AI-Enabled Social Cyber Maneuver Detection and Creation

Matthew Hicks

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Software and Societal Systems Department
School of Computer Science
Carnegie Mellon University
Pittsburgh, PA 15213

Thesis Committee:
Kathleen M. Carley, Chair
Patrick S. Park
Mohamed Farag
David M. Beskow (United States Military Academy)

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Abstract

As social media platforms have become central to information dissemination, influence operations, and narrative shaping, understanding their role within the broader information environment is increasingly vital. The BEND framework offers a structure for analyzing online influence by identifying social-cyber maneuvers.

The BEND framework was previously operationalized at the message and individual levels. In this thesis, I operationalize the BEND framework at the population and effects levels, integrate both sets of work, and align them with U.S. military doctrine and training. In doing so, I identify the critical need for complex, realistic, and scalable social media training environments.

To meet this need, I introduce the AI-Enabled Scenario Orchestration and Planning (AESOP) tool, which enables planners to create training scenarios that specify events, actors, social media platform accounts, and narratives. AESOP generates synthetic templates associated with the scenario and accompanying news articles, media content, and URLs.

I then present SynTel and SynX, agent-based simulation and generation tools. These tools consume AESOP-generated synthetic templates and, with support from external large language models, produce realistic and interactive synthetic social media data for X/Twitter and Telegram. These simulations replicate influence ecosystems at scale.

Finally, I propose and validate a novel effects-based approach to detecting BEND maneuvers within topic-oriented groups. This technique is applied to real-world datasets to link maneuver effects to broader campaign impacts.

Together, these contributions enhance our capacity to detect, evaluate, and train against influence operations — making BEND a practical analysis framework for the information environment.

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Chapter 1

Introduction

1.1 Overarching Thesis Goals

Social media platforms have an immense impact on information dissemination, influence operations, and narrative shaping. This provides an avenue for interested actors to influence public opinion, manipulate people, and even conduct war by other means.[10] Despite the growing importance of these dynamics, existing analytical frameworks and doctrinal tools — particularly within the U.S. military — have struggled to adapt. While other domains of military planning apply rigorous models and systematic assessments, social media often remains under-analyzed, poorly integrated, or misunderstood in operational planning and in training

This thesis seeks to bridge the disconnect between emerging influence analysis frameworks and traditional U.S. military operations by synthesizing current doctrine with BEND - a social-cybersecurity framework - and providing practical tools for integrating social media into existing training exercises:

- AESOP (AI-Enabled Scenario Orchestration and Planning), a standalone Python-based application, empowers planners to construct, edit, and generate social-cyber scenarios grounded in real-world dynamics using configurable LLMs and structured inputs.
- SynTel and SynX, agent-based generators for Telegram and Twitter/X respectively, combine traditional simulation logic with LLM-driven message creation to produce realistic, platform-specific datasets.

These tools lower the barrier to high-quality scenario generation and provide a replicable method for developing training-ready content tailored to a variety of domains, including military, emergency response, public health, and law enforcement.

Additionally, this thesis seeks to enhance our ability to detect influence maneuvers — specifically those captured by the BEND framework. While BEND maneuvers are, by definition, effects-based, prior detection approaches have focused primarily on inferring the intent of the actor behind the message. This thesis reconceptualizes the detection problem by shifting the analytical emphasis to the observable effects of a maneuver within networks and narratives.

By developing a new effects-based detection methodology and integrating it with prior cue-based methods (e.g., CUE+), this research hopes to offer a more comprehensive, empirically grounded means of identifying influence activity in real-world social media datasets.

1.2 Overview of Chapters

This thesis is remarkably linear, with a single ”Golden Thread” running through it - creating an environment for training BEND. Chapter 3 introduces the major concepts of social cyber security - including the BEND framework and the current status quo. These provide the basis for envisioning what such an environment might - must - look like. Chapter 4 builds on this by providing an emerging practical application of BEND within the US Department of Defense (DoD). The conclusions from this chapter, namely that BEND training is required and demands realistic and complex social media datasets, provide the demand signal for a BEND training environment. In Chapter 5, I introduce the AI-Enabled Scenario Orchestration and Planning (AESOP) tool for the creation of social media exercise scenarios - the first major component of the BEND training environment. In Chapter 6, I introduce the second major component - LLM-connected agent-based synthetic data generators SynX and SynTel which take AESOP scenarios and output corresponding datasets. Finally, in Chapter 7, I propose and demonstrate an effects-based method for detecting BEND maneuvers that goes beyond the current intent-inference approach that relies on language cues. This enables the training audience to interact effectively with the training environment - identifying not just intended BEND maneuvers but also providing the ability to evaluate their effectiveness.

Chapter 2

Data and Tools

2.1 Data

Previous research has examined several large-scale datasets for BEND maneuvers using existing techniques.[14] [13] I will apply BEND maneuver detection again, both through the current methodology[13] and the extended effects-based BEND maneuver detection discussed later in this thesis.

Table 2.1: Corpora Summary Statistics

Corpus Topic	Time Period	# Messages	# Agents
Balikatan 2022	~2022-04-07 thru 2022-04-14	2,372	1,308
Nice, France Terrorist Attack 2020	~2020-10-16 thru 2020-11-09	612,257	221,200
Synthetic Scenario	~2034-05-01 thru 2034-05-10	19,719	91

Balikatan 2022 Balikatan is an annual bilateral military exercise between the United States and the Philippines. This data was collected from April 7 to 14 April, 2022, based on the keyword "Balikatan". Approximately 2,300 messages

French Attack in Nice 2020 An Islamic extremist attacked and fatally wounded three individuals inside a Roman Catholic church in Nice, France, on October 29, 2020. A research team from Singapore collected two weeks worth of Twitter data from the Fall of 2020. I focus on the data from October 26 to November 4, 2020, covering before and after the event. Approximately 380,000 messages.

Synthetic dataset This dataset consists of X/Twitter API v1 data synthetically created with SynX (see Tools) and covering a Balikatan-like scenario that occurs from 01 May to 10 May 2034, which was constructed with AESOP (see Tools). Approximately 19,700 messages.

2.2 Tools

2.2.1 Existing tools

ORA-Pro

Formerly, the Organization Risk Analyzer (ORA) - Professional version, now known simply as ORA-Pro. ORA-Pro is a dynamic network analysis and visualization tool. ORA-Pro can import Twitter, Telegram, and Reddit data for detailed analysis.[22]. This thesis takes advantage of the built-in stance detection, Leiden grouping, and social metrics as well as the BEND maneuver detection through CUES.

NetMapper

NetMapper processes text to identify concepts and their network relationships. It uses dictionaries and custom parameters to enrich text before extracting concepts, which it then links together to create either semantic or conventional meta-networks.[22] This thesis relies on NetMapper for extracting CUES from social media corpora before importing the CUES into ORA-Pro.

OpenAI Models and API

This thesis required large amounts of LLM interaction and the OpenAI API was user friendly and easy to integrate with Python.[65] I used a GPT4o mini model (gpt-4o-mini) for text and DALL-E model (dall-e-2) for images.

Local Large Language Model

Unfortunately, OpenAI models refused to respond properly to some requests for negative BEND maneuvers or to some negative topics due to guardrails. In those cases, I ran a large language model locally. For this thesis, I used mixtral-8x7b based on its effective responses, lack of guardrails, and small size.[6]

2.2.2 Tools developed for this thesis

AI-Enabled Scenario and Orchestration Planning (AESOP) Tool

AESOP allows Information Environment planners to develop social-cyber exercise scenarios from scratch or develop social-cyber vignettes for integration with existing scenarios. It is a standalone GUI coded in Python with PySide6 that leverages external LLMs.[70] AESOP was coded specifically to support the research in this thesis. A detailed description of AESOP can be found later in this thesis.

SynTel and SynX

SynTel and SynX are agent-based simulators, programmed in Python, that interact with LLMs to produce Telegram and X data, respectively. They were coded specifically to support the research

in this thesis. A comprehensive breakdown of how SynTel/X are constructed and operate can be found later in this thesis.

Chapter 3

Background and Related Work

3.1 Social Cyber Security

Looking at cyberspace through the lens of warfare is not new. Interactions between adversaries within cyberspace have often been referred to in military terms of attack and defense [26]. Cyberspace simulations have been used to model these conflicts, often closely emulating current physical military doctrine [36]. However, these simulations focus primarily on the cyber-terrain itself - accurately deducing that terrain has a large impact on the outcome of conflict [36]. However, just as the physical domain of warfare stretches into the digital space, so too does the information environment. This is social cyber security [21] [20]. Social cyber security welds the methodologies of the social sciences with the need to identify, assess, and counter the impact of information maneuvers.[20]

This field is often claimed/mishandled by multiple interested parties. In the US Department of Defense (DoD), there is not only Joint (all-service) doctrine[47] addressing it but there is also Service doctrine[30] and within services there is Branch doctrine[32] - all sticking a finger into the mess that is the social cyber security component of the much broader Information Operations.

Although recently identified as an academic field and still nascent within the Department of Defense, the need for a framework to scaffold understanding of these issues is not new and has led to the rise of various contenders. These include Ben Nimmo's 4 D's - dismiss, distort, distract, and dismay - focusing on Russian propaganda techniques.[61] Also, the ABC framework developed by Camille Francois[38], which looks at the Actors, Behaviors, and Content of a disinformation campaign and its successors ABCD[8] and ABCDE.[66] Finally, the SCOTCH framework - focusing on Sources, Channels, Objectives, Targets, Composition, and Hooks - was brought forward by Blazek in 2021.[16]

Amid this crowded field lies the BEND framework. BEND provides a framework for discussing social-cyber interactions using narrative and network structures, but borrows the idea of informational maneuver from maneuver warfare [12]. BEND is shorthand for the social-cyber maneuvers: back, build, bridge, boost, engage, explain, excite, enhance, negate, neutralize, narrow, neglect, dismiss, distort, dismay, and distract. These maneuvers and their definitions are taken from Beskow and Carley's 2019 work Social cybersecurity: an emerging national security requirement [12] as refined and validated by Blane et al. in 2022 [14] and later in Blane's thesis

work.[13] BEND arguably stands out from other frameworks for several reasons.

First, BEND is detailed enough to provide leaders with a lexicon capable of expressing their specific desires. Second, it focuses on communicating a general understanding of the intent and effects of the information maneuver without becoming a low-level enumeration of the tactics, techniques, and procedures used in the execution of those maneuvers. Both of these distinctions are more than just attempts at carving out a niche for BEND - there exists a broad requirement for discussions of the intent and effects of maneuver without getting bogged down in the execution - and it persists across domains. Here, BEND lives in stark contrast with SCOTCH, a more detailed framework that provides a much richer execution scope for maneuver at the cost of brevity. SCOTCH requires a full operations order, while BEND is focused more on evoking just the broader tactical task. ABCDE is similar in its lack of brevity - requiring five paragraphs for full enumeration - but does manage to keep all of it at the non-execution (operational) level. Third, BEND is not limited to disinformation or to just the narrative side of information maneuver - in contrast with Nimmo's 4Ds. BEND fully categorizes maneuvers through narrative and network space and positive and negative impact.[13]

Lastly, the maneuver portions of BEND can - and should - be used to enrich any social-cybersecurity framework. It is already present in Nimmo's 4Ds but is necessary as an extension to cover positive and network maneuvers. It fits well within the Effects (E) of the ABCDE framework - giving concise scaffolding to an otherwise bulky framework - and it provides a shorthand for grouping identified SCOTCH enumerated campaign events - without needing to specify the execution pathway of each. Because BEND is not just focused on being an identifying framework, but also on short-handing important motifs within social-cybersecurity it offers utility everywhere.

BEND is not just the expression of maneuvers, nor is it just the categorical formatting for them, it is also a methodology for extracting maneuver intent and effects from the information environment. Currently, the CUE+ method as outlined by Blane [13] is the cutting edge in BEND maneuver detection. This method has seen several iterative improvements - first in Uyheng et al. in 2020[72], then by Blane et al. in 2022[14], then Alieva, et al. in 2022[9], before Blane adopted the the current method in her thesis work.

In this method, linguistic cues are extracted from message text using NetMapper software.[22] These NetMapper cues are a proprietary blend of concepts that represent a message's sentiment and the author's emotional state.[20] These particular cues - now referred to as CUES - are then loaded into ORA-Pro[22] - a network visualization and analysis tool - where they are mapped to the original message. ORA-Pro is able to use these CUES, along with supplemental network information about the message sender, to provide a report that identifies BEND maneuvers associated with messages and actors - i.e. who is trying to do what to whom.

This is necessary to identify BEND maneuvers within messages. However, the BEND maneuvers themselves, even in the extended definitions provided by Blane, are not intent-based - who is trying to do something - but impact-based - what actually happens. Indeed, the BEND maneuver descriptions and illustrative impacts provided by Blane are diagrams or illustrations of the effects the BEND maneuver will have. For instance, the diagram for the Boost maneuver is shown in Fig. 3.1

There is no mention of the content required within the message that caused the boost - the implication is that the message is defined by the impact it had. Blane goes on to derive message

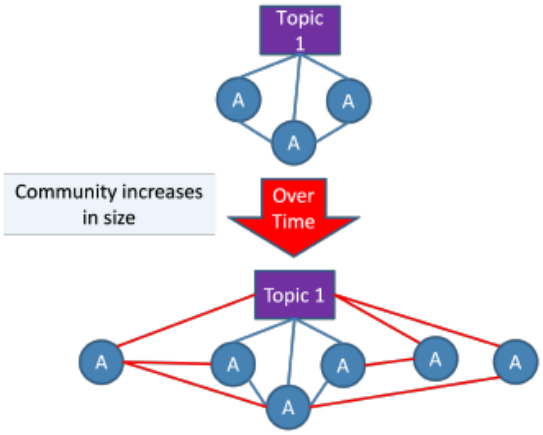


Figure 3.1: Excerpt from Blane's thesis work "Social-Cyber Maneuvers for Analyzing Online Influence Operations".[13]

content requirements based upon CUES. Again, this is necessary to identify which messages are attempting to conduct which maneuvers. However, assessing the effects of the messages - detecting BEND not within the messages but in the effects these messages had on their targets - is missing. This represents a fundamental disconnect between the state of the art in BEND detection (CUE+ based) and the actual intended use of BEND. The crux of this thesis aims at bridging this disconnect.

Chapter 4

US Military Doctrine

4.1 Research Questions

As the Department of Defense continues to evolve its approach to operations within the Information Environment (IE), it faces significant challenges in conceptualizing, organizing, and executing influence efforts—especially on social media. The BEND framework offers a structured, effects-based lens through which influence and manipulation can be analyzed and operationalized. However, for BEND to serve as a useful tool in defense planning and operations, it must align with existing doctrine and be expressed in language and formats familiar to military decision-makers.

This chapter examines how the BEND framework can be nested within current U.S. military doctrine and proposes doctrinally consistent products that apply BEND to support decision-making and planning processes. The aim is not only to demonstrate BEND's conceptual fit, but to create doctrinally relevant outputs—such as overlays, situation templates, running estimates, and targeting inputs—that enhance the military's ability to visualize and respond to the social media dimension of the IE.

The key research questions for this chapter are:

- How does the BEND framework fit into current military doctrine?
- How can BEND enhance current information environment analysis?

To answer these questions, the chapter synthesizes numerous doctrinal sources, including Joint Publications, service-specific field manuals, and defense instructions, while highlighting existing gaps in how social media is conceptualized and managed. It also draws from practical applications in training environments, particularly the Project OMEN series, to show how BEND can inform both planning and execution through standardized outputs.

Ultimately, this chapter demonstrates that BEND can serve as a doctrinal bridge—linking narrative analysis, social media maneuver detection, and operational planning in a coherent, scalable way. It concludes by identifying a key area of opportunity within the DOTMLPF framework: the urgent need for realistic, doctrinally informed training to prepare military personnel to operate effectively within the social-cyber domain.

