision-making). Thereby, human advisors will always be between the decision makers decision and technology. On another note, for slower timeline periods, we do find immediate utility of GDELT and Gray Zone Data Pipeline and Offline Training System for a more efficient and expeditious means to generate products and conceptual models for planner, instructors, exercise planners, and/or wargamers to balance the art and science of international relations. For example, while wargames are a blend of art and science, they tend to be more art-minded; M&S tends to be mainly scientific. Today, a great divide exists between

wargames and M&S. These communities struggle to effectively integrate and employ their processes and products into a coherent, easy to use solution. Wargames tend towards non-deterministic functions and plausibility to promote human decision making and provides a “means for anticipating—not predicting—choice consequences” (USNWC Wargaming Course, 2019); Yet, wargame outputs are often qualitative, based on the education and/or experience of available ‘SME(s),’ and do not facilitate generating conclusions or calculating outcomes. Whereas M&S produces quantitative outputs which favor deeper exploration in multiple run ‘what if’ theories or scenarios, providing a reproducible environment, and thereby calculating outcomes; Conversely, M&S tends to be highly deterministic and based on a rigid mechanism of adjudication where players are often bound to inflexible predetermined scenarios, rules, and procedures. To compound the limitations of fundamental M&S is the aforementioned ‘fuzzy-logic’ of ‘soft power’ modeling of actions (DIME-FIL) and effects (PMESII-PT). We have illustrated our approach could bring both qualitative and mathematical quantitative model attributes to bear, to better facilitate wargaming solutions via semi-rigid, or hybrid adjudication based. In other words, a blend of the best attributes of ‘free adjudication’ (e.g., SME based or when SMEs are unavailable, recruited augmentees informed by historical events) and ‘rigid adjudication’ (e.g. math and physics-based M&S). Through the integration of our evolving gray-zone framework with wargaming and planning solutions, decision-makers and their teams can explore and investigate plausible “blue” actions (decisions), “red” reactions (consequences of decisions), and “blue” counter-actions in the operational or tactical execution of strategic decisions. In essence, to provide means for anticipating and assessing choice consequences—through the employment of PMESSI-PT effects models—to counter gray-zone tactics and feed assessment to a simple scoreboard that indicates DIME-FIL impacts to nation-state or non-state actors. There is potential usefulness of mention counts for risk-cost-benefit analysis to aid decision-making as well as the power of RTA to provide alternate analyst frameworks. This presents multiple possibilities, including data fusion coupling with other data sources (e.g., ICEWS; X (a.k.a. Twitter); Facebook; etc)). Newsfeed mentions can be used as a kind of currency in events such as wargames for risk-cost-benefit-risk calculations that factor in GDELT’s metadata. Figure 8 characterizes a simple application of our research’s ‘what’ and ‘how,’ to answer the questions ‘so what’ (i.e., ‘why do I care’) and ‘how can I use it.’ Pointedly, our process can more expeditiously produce the information required in Figure 8 and bring the flexibility and adaptability required to enable creativity and ideation.



Figure 8. Simple Application of GDELTs Gray-zone Data for Wargaming and Planning

CONCLUSION

Historical journalism data, appropriately filtered through GDELT themes identified by user-defined composite behavior themes can assist decision support through both qualitative (e.g., context; sentiment; tone; actions; consequences) and quantitative mechanisms (e.g., signatures; statistical correlations; timeline and other graphs). Exploiting GDELT through our proposed data pipeline and offline training system (Figure 2) enables a more expeditious means to sort through a massive data corpus to a much smaller data set to then provide a qualitative possible starting point (mentions) and the primary source article which then immediately reviews additional articles to explore. While we discussed mentions reveal what is important to journalists and the public, the events with no or the least mentions could be fascinating to explore (e.g., what may lie below the noise floor could be more important). Furthermore, our research provides a basis for better tracking evolving events associated with interactions of interest (e.g., DIME-FIL) between two or more actors. As such, improved search and refinement of themes and topics could support preparation for the future scenarios by providing convenient and efficient access to information about analogous historical situations consider in planning for the future application, examples include: (1) a means to anticipate expected actions, effects, and/or consequences; (2) identify triggers, decisive- and/or decision-points; (3) facilitate training or wargaming in both a preparation and moving context scenarios, qualitative probability tables of ‘softs-powers’ to augment SMEs (science and art); (4) be references for augmentees when SMEs are unavailable); etc. Finally, our process can be applied to future data corpus’ as the emerge to classify both gray-zone behaviors as they happen as well as the resulting DIME-FIL actions taken in response. It is anticipated, as theming capabilities of the system grow and begin to factor in sentiment analysis, predicative data patterns will emerge which serve to recommend course of action.

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