4.2 Doctrinal Synthesis

Current military doctrine on the social media aspect of the Information Environment (IE) is scattered between dozens of manuals and instructions and is encumbered by issues of both authority and ability. Current doctrinal examples that address the IE include:

- JP 3-13 Information Operations[47]
- NWP 3-13 Navy Information Operations[34]
- ADP 3-13 Information[33]
- AFDP 3-13 Information in Air Operation[30]
- CJCSI 3210.01C Joint Information Operations Proponent[23]
- DODI 3600.01 Information Operations[29]
- ADP 5-0 The Operations Process[31]
- MCWP 3-32 Marine Air-Ground Task Force Information Operations[41]
- JP 2-01.3 Joint Intelligence Preparation of the Operational Environment[46]
- ATP 2-01.3 Intelligence Preparation of the Battlefield[32]
- JP 3-60 Joint Targeting[45]
- JP 3-61 Public Affairs[48]

This is neither a comprehensive list of all applicable doctrine nor does it include those manuals which retain a either a Secret classification or Controlled but Unclassified Information (CUI) identifier. Throughout these doctrinal examples the IE is defined as ”The aggregate of individuals, organizations, and systems that collect, process, disseminate, or act on information.”[47] Unfortunately, because of the importance of the IE it is often discussed as the ”Information Domain” - something not explicitly found in US doctrine. In none of these manuals is ”domain” officially defined[4]; however, JP 1 Doctrine of the Armed Forces of the United States does discuss the ”the physical domains (air, land, maritime, and space); the information environment (which includes cyberspace); and political, military, economic, social, information, and infrastructure (PMESII) systems and subsystems.”[49] The fact that information is both an environment akin to the physical domains and a separately listed system should speak to its importance. The implication is that there exist separate regions marked by distinct physical characteristics (land, air, sea, etc.) and a mostly intangible information region. This is borne out in discussions of domains - they often include the information domain despite its lack of doctrinal pedigree[7].

The doctrine elsewhere includes the information domain as an instrument of national power[49]. These instruments of national power are laid out as a part of the DIME framework which defines diplomatic, informational, military, and economic instruments - more recently expanded to include finance, intelligence, and law enforcement (DIME-FIL)[68]. Indeed, the integration of the information ”domain” or environment was the driving force behind the Department of Defense’s Joint All Domain Command and Control (JADC2) initiative[5]. Whether a domain or an environment, information holds relevance equal to any of the physical domains.

As social media becomes increasingly important within the Information Environment[7], the BEND framework provides a solution for proper analysis and lexicon across warfighting func-

tions. There are a wide variety of actions and actors within the DoD concerned with information operations. These include Public Affairs Operations (PAO) - ”provide accurate and timely information” to the public[48] - Military Information Support Operations (MISO) - ”influence the attitudes, opinions, and behavior of foreign target audiences”[48] - and Military Deception (MILDEC) - ”deliberately mislead adversary... decision makers”[48]. All of these benefit from the common lexicon of tactics and maneuvers provided by BEND.

Unfortunately, US Department of Defense (DoD) actions in the IE are also hampered by issues of authority and capability. These issues are highlighted most clearly when considering social media. The authority for the DoD to conduct ”operations” within social media is limited by a wide array of both law and policy. Limiting factors include the Posse Comitatus Act[3], the Fourth Amendment[1], the Privacy Act of 1974[2], and numerous DoD directives and regulations. These factors severely limit the the collection of information on US citizens and the conduct of narrative campaigns (beyond informational) that target US citizens. This thesis does not address solutions for these issues and assumes the DoD has already established or will establish the proper authorities to conduct analysis and response within the social media subsystem of the information environment.

While these authorities remain a legal question, the capability issue can be addressed. Decision makers need mappings of the information environment to know how to analyze it and respond within it. In other domains, leaders rely upon the Modified Combined Obstacle Overlay (MCOO)[46]. The land domain MCOO is perhaps the easiest to conceptualize. Obstacles, avenues of approach, key terrain, observation and fields of fire, and cover and concealment are graphically depicted atop a topographic map of the battlefield. This provides decision makers with a clear understanding of how the pieces of the land battle interact. The MCOO is further enriched by adding the enemy situation template (ENY SITEMP). The enemy situation template shows the disposition of known enemy positions overlaid on the MCOO, as well as the enemy’s most dangerous or most likely course of action based on the enemy’s doctrine. The lifting of this concept and application of it to the IE is not a new idea and others have posited the creation of a Combined Information Overlay [27]. This is encouraged by the description of the Consolidated Systems Overlay in JP 2-01.3 Joint Intelligence Preparation of the Operational Environment [46], see Fig. 4.1, which is unfortunately never explicitly applied to the information environment.

The Social Media CSO/MCOO BEND is key to combining the methodological rigor of the Modified Combined Obstacle Overlay (MCOO) with the systems perspective of the Consolidated Systems Overlay (CSO) in order to graphically depict the current state of the social media component of the information environment for decisions makers. The information environment needs a MCOO for the social media subsystem to feed the social media enemy situation template, the social media running estimate, the friendly social media situation, aid in course of action development, and provide meaning to an IE impact assessment.

Project OMEN has been a major force in developing examples of the application of BEND within the military. Project OMEN is a training scenario designed to educate players on social media analytics.[52] In work done in support of Project OMEN, I constructed products that match each of these areas from the BEND reports and outputs available. Beyond this, I will develop a social media running estimate template for information operations staffers that includes these

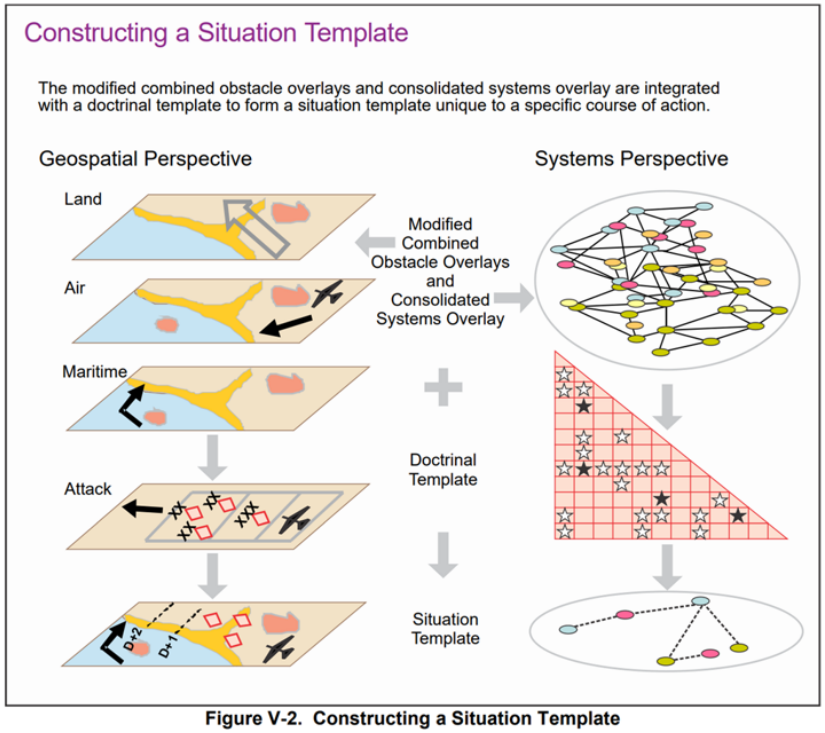


Figure V-2. Constructing a Situation Template

Figure 4.1: MCOO and CSO comparison from JP 2-01.3 Joint Intelligence Preparation of the Operational Environment

examples and accompanying narratives.

These products synthesize with current US military doctrine. They are aligned with the Joint Targeting Cycle (JTC)[45], Joint Intelligence Preparation of the Operational Environment (JIPOE)[46], and the Joint Operation Planning Process (JOPP)[50].

It is important to note that while social media is a critical component of the information environment, it is still only a subsystem. These products help scaffold the leaders and their staffs in understanding the role social media plays; however, social media is not a domain or an environment level consideration. The products outlined here reflect only a subset of those that would feed larger information environment planning processes and cycles. Samples of these products can be found in Appendix **??**.

4.3 A Training Requirement

The DoD uses a framework called DOTMLPF to identify where changes need to be made or can be made in the development or fielding of new solutions, be they equipment, units, or even concepts. DOTMLPF is an acronym addressing capability across seven interrelated domains: Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities. As a burgeoning concept within the DoD, social-cybersecurity is no different from any other capability. Thus far, Organization is assumed to be addressed as a nascent entity with the requisite

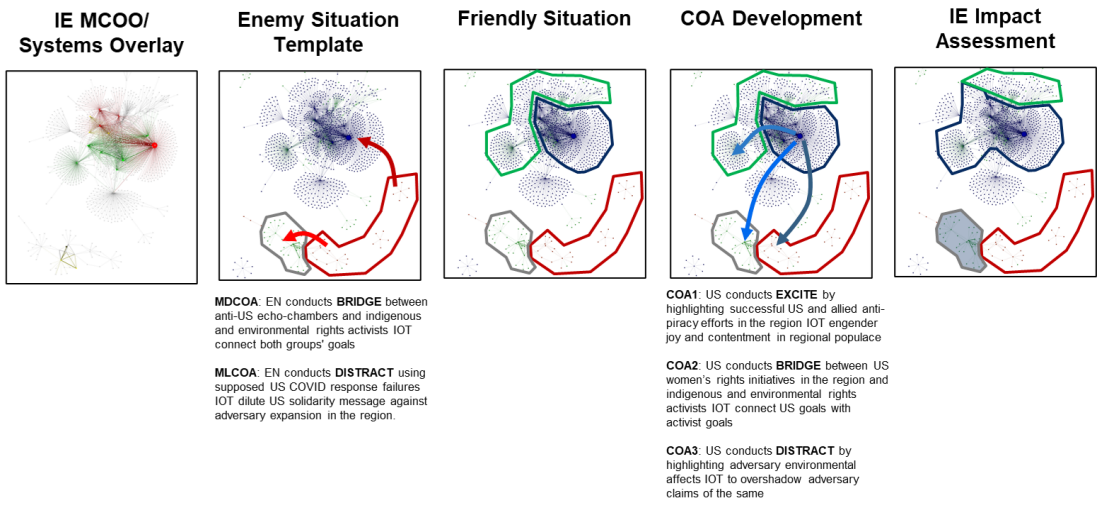


Figure 4.2: Information Environment products influence by BEND as a part of this thesis.

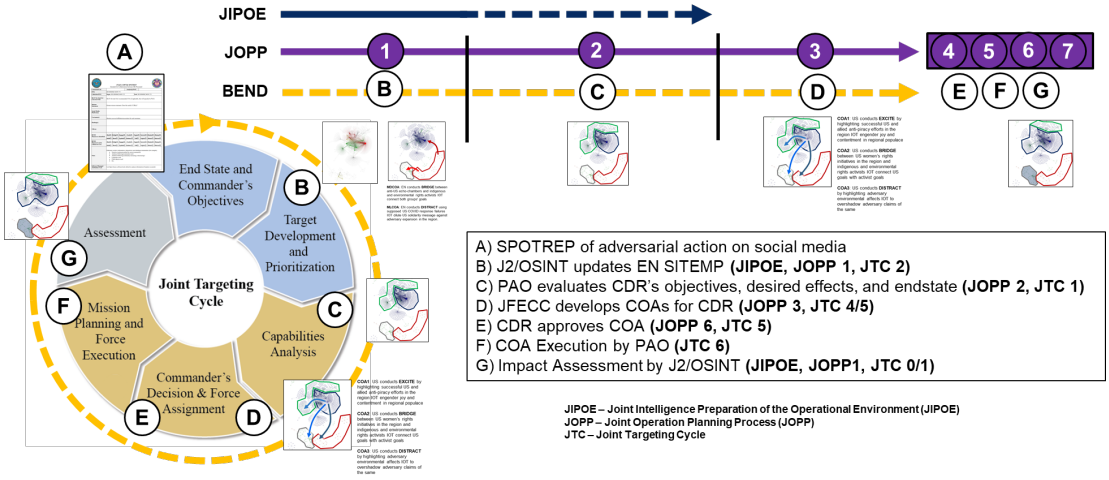


Figure 4.3: BEND integration with the Joint Targeting Cycle, JIPOE, JOPP.

authorities for conducting social media maneuve. Doctrine is addressed here, and while there is not yet clear understanding of particular doctrine, there is direction forward, which is sufficient for developing capabilities. Materiel, Leadership and Education, Personnel, and Facilities are well outside the scope of this thesis and require executive decision and legislative action. This leaves Training. There is an outstanding requirement for complex, realistic training within the social-cybersecurity landscape.

Chapter 5

AI-Enabled Scenario Orchestration and Planning (AESOP)

5.1 Research Questions

Understanding the BEND framework, identifying BEND maneuvers and their effects, and even conceptually understanding the doctrinal application of BEND fall short of fully operationalizing BEND. What is required is realistic training on a realistic corpus where a training audience can apply these concepts. A point of clarification is required here because training - especially when artificial intelligence and large-language models are included in the discussion - can mean different things to different people. Training often refers to model training, in which a model learns a classification task from a training data set.[39] This is not the case here. Here, training involves the instruction and learning reinforcement of living, breathing humans on BEND and social media analysis techniques.

Effective training for social-cyber analysts requires realistic, relevant, and dynamic data environments. However, the practical constraints of using real social media data—including legal, ethical, and operational limitations—often render it insufficient or inappropriate for targeted training needs. Synthetic data provides a compelling alternative, but its utility depends entirely on how well it mirrors the complexity and nuance of real-world online behavior, both in content and in structure.

This chapter introduces the AI-Enabled Scenario Orchestration and Planning (AESOP) tool, a system developed as part of this thesis to generate training-ready synthetic data grounded in real-world dynamics. Before diving into AESOP's design, this chapter begins by categorizing and evaluating the primary types of data available for social media training. Using criteria such as relevance, scalability, interactivity, and realism (both network and narrative), I compare real data, hybrid models, and various synthetic approaches to determine which best support different training objectives.

From this analysis, it becomes clear that synthetic data informed by real-world patterns—and built explicitly to support narrative and maneuver analysis—is uniquely suited for BEND training. AESOP operationalizes this insight by enabling scenario planners to design realistic and customizable information environments. Planners define actors, groups, events, narratives, and

supporting media, while AESOP scaffolds this creation process using large language models (LLMs) to reduce cognitive load and improve immersion. AESOP's outputs include both synthetic templates, which feed into generators like SynTel and SynX, and exercise-ready documents for participants and controllers.

By formalizing and standardizing the scenario design process, this chapter bridges the gap between high-level training objectives and low-level data generation, ensuring that synthetic social media corpora are not only technically robust but pedagogically effective.

The key research questions for this chapter are:

- How can we develop exercise training scenarios for the BEND framework?
- Can we extract a training scenario from real data without resorting to hand-crafting messages?
- How can we leverage AI/LLMs to enhance training scenarios and generate BEND maneuvers?

5.2 A Training Approach

The idea of realistic training for social-cyber security is not new. Project OMEN has been steadily increasing the complexity of training scenarios for the DoD since 2021[52], culminating in February 2023 with a hybrid of hand-altered real-world Twitter/X data and synthetically generated Telegram data. This mix of data is a result of increasing demands for relevance, scalability, and realism in networks and narrative.

Table 5.1: Comparison of Data Types for Modeling Social Media Environments

	Relevance	**Scalability**	**Interactivity**	**Realistic Networks**	**Realistic Narratives**
Real Data	–	+	–	+	+
Hybrid: Hand alteration	o	–	–	o	o
Hybrid: Automated alteration	o	o	–	o	o
Current Synthetic	+	+	+	–	o
Synthetic Derived from Real Data	+	+	+	+	o

Skipping over the question of scenario design for now, it is conceptually possible to train individuals on BEND social media analysis on a wide array of social media corpus. However, data selection should always match training objectives. It is, therefore, helpful to categorize the options for data that can be used during training and evaluate them across five areas.

The first area is relevance. Relevance is meant to encompass two related concepts - adaptability and applicability. This may seem an odd pairing for a single category, but they are closely woven together. Data can be applicable - it may include the exact topics and events required for training - and therefore does not require reconfiguration, or it may be adaptable such that it can be made applicable for the training. Relevance is here a measure of both as it pertains to the content of the data, i.e. is the data already topical or can it easily be made topical?

The second area is scalability. It can be difficult to draw an analysis out of too little data, just as it can be challenging to handle too much data. Ideally, data will be of sufficient size to

meet particular training objectives - scalability is measure of how easy it is to shift a dataset to the correct quantity.

The third area is interactivity. Thus far, the corpus is discussed as a monolithic entity for the training audience. However, feedback is an important part of training - the training audience requires reinforcement from the training environment when they are making the ”correct” action and negative feedback when they are making the ”incorrect” actions. Interactivity is a measure of how easily a data set can be changed such that the training audience can see both the effects of their own actions within the corpus and evaluate these effects against desired outcomes.

The fourth and fifth areas are closely related and deal with the realism of the data in both the network and narrative domains. The data should closely reflect real-world social network constructs and real-world narratives, and both must vary appropriately per platform, per topic, etc.

With these criteria in hand, we can evaluate several approaches to data construction for training purposes. Major data approaches include the harvesting of real data, the hand alteration of harvested real data, the automated alteration of harvested real data, the bespoke creation of synthetic data, and using real-world data to scaffold the creation of synthetic data. In general, these represent gradient lines on a spectrum and are not meant to be comprehensive of all approaches.

In looking at these approaches against the criteria, we can evaluate their suitability for training. Real data is inflexible in its ability to adjust to changing training requirements or objectives. It is highly unlikely that the exact event required for training happened at exactly the right time in a real-world scenario that enables collection of a suitable dataset. It is already focused on an event and/or topic - which may or may not fit within the confines of the training requirement. It is definitionally non-reactive and will never reflect the actions taken by the training audience. However, it is is scalable - just collect more - and the gold standard for realism from from both a network and narrative perspective. Hand altered real data is somewhat reconfigurable to meet training demands - however, doing so prevents any level of scalibility - it takes too long to alter large amounts of data - and the altering can reduce network and narrative realism. Automated alteration retains the benefits of hand altering but adds the ability to scale. Observed current synthetic environments are imminently reconfigurable and scalable but output unrealistic networks and weak narratives. These trade-offs are displayed in Table 5.1.

Toward this end, this thesis is concerned with using the analysis of real data to attempt to inform the construction of a tailored exercise scenario that includes defined actors, events, groups, and narratives to aid in the creation of synthetic data. The desired end result is a relevant, interactive, scalable, realistic dataset accompanied by corresponding products to enable training.

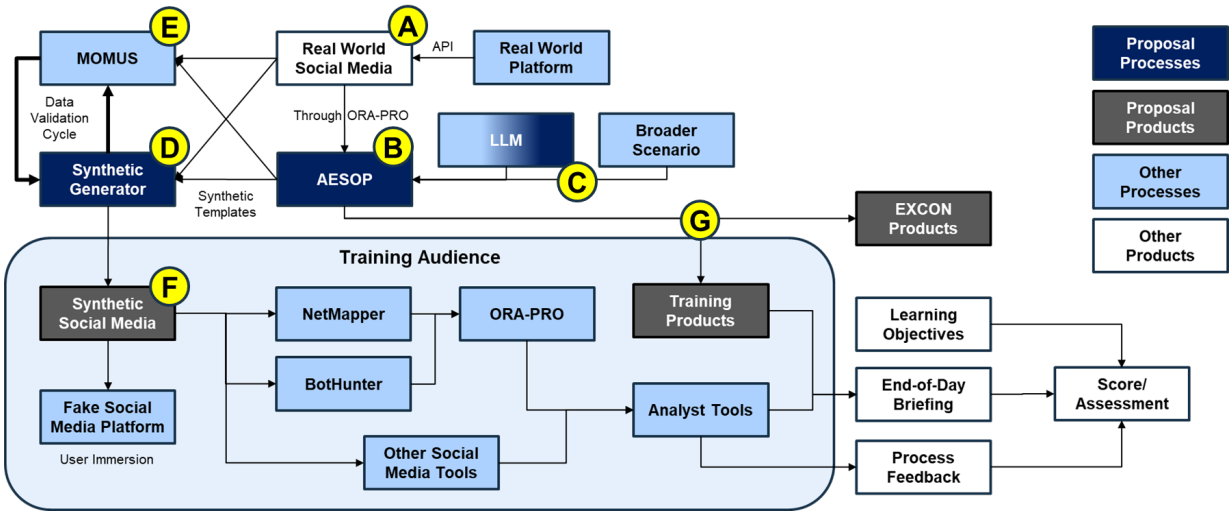


Figure 5.1: Project OMEN training flow.

In order to better understand how this might be accomplished it is helpful to look at the overall flow of an example training exercise. Fig. 5.1 shows the Project OMEN training flow - this training flow is generalizable to any social media analysis exercise.

- A) Real-world data is pulled from a social media platform using approved APIs and without violating the terms of service.
- B) Important network and narrative characteristics are drawn from real-world social media data using ORA-Pro. These characteristics are passed to a scenario planning tool called AESOP (AI-Enabled Scenario Orchestration and Planning).
- C) A scenario planner uses AESOP in conjunction with their understanding of the training objectives of the training audience to construct a scenario. AESOP leverages large language models to fill in the gaps between real-world characteristics and the desired scenario.
- D) AESOP outputs templates for actors, groups, events, narratives, and new stories that are passed to the synthetic generator. These templates represent both the ”needles” and the ”haystack” for the training scenario. The synthetic generator uses these templates to generate social media traffic - ostensibly creating the ”needles” and hiding them in the ”haystack.”
- E) The synthetic social media is passed to an automated evaluation system for scoring. In this case a Netanomics system called MOMUS. There is a cycle of validation as the synthetic generator iterates against evaluation system - whether MOMUS or something else.
- F) The synthetic social media is given to the training audience for training. The training audience uses tools to analyze the data - hopefully finding the ”needles” within the ”haystack.”
- G) AESOP also outputs two sets of documents along with the scenario templates. The two sets of documents are a list of events and hosted websites for exercise control personnel

and a set of baseline documents for the training audience that act as a breadcrumbs to orient them to the ”haystack.”

The scenario planning tool (AESOP) and the synthetic generator were constructed completely for this thesis. Outputs from work done as a part of this thesis include synthetic social media corpora, products for the training audience, and products for the exercise controllers.

5.3 AI-Enabled Scenario Orchestration and Planning (AESOP) Tool

AESOP allows Information Environment planners to develop social-cyber exercise scenarios from scratch or develop social-cyber vignettes for integration with existing scenarios. It is a standalone program coded in Python with a PySide6 GUI.[70] While AESOP was developed with US military exercise scenario development in mind, the principles and the tool can be applied to a wide swathe of exercises, including scenarios involving the health sector, emergency response, law enforcement, COOP and disaster recovery, etc.

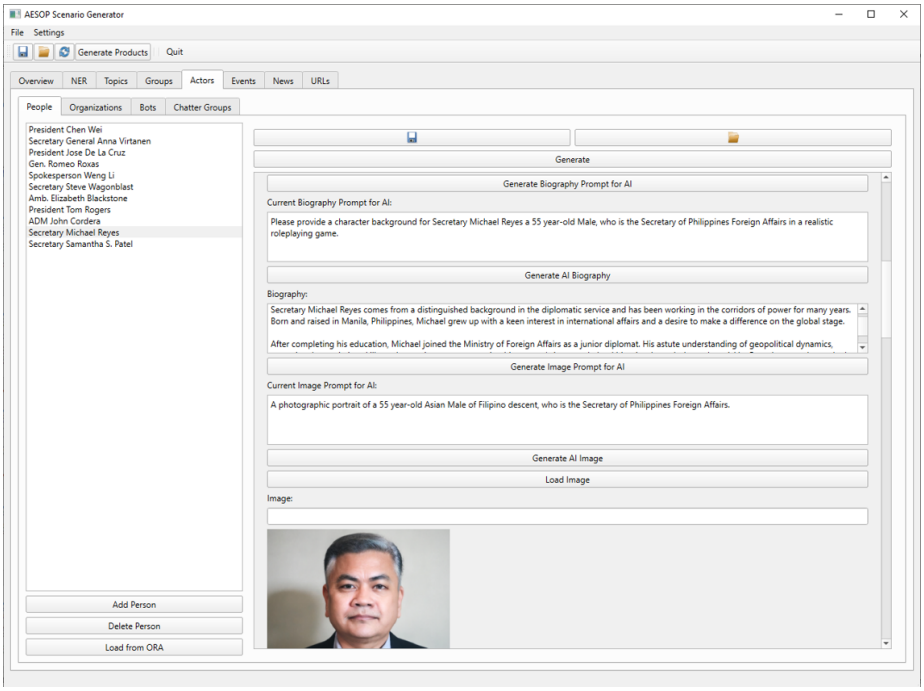


Figure 5.2: AESOP GUI Example. With an actor template being worked on.

AESOP leverages large language models (LLMs) to reduce planner load and increase realism and immersion for the training audience. Planners complete basic fields – such as date ranges and summaries – and AESOP develops an engineered prompt for a configurable LLM that is used to generate surrounding details. Planners can make additional changes to the prompt as required. Planners can also freely manipulate the details returned by the LLM. By default, AESOP reaches out to the OpenAI API[65] and uses a GPT4o mini model (gpt-4o-mini) for text and DALL-E

model (dall-e-2) for images. However, it is configurable to run against any LLM provider that has an OpenAI compatible API - such as the popular oogabooga/text-generation-webui.[64]

AESOP is primarily a tool for planners. "Planners" here is a catchall term for individuals participating in exercise design, exercise planning, and exercise preparation – AESOP helps with all three. In a military setting planners have training in defining the purpose, objective, and scope of a scenario, developing the overall exercise concept, and creating and aligning exercise injects to that concept. This means that they will necessarily bring some level of expert bias into the planning – and therefore to AESOP. Planners have both extrinsic assumptions – e.g. adversary playbooks and doctrinal templates – and intrinsic assumptions – e.g. cultural biases – that they will inject into the scenario. AESOP is not designed to combat this expert bias and without consideration may give planners additional tools (LLMs) to exacerbate them. For this reason, using scaffolding tools like AESOP should bring with it an increased focus on combatting undesired biases.

Planning a social media exercise is a complex topic that is beyond the scope of explanation for this thesis; however, understanding the basics is not difficult. The social media scenario will need non-training audience entities - sometimes called non-player characters (NPCs) - within the environment. The planners will want events to happen in the scenario in a time-sequence that is set or managed by the planners. The NPCs should hold opinions of their own on these events - and they should act based on these opinions. A social media scenario needs people (WHO) interacting about things (WHAT) in a certain way (HOW). The training audience will need to analyze the WHO/WHAT/HOW in order to intervene appropriately. There is obvious complexity missing from this brief explanation - the embedding of WHEN within both the WHO and the WHAT - the blending of the WHY with HOW, etc. But the WHO/WHAT/HOW explanation is sufficient to understand what is required for a scenario. To support scenario creation, therefore, AESOP is broken down into these three areas.

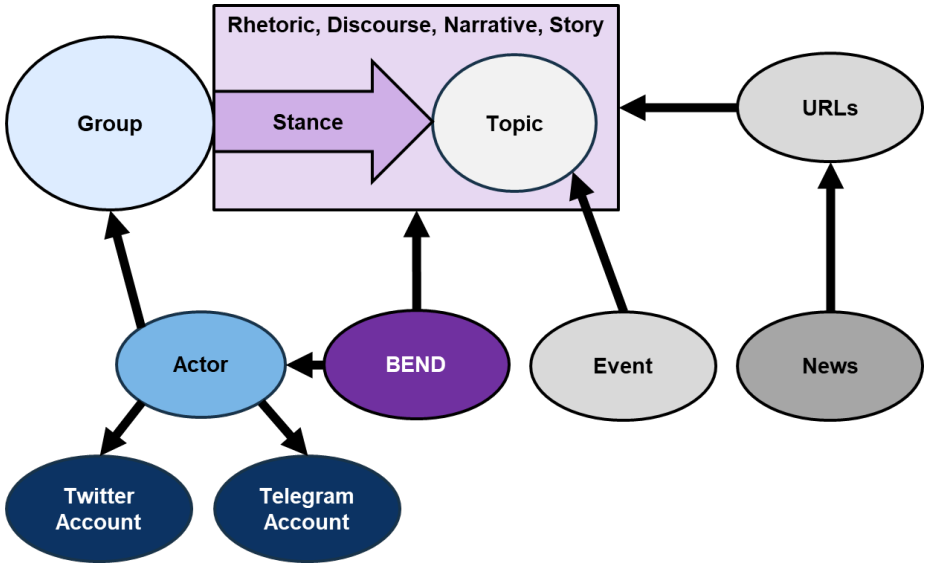


Figure 5.3: AESOP Relational Diagram. Blue is loosely defined as the WHO, purple is HOW, and gray is the WHAT.

Actors

The WHO area includes groups, actors, and accounts. Actors are the independent actors within a scenario - this includes individual persons, organizations, and bots. These actors have names and biographies, cross-platform identity markers that distinguish them, and they have individual proclivities for certain BEND maneuvers.

Person

- Name
- Leader Type [Political, Military, Organizational, Other]
- Title
- Organization
- Gender [M, F, Other]
- Race
- Nationality
- Age
- Entourage [Other Actor or Create New to establish relationships]
- Description
- Biography
- Image

Organization

- Type [Government, News, Corporation, NGO, Political, International, Armed Forces, Charity, Non-Profit, Education, Interest-based, Other]
- Organizational Leader
- Description
- History
- Image

Each organizational type also populates a sub-list of attributes that are not enumerated here.

Bots

Bots mimic either a person or an organization so they each include one set of the above attributes as well as:

- Type [Amplifier, News, Bridging, Repeater, Spam, Other]

The type then drives additional entries. For instance, a News bot has:

- Type of News [Regional, Industry, Political, Weather, Other]
- News Aggregator or News Producer
- Pink Slime
- Multiple Sources

- Retweeted accounts
- Common mentions
- Common places
- Keywords
- Hashtags

While this represents a large number of fields, AESOP scaffolds planners by filling in most of an actor's information based on just a few fields. Planners generally only need the first few fields (name, age, race, etc.) and a one-sentence characterization of the actor and then AESOP leverages a large language model to complete the rest, including biographies and images. This is done through the use of intelligent prompting similar in concept to the children's fill-in-the-blank game Mad-Libs. These prompts are visible to the planner and configurable/editable if the default mad-lib prompt provides suboptimal results.

Finally, in order to support dynamic changes and interaction with the training audience, each actor has an Actor Topic Map (ATM). The ATM is a vector with a length equal to the number of topics (defined later in this chapter) and an opinion value fro each from -5 to 5 approximating a Likert scale of approval for each topic.

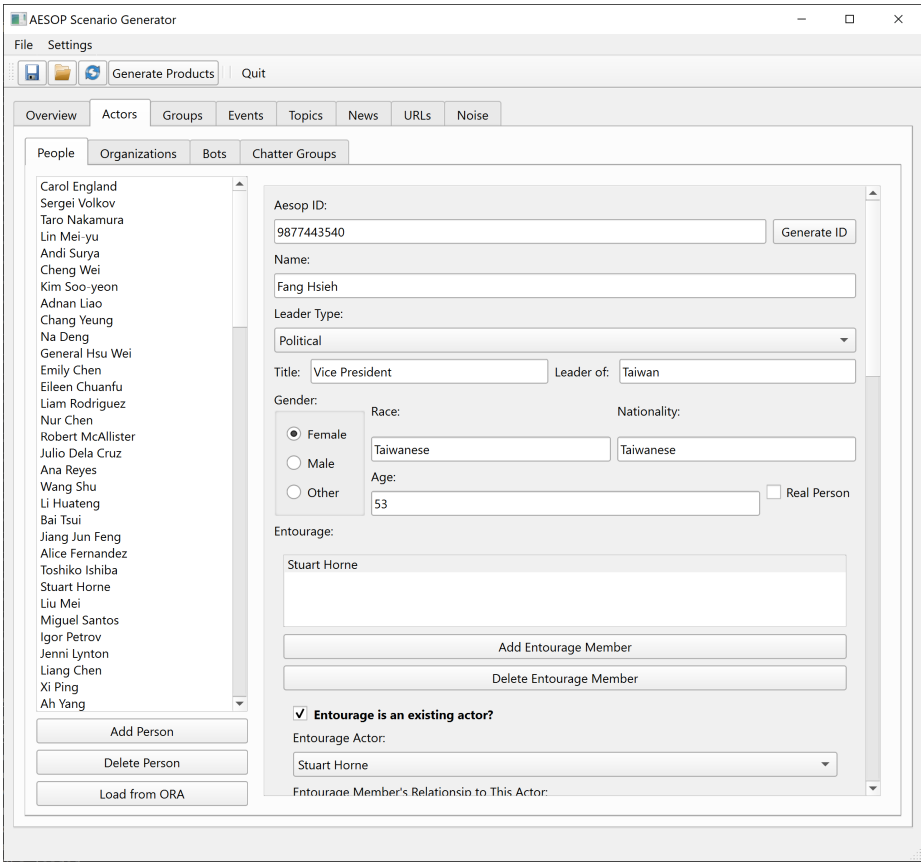


Figure 5.4: AESOP GUI for Actor creation.

Accounts

Each actor is tied to one or more accounts. These accounts represent that actor's presence on a social media platform. AESOP supports the creation of both X/Twitter and Telegram accounts with shells for Facebook and Reddit accounts.

The full enumeration of what AESOP outputs for each account can be found in the data standards annex. As a representative example, this is a sample list of the fields for a X/Twitter account:

- Twitter ID
- Username
- Active dates
- Bot status
- Verified status
- Tweet distributions per day
- Account creation date
- Number of followers
- Number of following
- Number of original tweets per day
- Top topics
- Number of mentions per tweet
- Accounts to mention
- Number of retweets per day
- Number of quotes/replies per day
- Number of hashtags per post
- Top hashtags
- Top words
- Account daily active period
- Percent of tweets/retweets that are Positive/Negative/Neutral in sentiment
- Ratio of Text/Images/Video
- Additional identity markers unique to the platform

Again, this many decisions would be daunting for exercise planners - especially since, within the DoD, such planners are not expected to have any social media experience. AESOP scaffolds planners here as well. There are three options. Option one is default entries - AESOP prefills everything except the username with intelligent averages. The Twitter ID is auto-populated with a Snowflake compliant identification number, the active dates default to the active dates of the overall scenario, account creation is set to random dates before the beginning of the exercise, etc.[76] For a general account this option might be good enough.

Option two is to load an actor from ORA. The planner can use a real-world data set in ORA and export a Node of Interest Characterization report for a node that they want to replicate within the scenario. This exported file can be loaded into AESOP and will create an account with all fields populated to match the original real node - except the Snowflake ID, username, and active dates. This is most helpful for planners that want a certain character that has an archetype readily available in a real dataset.

The third option is to load a corpus of data directly into AESOP. For X/Twitter this would be an API v1 JSON file containing the desired tweets. AESOP will process these tweets with Latent Dirichlet Allocation (LDA), statistical analysis, and LLM summarization calls to fill out all of the information as an average of the input data.[17] Again, except for the Snowflake ID, username, and active dates. In this way, planners are scaffolded towards defaults or choosing particular archetypes for their characters rather than creating bespoke accounts based upon platform-specific knowledge which they generally will not have.

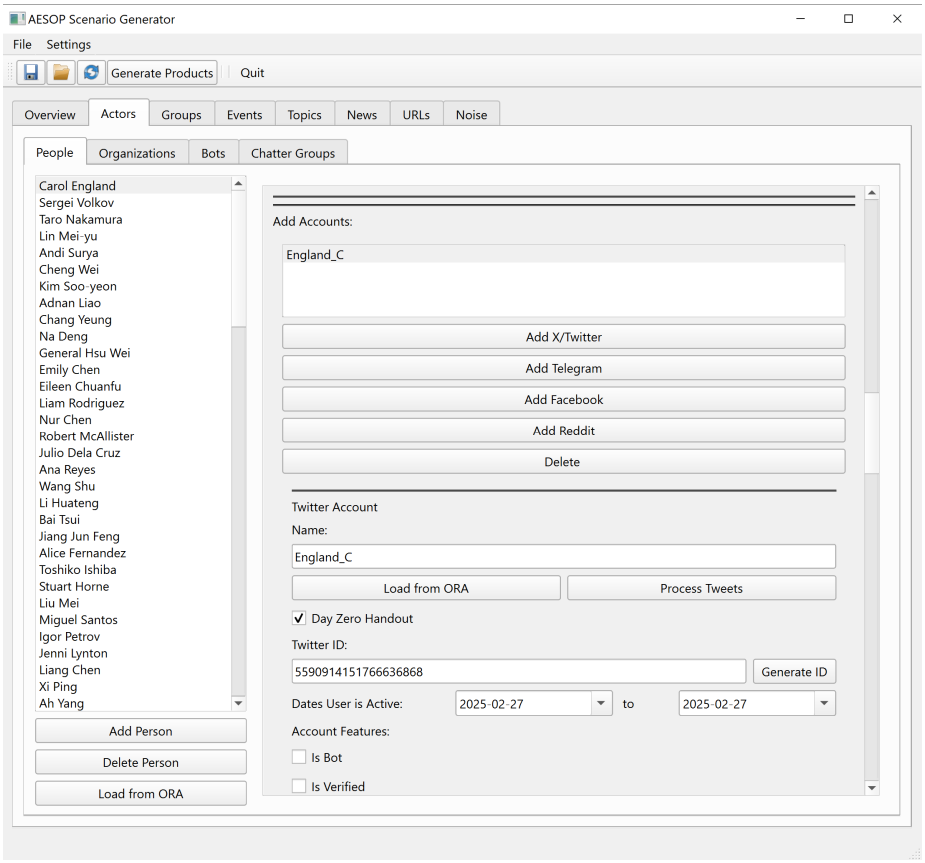


Figure 5.5: AESOP GUI for Account creation.

Groups

Groups are how a planner organizes actors (not accounts). Actors are a part of groups in one of three ways - full member, source-only, or leader. If they are a full member, then they espouse

the values and conduct actions in accordance with that group. If they are source-only, then full members of the group will repost, quote, or reply these source-only actors but the source-only actors themselves do not necessarily espouse the narratives of or act in accordance with that group. Actors can also be leaders of group - this distinction can only be given to actors that are also full-members and is to mark those actors that are the leaders of a group. Actors can be members of any number of groups and both full members and source only can be other groups - allowing for recursive placement for actors.

Groups also have a Group Topic Map (GTM) that is equivalent to the Actor Topic Map - a vector with a length equal to the number of topics and an opinion value from -5 to 5 for each topic. This represents the initial position of the group on each topic. Associated with the GTM is the group's Topic-to-Topic Map (TTM). This is a matrix of topics against topics (defined later in this chapter) with values ranging from -1 to 1 that represent the conflated relationship between two topics for this group. This matrix helps synthetic generation entities understand the relationship between topics within this group.

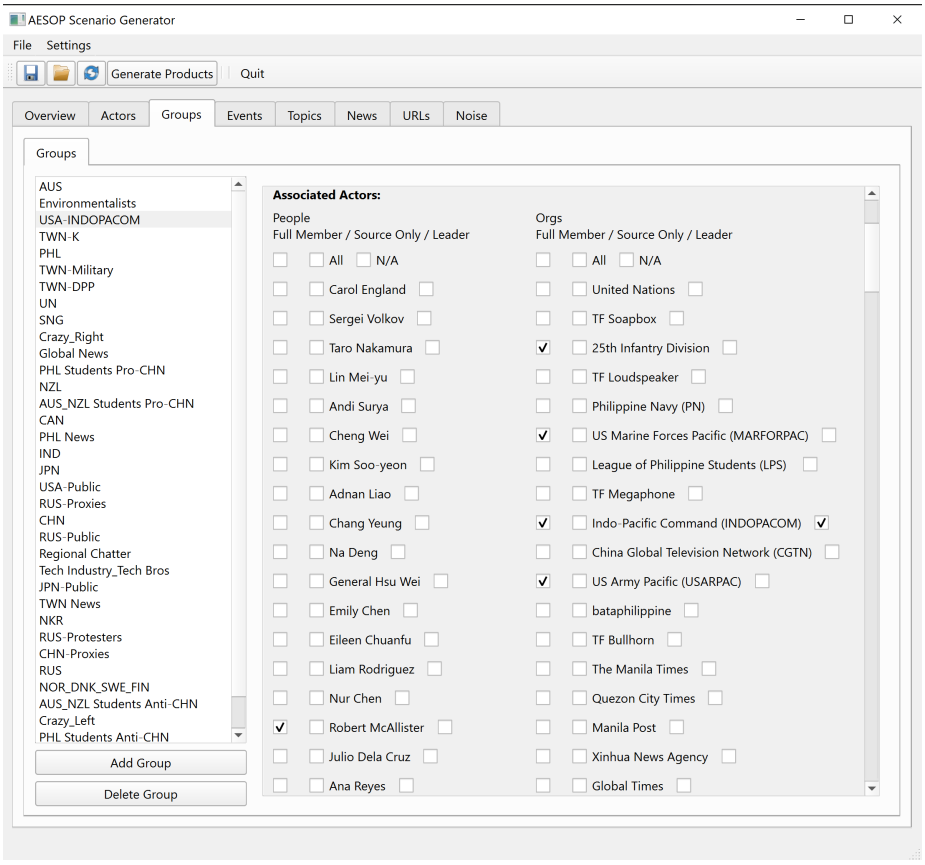


Figure 5.6: AESOP GUI for Group creation.

Events

The WHAT category includes Events, Topics, News, and URLs. Events are the simplest to understand. Planners require a way to dictate what happens during the course of an exercise -

these are called events. Each event is generally a purposeful attempt by the planner to solicit action on the part of the training audience.

Event

- Event name
- Type [NATO event, Health Crisis, Election, Climate Event, Conflict/War, Military Event, Diplomatic Event, Other]
- Excitement Level
- Event Start
- Event End
- Other countries involved
- Regions/Areas involved
- Event Leader information
- Postive Hashtags
- Negative Hashtags
- Event Purpose/Summary
- Event Description
- Event Image

Upon selection of the event type, a large number of additional fields are available for input. As an example these are the additional fields for a military event:

Military Event

- Lead nation
- Involved services
- Lead service
- Leaders rank
- Other involved countries
- Live Fire Exercise

In general, planners are more concerned with the name of the event, the start and end times, the purpose of the event, and the level of excitement. Almost everything else can be auto-filled by the large-language model. The excitement level in particular is important. Ranging from 1-10, this value acts as a cue to the synthetic generator for how impactful this event should be within the generated data - determining how often this event is discussed in comparison to other concurrent events and if actors/accounts should take more actions than usual while this event is occurring.

Events are also where planners can specify additional injects into the exercise that are related to that event. There are four major types of inject - Intelligence Summaries, Fragmentory Orders, Press Releases, and Other. An Intelligence Summary (INTSUM) is developed as an inject when the planner wants to provide additional information along with an artifact to the training

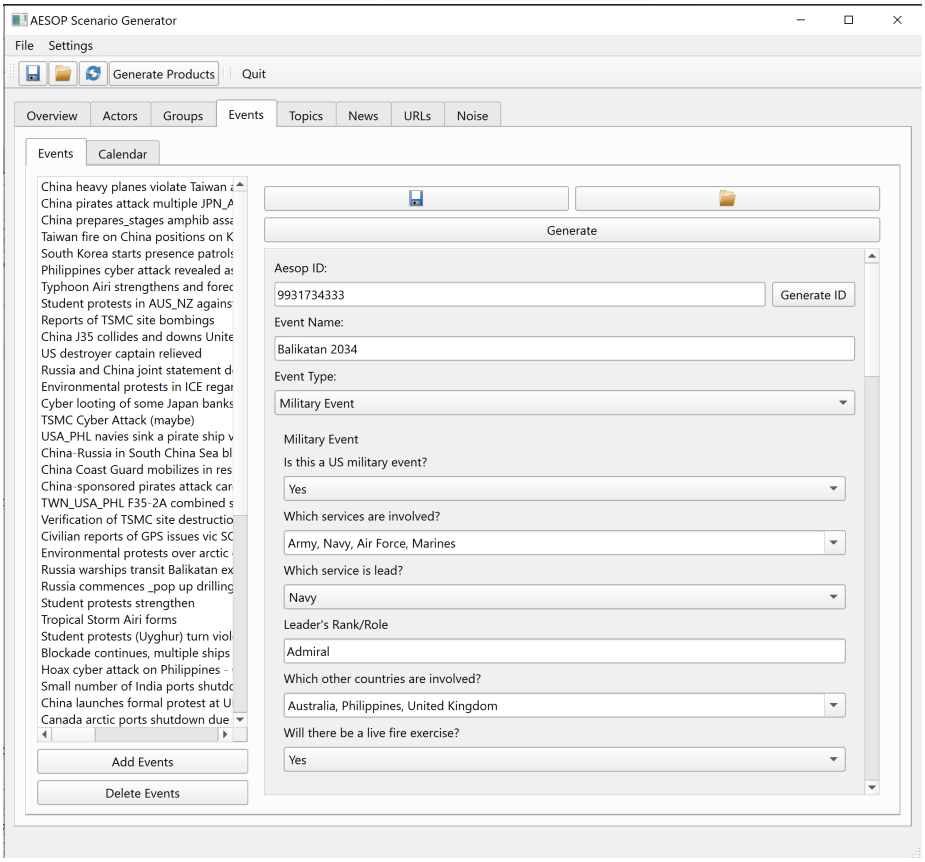


Figure 5.7: AESOP GUI for Event creation.

audience during the exercise scenario. For instance, if the training audience requests additional information about an account from the exercise controller, then the account information might be furnished to the training audience along with a corresponding INTSUM. A Fragmentory Order (FRAGO) is developed as an inject when the planner wants to forcibly redirect the training audience's attention or efforts. This is most often done to ensure the training audience conducts actions in accordance with a training objective. Within the US military a FRAGO is an amendment to an existing Operations Order; however, the concept can be applied to any incremental change of mission - even outside of military exercises. A planner develops a Press Release in order to help draw the attention of the training audience to an important event in a more subtle way - they are exactly what they sound like - a Press Release from a specifed entity that discusses recent events. The Other type inject allows for the planner to freely interact with the LLM and develop whatever event-related product they might want to pass to the training audience - including more conventional cyberspace maneuvers. Surprisingly, both the OpenAI models and locally run LLM display a very good understanding of INTSUMs, FRAGOs, and Press Releases and little prompt engineering is required of the planner except to click a button adding the inject and requesting the LLM to fill out.

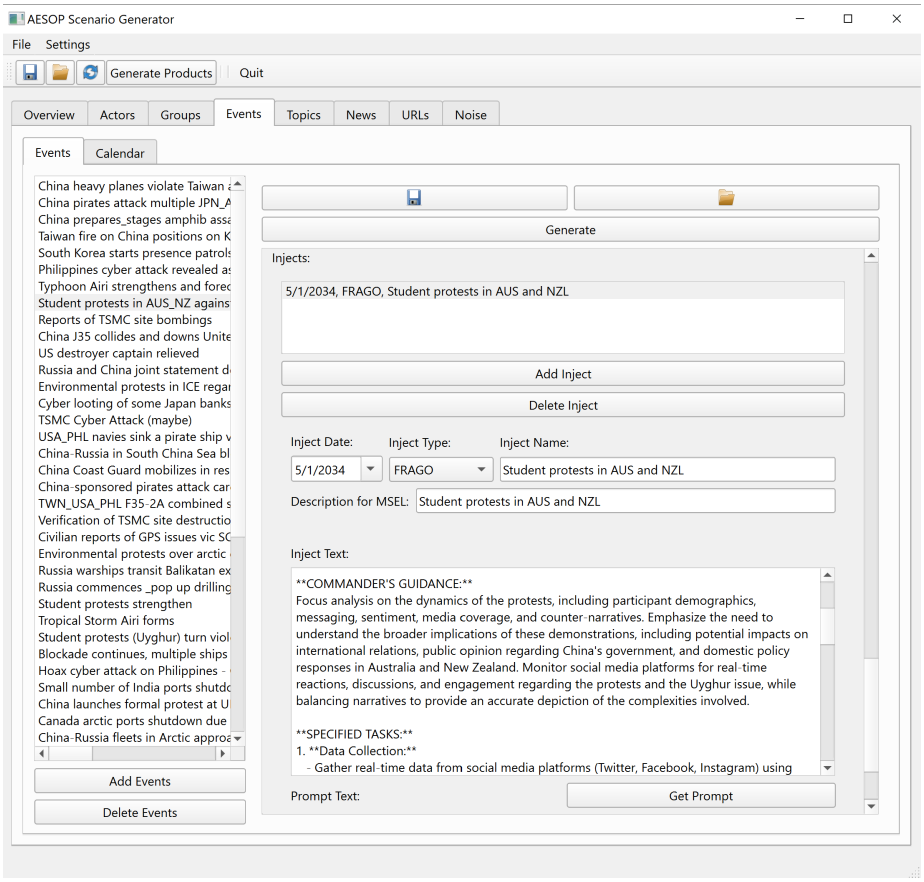


Figure 5.8: AESOP GUI for Inject creation.

Topics

Topics are high-level opinion statements that are relevant to the scenario or the training objectives of the training audience. Example topics are: Balikatan is good for the Philippines, US intervention in the South China Sea has been good for the region, US anti-piracy actions have been ineffective and dangerous. Topics themselves have relatively few attributes.

Topic

- Topic name
- Associated hashtags
- Topic description

However, topics are where narratives are added to the scenario. Narratives are added beneath each topic. In this case, a narrative is defined as messaging or discourse that reflects a particular stance on a topic. For instance, if the topic is ”Dogs make the best pets” - a pro-narrative might be ”Dogs are the most loyal of all domesticated animals” and an anti-narrative might be ”Dogs chew everything and are destructive pets” - they each represent a stance on the topic as well as a distinct message. Narratives are where planners will spend most of their time. They need

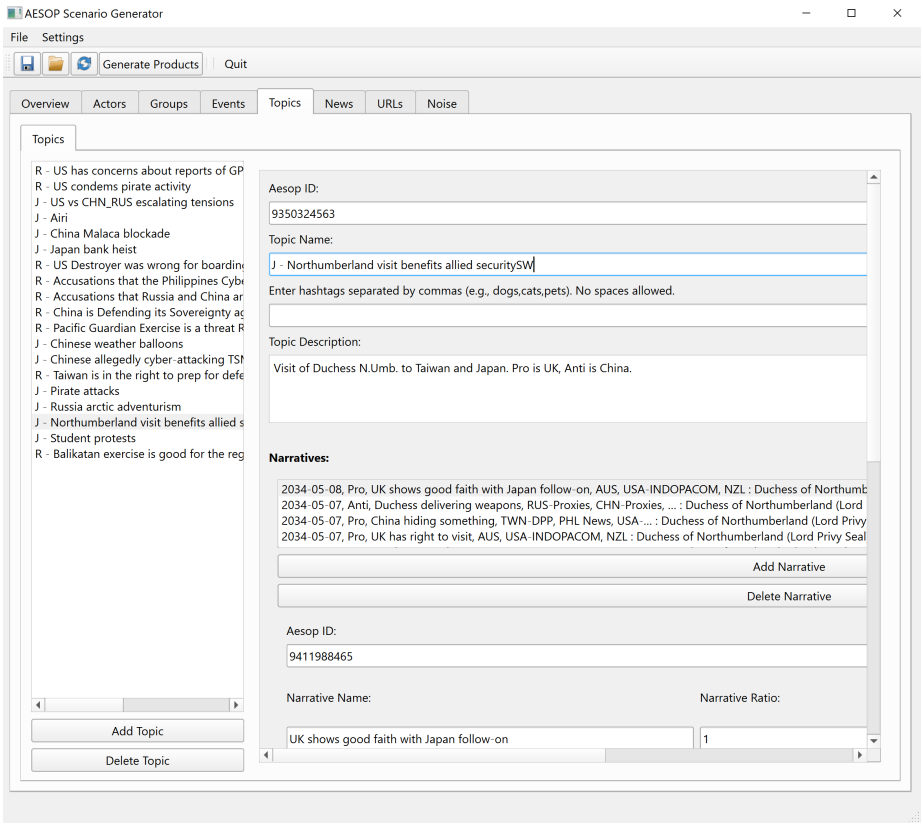


Figure 5.9: AESOP GUI for Topic creation.

to select topics that are required by the scenario and make sense to the training audience and then develop pro- and anti-topic narratives that reflect the stances of various NPCs within the scenario. Most often there are multiple pro- and anti-narratives for every topic that reflect the disparate groups engaging with each other in the scenario.

Narrative

- Narrative Name
- Narrative Ratio
- Topic Stance [Pro, Anti, Neutral]
- Associated Groups
- Associated Events
- Hashtags
- Narrative Description
- Example Messages

Narratives are the bridge between the WHO (groups, actors, accounts) and the WHAT (events, news, URLs). Each narrative is associated with one or more groups that espouse it and also zero or more events that are linked to that narrative. A group linked to a narrative means that mem-

bers of that group will propogate that narrative. An event linked to a narrative means ties that event's excitement level to the narrative - influencing how often group members use that narrative through time.

Therefore, while the topics themselves are firmly in the WHAT category, these narratives encompass the HOW. Indeed, each narrative also includes a set of BEND maneuver preferences expressed as ratios that set the likelihood of those maneuvers being a part of that narrative's messaging.

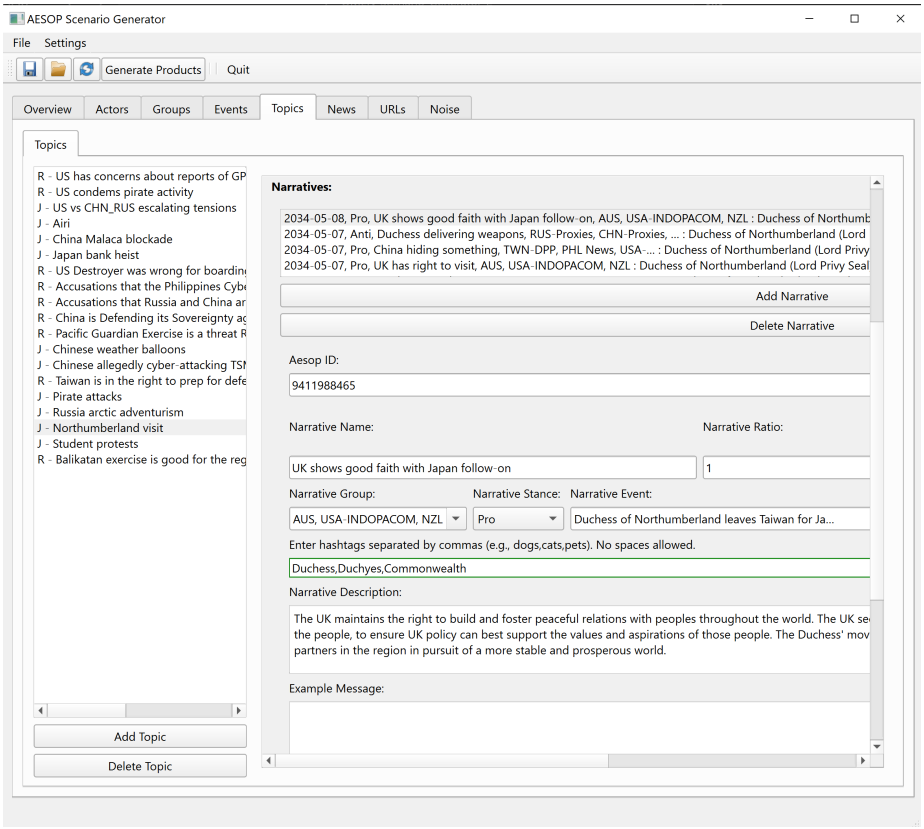


Figure 5.10: AESOP GUI for Narrative creation.

News

In general, planners have now constructed who will be taking about what and how - but there are more supporting details required for robust and immersive training. In particular, messages rarely exist without corresponding news articles, images, memes, or other multimedia. AESOP provides planners the ability to create and connect news articles into the scenario. AESOP's News tab is where planners create news agencies, their websites, and these corresponding articles. These articles provide both immersion and additional avenues for information transfer to the training audience.

News Agency

- Agency Name
- Agency Type [Real News, Pink Slime, Disinformation, Other]
- Available date range
- Editor
- Home country
- Targeted regions
- Bias [Extreme Left, Left, Center Left, Center, Center Right, Right, Extreme Right]
- Credibility [Low, Medium, High]
- Questionable Characteristics *[Conspiracy Theories, Pseudoscience, Propaganda, Poor Sources, Failed Fact Checks]
- Summary
- History

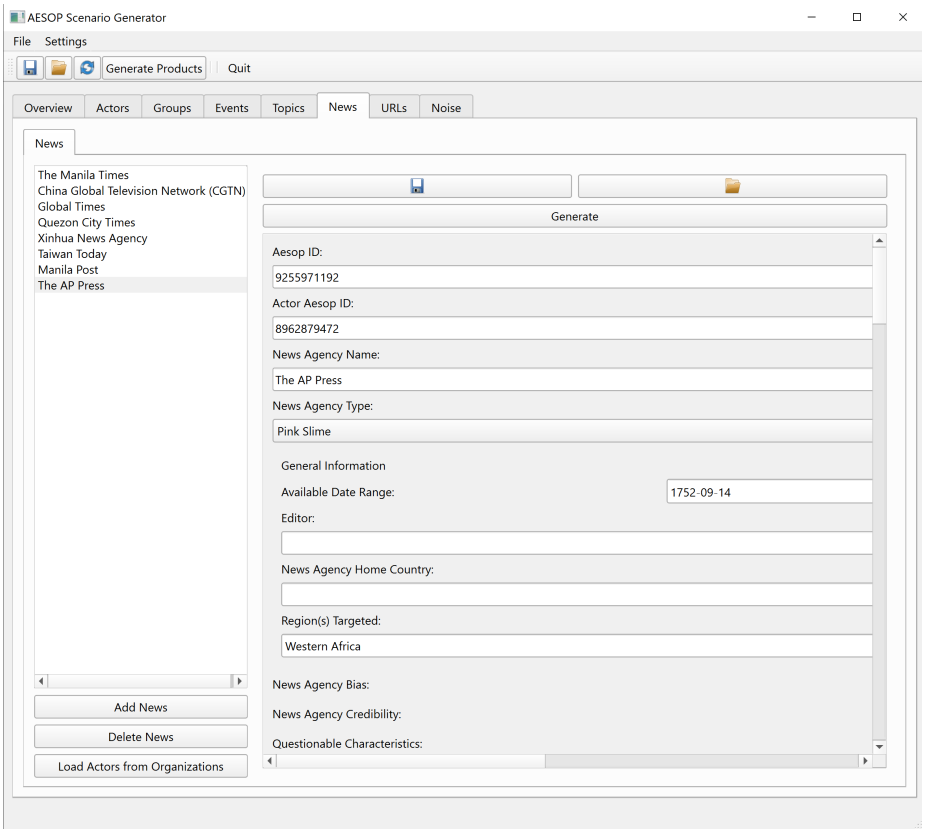


Figure 5.11: AESOP GUI for News Agency creation.

Individual articles have the following properties:

Article

- Media Type [Real News, Pink Slime, Disinformation, Other]

- Article Topic Category [Industry, Health, Political, Ideas, Social, Lifestyle, Cultural, Awards, Education, Community, Other]
- Publication Date
- Headline
- URL
- Associated Narratives
- Author
- Targeted Region
- Article Bias [Extreme Left, Left, Center Left, Center, Center Right, Right, Extreme Right]
- Article Credibility [Low, Medium, High]
- Agency Type [Real News, Pink Slime, Disinformation, Other]
- Available date range
- Editor
- Home country
- Targeted regions
- Bias [Extreme Left, Left, Center Left, Center, Center Right, Right, Extreme Right]
- Credibility [Low, Medium, High]
- Questionable Characteristics *[Conspiracy Theories, Pseudoscience, Propaganda, Poor Sources, Failed Fact Checks]
- Number of Paragraphs
- Summary

AESOP supports the individual creation of both news agencies and their associated articles. However, if planners have already created an Actor that is of the type News Agency, then AESOP provides a push button capability to auto-create a matching news agency for every Actor of that type. Additionally, if the planner has already completed the Groups, Events, and Topics, then AESOP can auto-create articles for every narrative and event combination corresponding to the news agency actor's group membership. In this way, large numbers of appropriate articles can be quickly created to support the scenario without intervention from the planner.

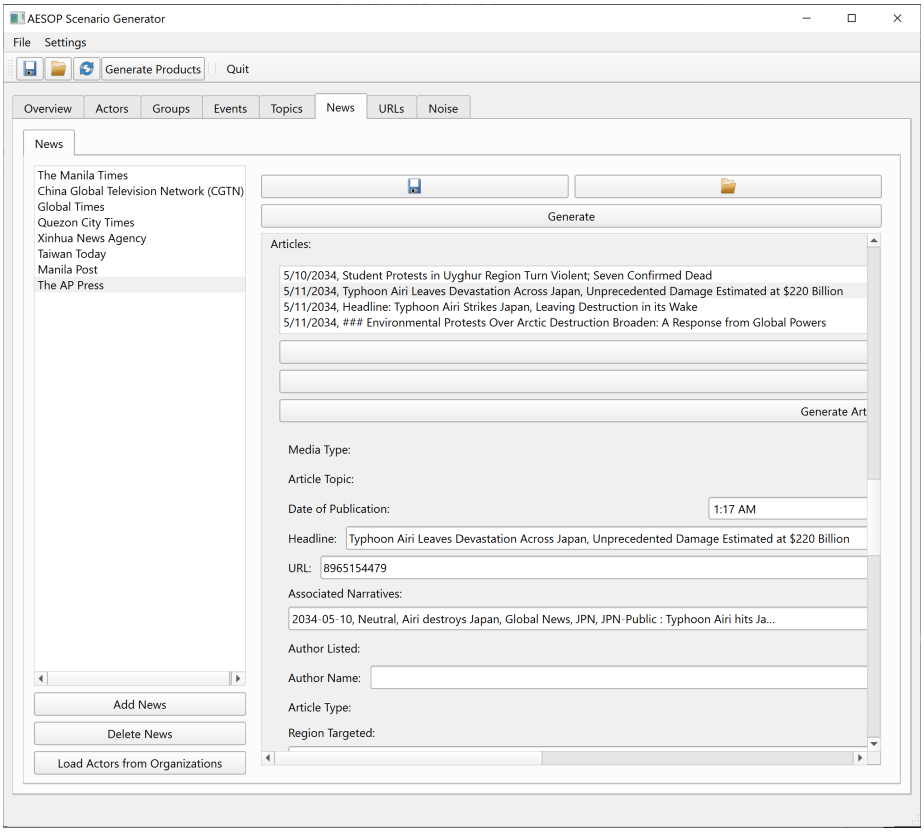


Figure 5.12: AESOP GUI for Article creation.

URLs

Finally, planners need to provide URLs for all media that can be referenced by NPCs within the exercise scenario. For news articles, AESOP will auto-populate a URL for each of the news articles. However, for externally created videos, images, and other multimedia, planners will need to create URL entries, choose the dates when the media is available for reference, and decide what narratives are associated with these media. AESOP does not host any of this media.

URL

- URL
- Date Available
- Type [SITE, IMAGE, VIDEO, OTHER]
- Associated Narratives
- URL description

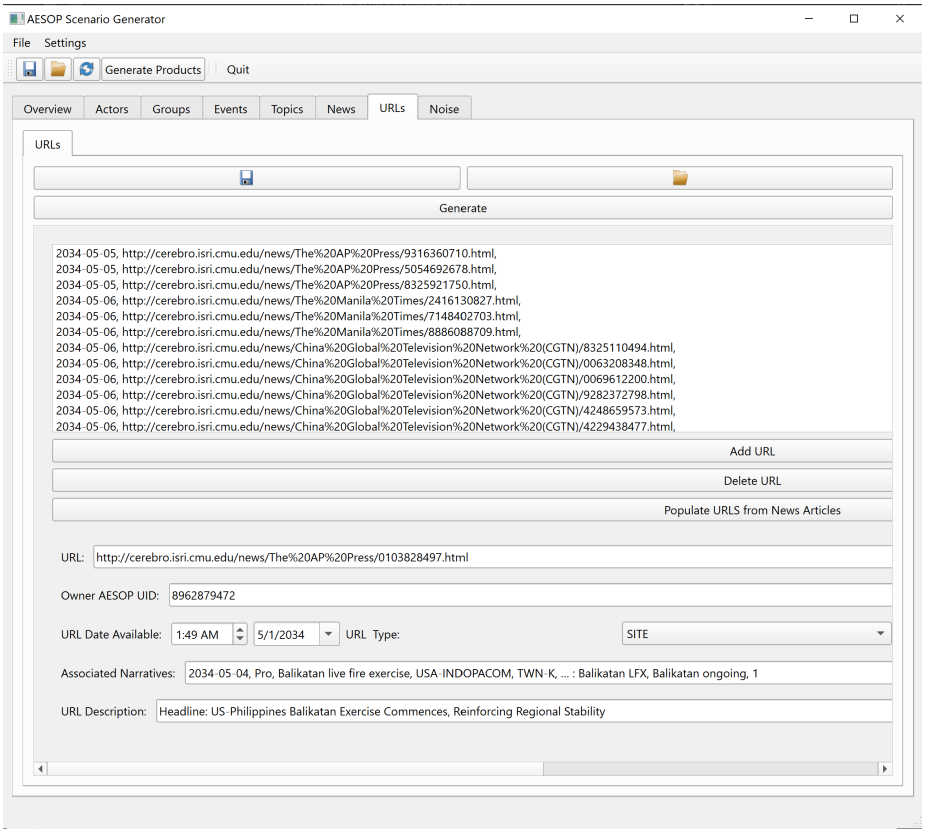


Figure 5.13: AESOP GUI for URL creation.

Noise

Thus far, planners have concerned themselves with what can be thought of as ”the needles” - these are what planners want the training audience to respond to. AESOP’s noise tab is where the planners define the ”the haystack” - the background noise from which the training audience needs to glean the needles. In its current state, this tab is primarily concerned with X/Twitter noise. Planners need to determine the correct number of overall messages for the haystack, where these messages come from, and the date range for the messages. Additionally, because AESOP is trying to facilitate realistic training, it is important that planners consider what imaginary search terms were used to pull from the X API to get the needle + haystack dataset. This lets synthetic generators know what topics should be present in the dataset and prevents completely spurious data from being present.

Noise

- Total messages
- Noise locations
- Date range
- Search terms
- Additional notes

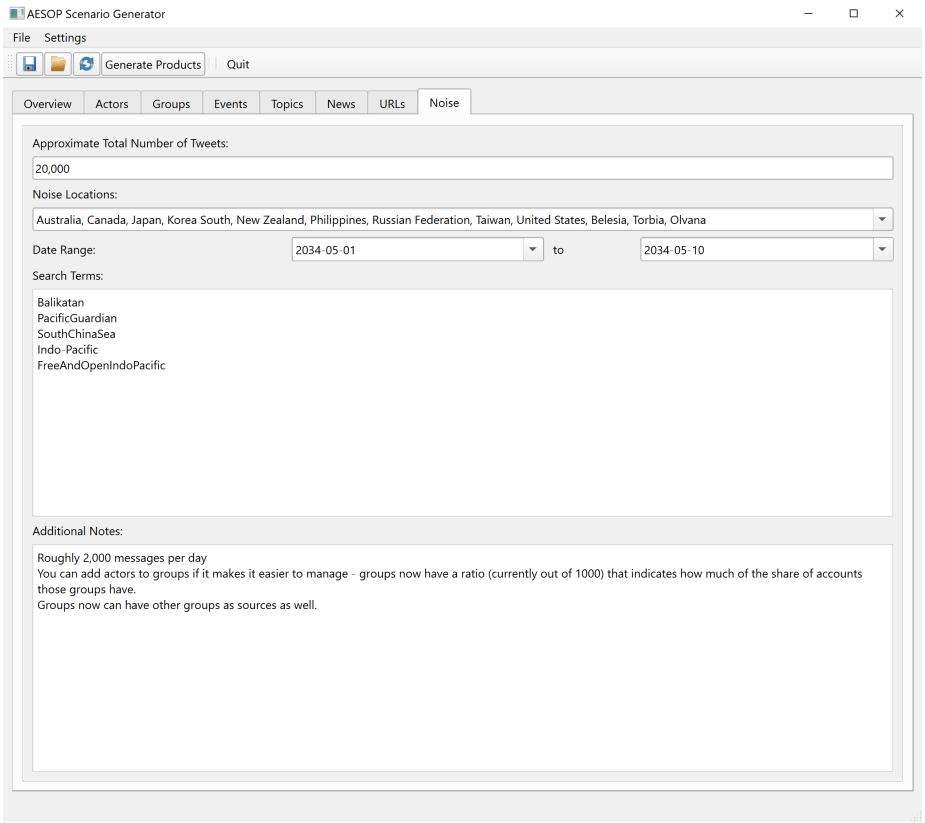


Figure 5.14: AESOP GUI for Noise creation.

5.4 AESOP Outputs

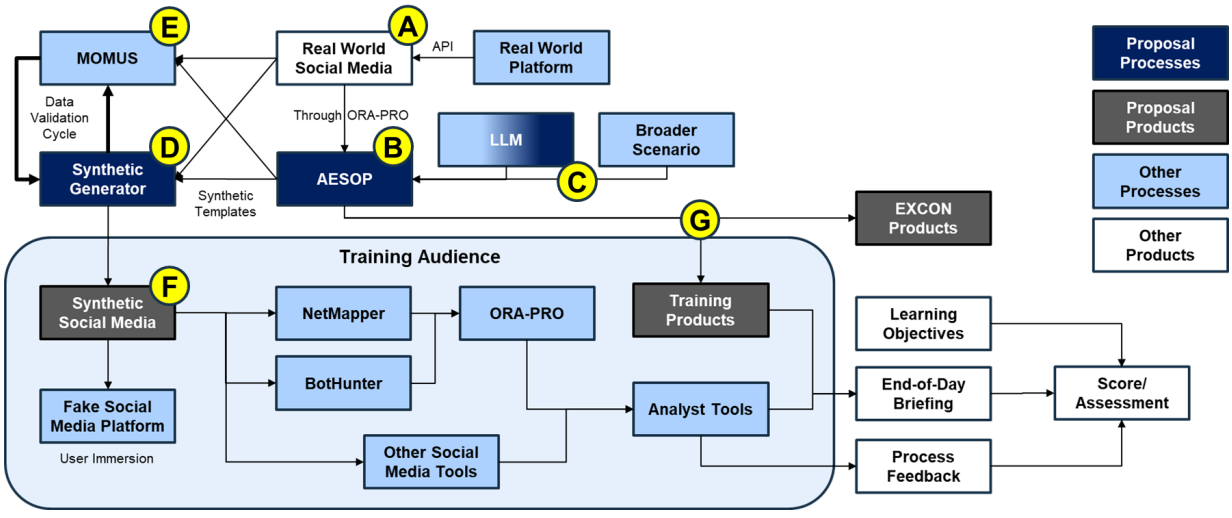


Figure 5.15: Project OMEN training flow.

After completing scenario construction within AESOP (B in Fig. 5.15), planners use AESOP to generate two main components. They generate synthetic templates for consumption by synthetic generators (D in Fig. 5.15) and generate products for the training audience and the exercise controllers (G in Fig. 5.15). These are two very different products. The products for the training audience and exercise controllers are meant to be artifacts for inclusion in the actual exercise. As such, they come in formats that should be familiar: MS Word Documents and MS Excel spreadsheets. As a bonus, AESOP can apply cover pages, security release footers, and custom formats to all of these ”paper” products. These documents are output in separate folders designated for either the training audience or exercise control. Examples of these products can be found in Appendix **??**

Standard (Acronym)	Purpose	Key Components	Primary Use Case	Data Format	Adoption	Website Reference
Structured Threat Information Expression (**STIX**)	Cyber threat intelligence, tracking actors, events, and campaigns	Identity, Threat Actor, Campaign, Incident, Observables	Tracking cyber threats, disinformation campaigns, and influence operations	JSON, XML	Cybersecurity, threat intelligence, law enforcement	https://oasis-open.github.io/cti-documentation/
Activity Streams 2.0 **(AS2)**	Social media activity representation	Actor, Object, Verb, Target, Group	Modeling social media interactions and behavioral dynamics	JSON-LD, ActivityStreams format	Decentralized social media platforms and Web3 applications	https://www.w3.org/TR/activitystreams-core/
Friend of a Friend **(FOAF)**	Describes social relationships and online identities	Person, Group, OnlineAccount, Knows	Semantic web applications and social network analysis	RDF (Resource Description Framework)	Semantic web, academic research, social network modeling	http://xmlns.com/foaf/spec/
Semantically-Interlinked Online Communities **(SIOC)**	Defines social media discussions and interactions	UserAccount, Post, Forum, Community, Topic	Online community tracking and engagement analysis	RDF, XML	Online discussion forums, enterprise knowledge management	https://web.archive.org/web/20220331224416/http://sioc-project.org/
Intelligence Community Information Resource Metadata **(IC-IRM)**	Intelligence metadata for information security, discovery, and analysis	Resource descriptions, classification, access control, XML/HTML encoding	Intelligence and national security data management	XML, HTML metadata	US Intelligence Community (IC)	https://www.dni.gov/index.php/who-we-are/organizations/ic-cio/ic-technical-specifications/information-resource-metadata
Unnamed Synthetic Social Media Scenario Data Standard **(USS-MSDS)**	Describes actors, events, groups, and narratives within a scenario	Actor, Account, Event, Group, Topic, Narrative, Article, URL	Communicating the structure and component of a social media scenario from the scenario planner to a synthetic generator	JSON	NONE	NONE

Figure 5.16: A comparison of related data standards.

The synthetic templates are not meant for the training audience or the exercise controllers, instead they are meant to define the scenario for the synthetic generators. To facilitate the transition of the planners intent as expressed in AESOP to the information required for the generation of that intent, I propose a data standard for synthetic social media scenarios. In general, it is a very bad idea to create new data standards.[59] However, there are no existing candidates within this space. Structure Threat Information Expression (STIX) has actor and event enumeration - similar to AESOP’s outputs; however, it focuses on cyber threat intelligence and the fields required for creating social media from the actors and events are missing.[62]. Activity Streams 2.0 also represents social media activity using an Actor format. Unfortunately, its focus is on providing a method for itemizing actual behavior rather than quantifying typical behavioral patterns needed for synthetic generation.[69] Friend of a Friend (FOAF) allows for the compact representation of an existing social network but it does not provide sufficient information for constructing or deriving new ones.[19]. The Semantically-Interlinked Online Communities (SIOC) standard is closer to what is required for synthetic generation but lacks definitions for the reasons (Events, Narratives) behind actions taken by its equivalent Account entity - UserAccount.[18] Lastly, the US Intelligence Community has a robust standard for metadata - the Intelligence Community - Information Resource Metadata (IC-IRM) standard. This standard in no way describes social media network components for use in synthetic generation. However, its broad adoption within the DoD, its extensibility, continuous development, and ever broadening scope mean that almost

all burgeoning data standards are compared to it.[63] The IC-IRM does not currently have any overlap with required components for synthetic data generation. The complete data standard used for the synthetic templates can be found in Appendix D.

A full list of AESOP outputs can be found in Table 5.2. The archive files are the save system that AESOP uses, the synthetic templates are set against the data standard, the EXCON column are the products furnished to the exercise control and the Participants column is for the training audience.

Needles, Haystacks, and Noise

A major consideration for the planner is the ratio of 'needles' to 'haystack'. Here the term 'needles' refers to the actors, narratives, and events that are critical for the training audience to track for analysis and the 'haystack' refers to the surrounding material within which these critical items are hidden. This is complicated by the fact that the scenario that AESOP is defining will go on through SynTel/X to produce a single corpus that represents a targeted API pull from a commercial platform. The haystack cannot simply be random – because no API pull should be getting random detritus – rather AESOP needs to specify haystack material that is at least tangentially related to the needles and therefore both could be conceivably pulled at once from a platform API. An example of this is found in the real-world Balikatan 22 dataset, where extraneous messages were pulled because "Balikatan" means literally shoulder-to-shoulder in Tagalog and some gym enthusiasts in the Philippines were using this same hashtag. Planners need to carefully select their haystack material to hide needles in a similar way.

Furthermore, once planners have found an appropriate haystack, they need to ensure that the ratio of needles to haystack matches the training objectives of their audience. If the training audience is in the crawl phase, then it might be appropriate to have very little haystack, whereas the haystack should grow if the training audience is in the walk or run phases.

The requirement for a larger haystack puts more pressure on the planner to creatively use AESOP. There is a "Noise" tab in AESOP that allows for planners to request from the synthetic generator how much haystack they want – it includes the search terms that this haystack should theoretically meet and the quantity – however, this puts a lot of burden on the synthetic generator. SynTel/X does not currently meet this burden and ignores this tab. This forces planners to imagine and develop the haystack within AESOP.

For the scenario created for this thesis, I – acting as the planner – created actors, events, and narratives that correspond to the haystack. I did this by recognizing that if you create enough needles you really can create a haystack. If you create enough important events – typhoons, cyber attacks, aircraft collisions, conspiracy theories – then each slice of the scenario is important to a part of the training audience but not all slices are equally important to all of the training audience. Therefore, while each aspect of the whole is important, taken altogether the corpus acts as noise/haystack for the individual parts. The infrastructure damage caused by a typhoon is important to the engineering and public affairs segments of the training audience but might be noise to the training audience segment looking for nefarious actors. Future work for SynTel/X should include developing methods for leveraging population models to quickly deploy additional appropriate haystacks and noise.

Safety and Ethics

In a Joint Cybersecurity Advisory released by the Federal Bureau of Investigation (FBI), the Cyber National Mission Force (CMNF), the Netherlands General Intelligence and Security Service (AIVD), Netherlands Military Intelligence and Security Service (MIVD), the Netherlands Police (DNP), and the Canadian Center for Cyber Security (CCCS), they accused Russian affiliated groups of using sophisticated AI-enhanced software packages to perform information maneuvers online. [37] The software package was called Meliorator - with a front-end called Brigadir and a back-end called Taras. Brigadir has tabs for "souls" - similar to AESOP's Actors - and "thoughts" - roughly analogous to AESOP's narratives. There exists some level of superficial similarity between Meliorator and AESOP. However, the Meliorator output through Taras includes code that creates and manipulates actual online accounts on live social media platforms in concert with fake personas. AESOP only outputs the characteristics of actors. There is no connection to any real world platform - no scripting, no scraping, no interface whatsoever. The purpose of AESOP is to enable the construction of training scenarios so that real-world interaction is not unnecessary.

5.5 Future Work

AESOP is an effective tool for quickly putting together a high-quality scenario. However, it is primarily an engineering solution with a simplified GUI skin. There are significant improvements that should be made in the future that would increase its functionality and would also increase planner's quality of life when interacting with AESOP. As priorities, the following should be accomplished first:

AESOP takes a grounded approach to scaffolding the planner with generative-AI. This approach works because AESOP is generally asking the LLM to provide generative material that is well-known or similar to well-known data the LLM has been trained on. LLMs have no issue making up backstories for politicians or providing details of fake ship collisions. However, as the capability of AESOP continues to expand, more advanced LLM techniques should be explored.

AESOP should be tied with retrieval-augmented generation (RAG) to limit hallucinations and provide additional support to the mad-lib method of prompt-engineering used to scaffold the planner. RAG would allow planners to rely upon a corpus of validated material to supplement the LLMs trained knowledge.[55]

AESOP might benefit from a two-stage method of requesting from the LLM. Stage one would look identical to the current request method but instead of asking for a response it would ask the LLM to format a better prompt based on this initial prompt. Stage two would involve passing the improved prompt back to the LLM for actual execution. Having an LLM reform the prompt first might help with the returned results and is an avenue that should be explored.

AESOP should allow for the quick integration of multiple LLMs for specialized purposes. Currently, the LLM is set at the global level within AESOP and this pushes AESOP toward using large generalized models - favoring commercial models over local LLMs. The ability for AESOP to operate with purely local LLMs does already exists but specifying multiple, smaller, specialized LLMs for agent creation versus journal/article writing versus press releases would

increase quality while still allowing for disconnected operation.

AESOP should also look at dynamically using low-rank adaptation (LORA) to mimic fine-tuning of a local model. When shifting to a local LLM – away from a commercial provider – AESOP should have access to trained LORAs (each) for press releases, operations orders, intelligence summaries, biographies, etc. This would allow for a smaller generalized local model to be run as if it has been fine-tuned for each process, effectively mimicking the capability of a much larger generalized model.[42]

Finally, AESOP should make good-faith efforts to help planners recognize and prevent undesired biases while facilitating desired biases. In the future, the ability to apply adversary playbooks and doctrinal templates can increase the accuracy and realism of the scenario – desired biases. Simultaneously, AESOP should integrate the ability to populate personas drawn from population modeling of a demographic. This would provide an effective method for determining the types of personas that are representative of a demographic, rather than relying upon the planner to select and fill these attributes by hand. This would eliminate some level of planner cultural biases or prejudices.

5.6 Conclusions

AESOP provides planner's a faster way of integrating social media scenarios into an existing exercise or training event. It also helps them plan independent social media exercises without high-levels of domain knowledge. This two fold reduction in effort - both in time and in requisite domain knowledge - represents a major step forward in social media exercise planning. Additionally, the use of a data standard means that as AESOP continues to grow and change - or is replaced by other planning tools - the connective tissue between the planner and the generation capability remains unsevered.

Table 5.2: AESOP Outputs and File Types

Feature	Archive File	Synthetic Template	EXCON	Participants
Agents				
People	JSON	JSON	DOCX	DOCX
Organizations	JSON	JSON	DOCX	DOCX
Bots	JSON	JSON	DOCX	DOCX
Telegram				
Account	JSON	JSON		
Channel	JSON	JSON		
Messages	JSON	JSON		
X/Twitter				
Account	JSON	JSON		
Messages	JSON	JSON		
Groups				
Group	JSON	JSON	DOCX	
Topics				
Topic	JSON	JSON	DOCX	
Narrative	JSON	JSON	DOCX	
Events				
Event Summary	JSON	JSON	DOCX	DOCX
Fragmentory Orders	JSON		DOCX	DOCX
Press Releases	JSON		DOCX	DOCX
Intelligence Reports	JSON		DOCX	DOCX
Other	JSON		DOCX	DOCX
News				
News Agency	JSON			
News Articles	JSON			
URLs				
URL	JSON	JSON		
Master Synch Event List				
Populated MSEL	JSON		XLSX	
Scenario Overview				
Scenario Description	JSON		DOCX	DOCX
Mission	JSON		DOCX	DOCX
Higher HQ Mission	JSON		DOCX	DOCX
Commander's Guidance	JSON		DOCX	DOCX
Strategic Coms Guidance	JSON		DOCX	DOCX

Chapter 6

Synthetic Social Media Creation

6.1 Research Questions

The creation of realistic, dynamic, and controllable synthetic social media data is a critical component of operationalizing social-cybersecurity training and evaluation. While real-world data provides valuable context, it often lacks the adaptability, interactivity, and narrative specificity needed for focused training objectives—particularly when the goal is to understand and identify complex influence maneuvers.

The key research questions for this chapter are:

- How can we create synthetic data that includes BEND maneuvers to support a training scenario?
- How can we appropriately leverage large-language models in the creation of synthetic social media datasets?

To answer these questions, I describe the design and implementation of a hybrid simulation framework built to generate synthetic social media corpora. This framework integrates the structure and intent derived from training scenarios authored in AESOP with the flexibility and realism of large language models (LLMs), yielding datasets that reflect both network-level interactions and narrative maneuvering.

The chapter begins by surveying the broader landscape of synthetic data generation, outlining the strengths and limitations of both top-down (system-level) and bottom-up (agent-based) approaches. I then introduce SynTel and SynX, the agent-based generators developed for this thesis, which combine traditional simulation logic with LLM-powered message construction. By controlling when and how LLMs are used—specifically for generating realistic text rather than building the entire network—I sidestep key scalability challenges while maximizing narrative fidelity.

Finally, I walk through the end-to-end process of how SynX operates: from determining agent actions to generating messages consistent with BEND maneuvers and validating them using effects-based detection methods. This approach ensures that the resulting synthetic data is

both analytically useful and operationally relevant for training, experimentation, and scenario-based planning.

6.2 Synthetic Generation Approaches

There are two main approaches to synthetic generation, top-down and bottom-up. These are also referred to as macro-level or system-based and micro-level.[58] [25] In the top-down approach, a simulation assumes a desired heterogeneous/multi-modal network fabric based on real data and then fills that fabric with appropriate actors, message types, and narratives that match nodes and link types. Alternatively, using the bottom-up approach, the simulation starts with agents programmed from first principles with detailed interaction rule sets. The agents then interact with each other hoping for emergent networks and narratives that are realistic and relevant.[**?**] This dichotomy mirrors approaches by others, including Chang et al. in 2024.[24] Interestingly, Change et al. also point out a new dichotomy - the use of large-language models versus traditional network construction algorithms. They explore an LLM-only methodology that revealed the strength of the bottom-up approach but also found limitations with their LLM-only system. That is, their LLM-only methodology is not capable of scaling when combined with the bottom-up approach. The LLM prompts require iterating through all personas with each persona provided the information about all other personas. This is unwieldy, even if there are only dozens of actors in a network.

For SynTel/X and its synthetic generation of social media networks, I opted for a hybrid approach along both spectra. SynTel/X is grounded in agent-based simulation, with each Actor/Account acting independently based upon an action rule-set derived from their attributes and features. However, rather than let agents organically build their own networks and form narratives, I dictate who their groups members are and what narratives they can express. This approach might seem obvious from the data standard composition of the synthetic templates supplied by AESOP, but the data standards were derived post hoc from the system. A data standard should not drive how a system executes.

Furthermore, rather than using an LLM-only system, SynTel/X incorporates LLMs only in the final stages of generation. Network construction is done entirely by traditional algorithms, and LLMS are leveraged only for narrative construction - this eliminates the need for prompts to have information about every other actor, solving scalability issues, and also leverages LLMs for what they are best at - sounding like real people.[40] [67]

This hybrid approach reflects a difference in the desired outcome compared to other efforts. Generally, other approaches are looking to maximize one of three outcomes: the re-creation of the structure of real social media,[24] the recreation of human social media text output,[73] or the generation of a specific set of synthetic training data.[75][39][53] The SynTel/X output needs to accomplish the first two, but can eschew the latter. In order to provide realistic training, SynTel/X needs to produce social media data equivalent to the social media data collected directly from an API of a real-world platform.

There are three related simulations from which SynX draws:

The twitter_sim2.0 model – as outlined by Blane, Moffit and Carley in 2021 [15] – is a model focused on Twitter interactions. The simulation accounts for both emotion and logic – ensuring

Table 6.1: Docking Lite

Feature	SynX	twitter_sim2.0	Construct	LLM-Social-Network
Media Agents	✓	✓	✓	✓
Opinion Leaders	✓	✓	✓	
Information Access	✓	✓	✓	
General Memory	✓	✓	✓	
Homophily	✓	✓	✓	✓
Limited Attention	✓	✓	✓	
Dynamic Network	✓	✓	✓	
Emotional Response		✓	✓	
All BEND Maneuvers	✓		✓	
Full Diffusion			✓	
Live Visualization			✓	
AESOP inputs	✓			
Full Messages	✓			
Context Inputs	✓		✓	
X APIv1/v2 Format	✓			

tweets that emotionally correspond with a recipient have magnified effects. Importantly, it cannot take in existing or user generated tweets as context and while it includes BEND maneuvers it is not interpretable by ORA-Pro. It also does not produce a message corpus for external evaluation.

Construct is a simulation framework for implementing agent-based modeling in C++20[35]. Construct can parse DynetML files from ORA or CSV. It allows for the custom creation of models - including those for information diffusion. However, it does not produce a message corpus.

LLM-Social-Network by Chang et al. in 2024, leverages large language models to reconstruct agent x agent networks.[24] It also stops short of generating an associated message corpus and also offloads agent-based decision making to an LLM.

Table 6.1 shows a comparison between these simulations with respect to their nodes and features of network construction - it does not take into account their simulation processes.

6.3 SynX

SynX and SynTel are synthetic generators that take synthetic templates from AESOP (required), existing X/Telegram corpora (optional), and injected tweets/messages from the training audience (optional) and use an LLM to output synthetic social media data. SynX produces X/Twitter APIv1 data.

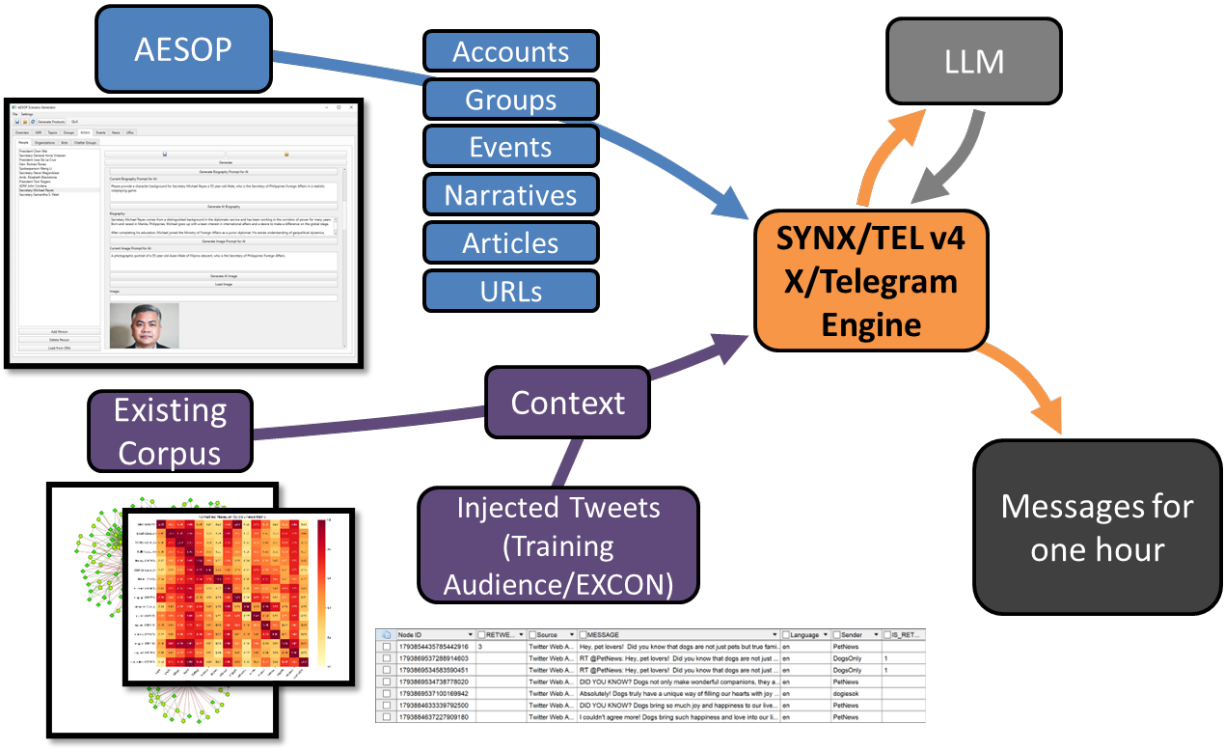


Figure 6.1: Overview diagram of SynTel/X

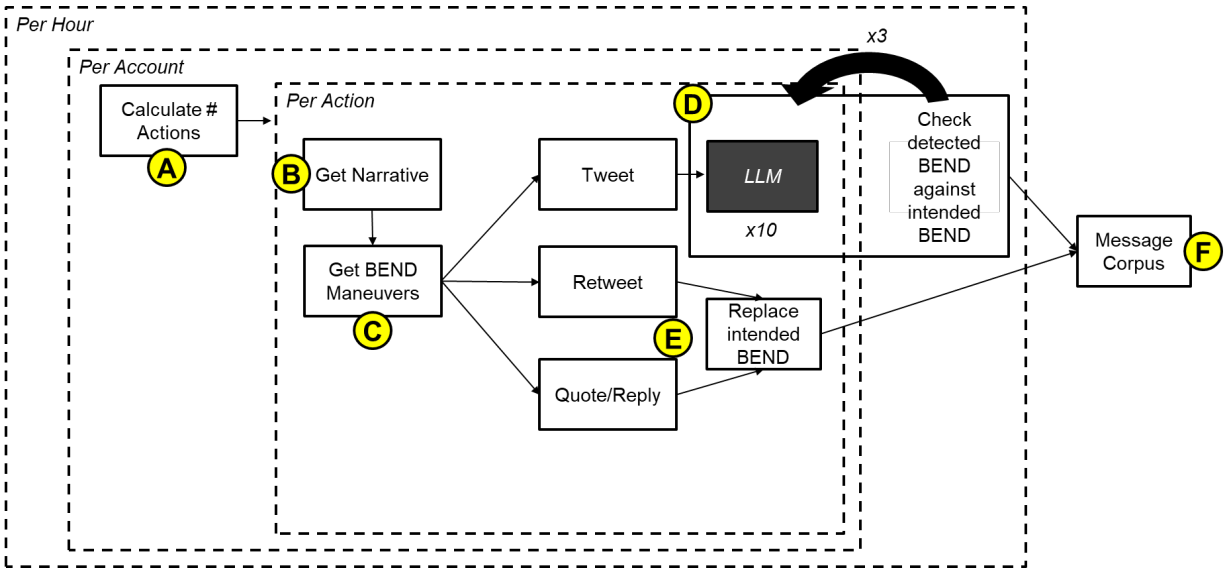


Figure 6.2: Example SynX logic flow.

SynX Flow Overview

- A) Calculate Actions: Per hour, per account, SynX determines the number of actions to be taken by the account.
- B) Find a Narrative: For each action, SynX determines a narrative from a weighted sampling of all narratives associated with groups of which the Actor/Account is a member.
- C) Determine BEND Maneuvers: Based on the BEND maneuvers associated with that narrative and conflated with the BEND maneuvers associated with the Actor/Account, a seed BEND maneuver is selected and then a full chain of maneuvers is determined.
- D) Construct the Prompt: If the BEND maneuvers suggest an original message, then a message shell is created and metadata adjusted to match the intended BEND maneuvers. Then a prompt is constructed and an LLM call is made to create a message - this may happen several times as SynX attempts to make sure that the intended BEND maneuvers are detected within the output message.
- E) Find Another Message: If the BEND maneuvers suggest a derivative message, then an original message is selected from this narrative, and the derivative message is constructed with a partial replacement of the BEND maneuvers.
- F) Produce Output: All of the messages are combined into the message corpus.

A) Calculate Actions

SynX simulates an hour of X messages at a time. To do this, all X accounts go through the decision-flow process summarized above. First, the account determines how many actions to

take in a given hour.

Let:

- $R_o = [r_{o,\text{min}}, r_{o,\text{max}}]$ be the range of original tweets per day
- $R_r = [r_{r,\text{min}}, r_{r,\text{max}}]$ be the range of retweets per day
- $R_q = [r_{q,\text{min}}, r_{q,\text{max}}]$ be the range of quote/reply tweets per day
- E be the excite number for the day (the max of all excite variables from scenario events occurring during that day)

Then:

$$\begin{aligned}
\text{min_posts} &= r_{o,\text{min}} + r_{r,\text{min}} + r_{q,\text{min}} \\
\text{max_posts} &= r_{o,\text{max}} + r_{r,\text{max}} + r_{q,\text{max}} \\
\text{adjusted_min} &= \lfloor \text{min_posts} \times E \rfloor \\
\text{adjusted_max} &= \lfloor \text{max_posts} \times E \rfloor
\end{aligned}$$

Finally, the number of posts to generate is randomly selected from the integer interval:

$$\text{post\_count} \sim \mathcal{U}(\text{adjusted\_min}, \text{adjusted\_max})$$

However, the number of posts per day is not sufficient for SynX, because the accounts are run per hour. In order to transform the total posts per day into a probability of a post(s) occurring during a single hour, we also need the active daily schedule of an account - this is given in the synthetic template for that account.

Let $h \in \{0, 1, \ldots, 23\}$ be the hour of the day, and let T be the total number of posts the account will make in a day. If the active schedule of the account is from 0900 to 1800 then we want higher probabilities during that time and reduced but tapering probabilities during other times.

We can therefore define the unnormalized hourly probability $P(h)$ as:

$$P(h) = \begin{cases}
1 & \text{if } 9 \leq h < 19 \quad \text{(flat period)} \\
1 - \dfrac{r(h)}{11} & \text{if } h \in \{18, 19, \ldots, 23, 0, 1, 2, 3, 4\} \quad \text{(tapering)} \\
\dfrac{s(h)}{5} & \text{if } 5 \leq h < 9 \quad \text{(rising)} \\
0 & \text{otherwise}
\end{cases}$$

Where:

- $r(h)$ is the rank (0-indexed) of hour h in the tapering list: $[18, 19, 20, 21, 22, 23, 0, 1, 2, 3, 4]$
- $s(h)$ is the rank (0-indexed) of hour h in the rising list: $[4, 5, 6, 7, 8]$

Normalize the probabilities:

$$\tilde{P}(h) = \frac{P(h)}{\sum_{i=0}^{23} P(i)}$$

Then the final expected number of posts at hour h is:

$$\text{ExpectedPosts}(h) = T \cdot \tilde{P}(h)$$

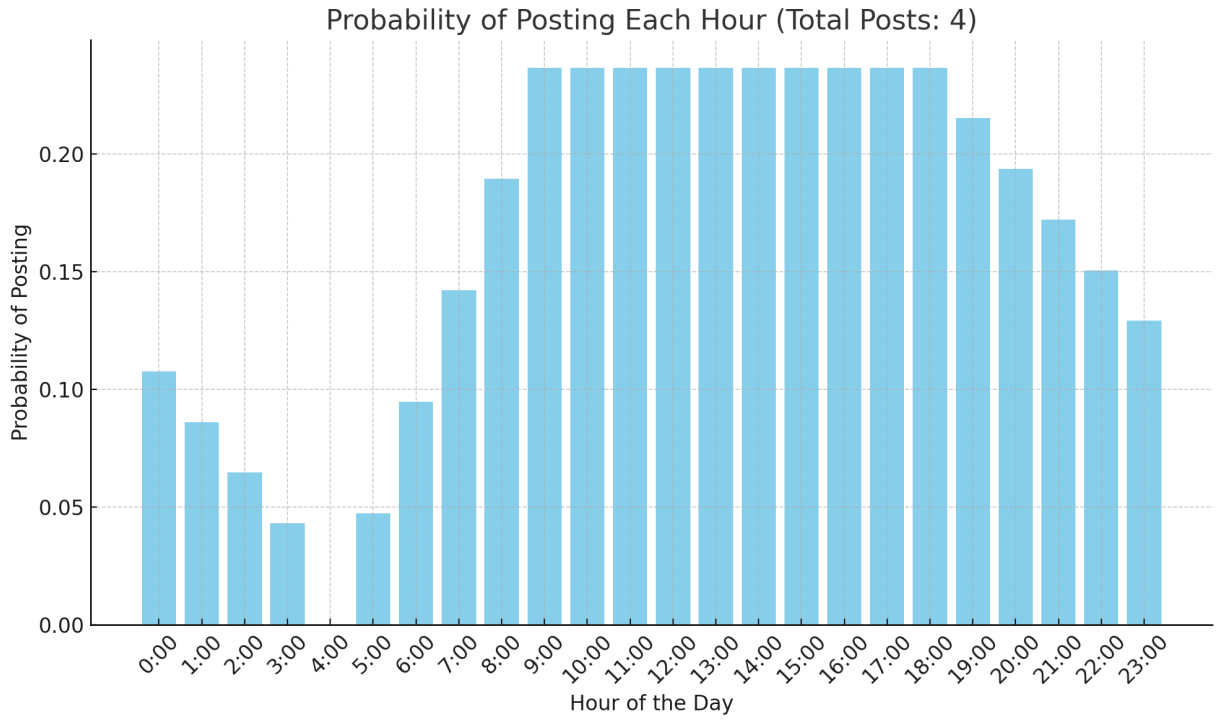


Figure 6.3: Graph of probability of posting each hour for a user active 0900 to 1800 who posts 4 times a day.

Fig. 6.3, graphically depicts the probability of posting each hour for a user with four total posts in a day. The distribution is flat from 09:00 to 18:00, tapers off between 18:00 and 04:00, and gradually increases from 04:00 to 09:00.

B) Find a Narrative

Now that we have calculated the number of actions to be taken in a period, we need to know what type of actions will be taken. Naively, the original posts, retweets, quotes/replies would not have been amalgamated into total actions, and each would be run separately. However, while it makes sense for planners and even social media analysis tools to calculate individual ranges for each type of posting, this does not work well at an agent level. The outcome of the training is the analysis and understanding of the BEND maneuvers. Ostensibly, an account posts not because

of a number on its template but because that account is trying to execute a BEND maneuver. Because certain BEND maneuvers are closely associated with each type of X post, we must have accounts choose BEND maneuvers that determine a post type rather than choosing a post type that then dictates BEND maneuvers.

Therefore, for each action to be taken in a period, the account finds a narrative. This narrative is drawn as a weighted random selection or categorical distribution from all narratives associated with all groups of which the account's owning actor is a member.

Let:

- A be an actor
- $\mathcal{G}(A) = \{G_1, G_2, \ldots, G_m\}$ be the set of groups that actor A belongs to
- $\mathcal{N}(G_j)$ be the set of narratives associated with group G_j
- $\mathcal{N}_A = \bigcup_{j=1}^{m} \mathcal{N}(G_j)$ be the full set of candidate narratives for actor A
- Each narrative $N_i \in \mathcal{N}_A$ has an associated weight $w_i > 0$

Define the probability of selecting narrative $N_i \in \mathcal{N}_A$ as:

$$P(N_i \mid A) = \frac{w_i}{\sum_{N_j \in \mathcal{N}_A} w_j}$$

Then, the selected narrative N^* for the message is drawn from the categorical distribution:

$$N^* \sim \text{Categorical}\left(\{P(N_i \mid A)\}_{N_i \in \mathcal{N}_A}\right)$$

C) Determine BEND Maneuvers

After a narrative is selected per action, a second weighted random selection is executed. The algorithm for this is similar to the narrative selection above except this time the algorithm is choosing BEND maneuvers based upon weights associated with that narrative conflated with the individual account BEND maneuver weights.

Let:

- $M = \{M_1, M_2, \ldots, M_{16}\}$ be the set of BEND maneuvers
- $w_i^{(n)}$ be the weight of maneuver M_i from the selected narrative
- $w_i^{(a)}$ be the weight of maneuver M_i from the actor profile

Define the combined weight for each maneuver M_i as:

$$w_i^{(\text{combined})} = \left(w_i^{(n)}\right)^{2/3} \cdot \left(w_i^{(a)}\right)^{1/3}$$

Normalize to obtain a probability distribution over the 16 maneuvers:

$$P(M_i) = \frac{w_i^{(\text{combined})}}{\sum_{j=1}^{16} w_j^{(\text{combined})}}$$

Then sample one maneuver M^* from the categorical distribution:

$$M^* \sim \text{Categorical}\left(\{P(M_i)\}_{i=1}^{16}\right)$$

From this seed BEND maneuver we can use a variable-order Markov model with set-based context and non-replacement sampling to determine the total BEND maneuvers for the action.

BEND Sequence Generation from a Start Maneuver

Given a starting maneuver m_0, we build a sequence $S = [m_0, m_1, \ldots, m_k]$ by repeatedly sampling from the conditional probability distribution:

1. Initial Maneuver

$$S_0 = [m_0]$$

2. At Each Step

Let the current sequence be $S_t = [m_0, m_1, \ldots, m_t]$, and let

$$\mathcal{S}_t = \text{sorted}(S_t)$$

Then, compute the conditional probabilities for the next maneuver m_{t+1}:

$$P(m_{t+1} \mid \mathcal{S}_t)$$

3. Mask Already Chosen Maneuvers

To ensure uniqueness, set:

$$P(m \mid \mathcal{S}_t) = 0 \quad \text{if } m \in \mathcal{S}_t$$

4. Normalize Probabilities

$$\hat{P}(m \mid \mathcal{S}_t) = \frac{P(m \mid \mathcal{S}_t)}{\sum_{m' \notin \mathcal{S}_t} P(m' \mid \mathcal{S}_t) + P(\text{END} \mid \mathcal{S}_t)}$$

5. Sampling

Sample $m_{t+1} \sim \hat{P}(\cdot \mid \mathcal{S}_t)$

6. Termination Condition

If $m_{t+1} = \text{END}$, stop.

From this we arrive at our full sequence of BEND maneuvers: $S = [m_0, m_1, \ldots, m_k]$. This set of BEND maneuvers determines if this message is an original tweet, a retweet, a reply, or a quote. If the BEND maneuvers include back, engage, or neutralize, then the post is likely a derived type (retweet, reply, or a quote) as these BEND maneuvers are closely associated with these types of posts.

Let:

- $B = \text{BEND}(narrative)$
- $D = \text{isDerived}(B) = \begin{cases} 1 & \text{if } B_{\text{back}} = 1 \text{ or } B_{\text{engage}} = 1 \text{ or } B_{\text{neutralize}} = 1 \\ 0 & \text{otherwise} \end{cases}$

Then the tweet type T is sampled as follows:

$$T = \begin{cases} \text{DerivedType()} & \text{with probability } \frac{2}{3}, \text{ if } D = 1 \\ \text{Tweet} & \text{with probability } \frac{1}{3}, \text{ if } D = 1 \\ \text{Tweet} & \text{if } D = 0 \end{cases}$$

Where:

$$\text{DerivedType()} = \begin{cases} \text{Retweet} & \text{with probability } \frac{3}{5} \\ \text{Reply} & \text{with probability } \frac{1}{5} \\ \text{Quote} & \text{with probability } \frac{1}{5} \end{cases}$$

D) Construct the Prompt

If the BEND maneuvers suggest an original message, then a message shell is created and metadata adjusted to match the intended BEND maneuvers. This is important because, as will be discussed at length in the following chapter, current methods of detecting BEND maneuvers operate on a per message level and evaluate for maneuvers based on both the content of the message and the metadata. As a general rule, metadata is more influential in determining network maneuvers, while the content of the message itself is more influential in determining narrative maneuvers. In particular, the term metadata is used here to describe anything outside of the message field (text or full_text) of the tweet - to include portions of the message field that are enumerated externally. For instance, URLs and mentions are included in the message field, but are then enumerated more particular outside of it - they are considered metadata by SynX. This makes sense because in both SynX and SynTel, the LLM is not given leeway to insert references to URLs, nor is it given enough information about all possible actors for it to determine appropriate mentions. Indeed, recall the dangers of this approach from Chang, et al. in 2024, where requiring the LLM to know about all other nodes raised scalability issues.[24] Instead, both URLs and mentions are handled by the simulation and considered metadata rather than parts of the message. SynX therefore makes changes to the metadata of the original message based on the BEND maneuvers. Table 6.2 illustrates which BEND maneuvers are derivative (associated

with retweets, replies, quotes), which maneuvers are associated with the presence of mentions and which are associated with the presence of URLs.

Table 6.2: Metadata by BEND Category

	Derivative	**Mentions**	**URLs**
Bridge		✓	
Build		✓	
Boost		✓	
Back	✓	✓	
Engage	✓		✓
Explain			✓
Excite			
Enhance			✓
Negate		✓	
Neutralize	✓	✓	
Narrow			
Neglect		No Mentions	
Dismiss			
Distort			
Dismay			
Distract			

Once the metadata adjustments are made, a prompt is constructed in preparation to request a message from the LLM. Prompt construction has two major components - the system prompt and the user prompt. The system prompt is used to outline the role given to the LLM and provide background information and context. It has four major parts:

- *An introduction:* You will be participating in a role playing game to help users identify misinformation, disinformation, and manipulation on social media. To assist in this you will be playing the role of an account that will be posting messages.
- *Formatting instructions:* 'Provide your response as a JSON object in the following example format: { "topic": "dogs", "hashtags" : ["yaydogs", "dogscool"], "full_text" : "Dogs are great, #yaydogs #dogscool", "refuse_to_answer" : 0 } The "refuse_to_answer" field is where you should return a 1 if you do not feel comfortable generating a tweet about the subject. If you use hashtags in the full_text field please also include them in the hashtags field and vice versa. Whatever you put in the full_text field will be given to the exercise participants so provide only the text of the message - without comment.
- *BEND Definitions:* As you craft the message/tweet you are trying to accomplish something - what you are trying to accomplish is defined by the BEND Framework. BEND is a framework for describing social-cyber maneuvers. BEND includes 16 different maneuvers. These 16 maneuvers have the following definitions: The BUILD maneuver primarily creates a community. The BACK maneuver primarily increases the importance or effectiveness of a leader... *other maneuvers...*

- *Identity:* You are a Twitter user who is trying to make a post that will be engaging and interesting to your followers. You have a unique style and voice that you want to maintain in your posts. Here are your personal details: {Name}, {Title}, {Age}, {Race}, {Gender}, {Nationality}, {Biography}.

The user prompt is where the LLM is given details about this specific message:

- *Narrative:* You will be posting on the following narrative: {narrative description}
- *Last three messages by this account:* The last three messages you posted looked like this - say something different than these: *Last three messages here...*
- *Last three messages on this narrative:* The last three messages others posted on this narrative looked like this - say something different than these:"*Last three messages from narrative here...*
- *Suggested Hashtags: List of suggested hashtags...*
- *BEND Maneuvers:* "The message you send will include some BEND maneuvers. In this case: *List of BEND maneuvers...*

The system and user prompts are sent to the LLM and a message is returned. Ideally, the returned message is in the correct JSON format and the LLM has not refused to create the message due to subject matter. No effort was made to jailbreak any LLM in the work done for this thesis - if the OpenAI commercial LLM was unwilling to create a tweet, then SynX defaults to a locally run LLM. A more comprehensive breakdown of SynX prompt construction can be found in Appendix **??**

The returned text is added to the tweet and there is now a complete post. However, there is no guarantee that the message returned by the LLM contains the intended BEND messages. Because SynX is creating synthetic data for training on BEND maneuvers, ideally it should check the synthetic data for those BEND maneuvers using the same tools that the training audience would have available to them. Thus, SynX uses a combination of NetMapper and ORA-Pro to check for BEND maneuvers in each message. For scalability purposes, SynX can evaluate all posts in an hour together or wait and conduct the evaluation on a full day at a time.

BEND Check Process

- Messages are cleaned for processing by NetMapper
- NetMapper processes the posts and returns a .tsv of cues per message
- The posts are converted into DyNetML (XML) format for processing by ORA
- The cues .tsv is parsed and the cues injected into the DyNetML
- The BEND calculations are done using templates from ORA-Pro's batch mode
- Each message now has vectors for intended BEND and detected BEND

This process is computationally expensive, therefore, SynX can simultaneously asks the LLM for multiple variations of a message - evaluating and then keeping only the message with the highest score. The scoring algorithm requires that the detected BEND maneuvers in a message

at least encompass the intended maneuvers. Then it gives higher scores to those messages that have the fewest detected BEND maneuvers that are not in the intended BEND maneuvers set.

Let:

- $\mathbf{i} = [i_1, i_2, \ldots, i_{16}]$ be the intended BEND maneuver vector
- $\mathbf{d} = [d_1, d_2, \ldots, d_{16}]$ be the detected BEND maneuver vector
- $i_k, d_k \in \{0, 1\}$ for $k = 1, 2, \ldots, 16$

Define the score $S(\mathbf{i}, \mathbf{d})$ as:

$$S(\mathbf{i}, \mathbf{d}) = \begin{cases} 1 - \dfrac{\sum_{k=1}^{16} [d_k = 1 \wedge i_k = 0]}{16}, & \text{if } \forall k,\ i_k \leq d_k \\ 0, & \text{otherwise} \end{cases}$$

That is:

- If all intended maneuvers are present in the detected set ($i_k \leq d_k$ for all k),
- then subtract the proportion of "extra" detected maneuvers from 1,
- else, assign a score of 0.

If no suitable messages are found within the batch (all have scores of 0), then SynX will ask for an entirely new batch of messages up to three times. Ultimately, only the best message is kept and added to the corpus.

E) Find Another Message

If the BEND maneuvers suggest a derivative message - a retweet, reply, or quote - then SynX will need to find an appropriate message to be derivative of. The first step in this process is to determine a subset of messages available for derivative use. This step is done for each hour all at once - reducing computational requirements.

Messages less than or equal to 1 day old have a 100 percent probability of remaining available for derivative use. For older messages, the probability decays exponentially based on age, with the base rate applied to the power of the number of days old the message is - 1.

$$P(\text{keep}) = \begin{cases} 1 & \text{if } \Delta t \leq 1 \\ \beta^{(\Delta t - 1)} & \text{if } \Delta t > 1 \end{cases} \tag{6.1}$$

With a default base keep rate of 0.5, this creates a probability that halves with each additional day of age beyond the first day. This ensures that accounts are generally making derivative messages based upon more recent tweets, while still allowing for significant reach back. Derivative tweets can be eligible for derivative use, but if selected the original tweet and not the derivative is used instead. This means that the derivative use of a tweet essentially refreshes its age out timer.

Recall, that the derivative tweet already has a narrative, therefore, the subset of tweets available for derivative use this hour is further narrowed (for this tweet) by eliminating all tweets that do not share this narrative.

From this shared-narrative set of eligible tweets, SynX will make a selection based on a hybrid of leader-based selection and preferential attachment. The intent is that the network should reflect the scale-free structure provided by preferential attachment; however, the beneficiaries of that scale-freeness need to be the enumerated leaders provided by the group synthetic template from AESOP.

Let T be the set of candidate tweets, where each tweet $t \in T$ has an associated retweet/reply/quote count $R(t) \geq 0$, and a leader indicator $L(t) \in \{0, 1\}$, where $L(t) = 1$ if the tweet was posted by a leader of the group.

Define $T_L \subseteq T$ as the subset of tweets authored by leaders:

$$T_L = \{t \in T \mid L(t) = 1\}$$

We define the probability $P(t)$ of selecting tweet t as follows:

$$P(t) = \begin{cases} \dfrac{1}{|T_L|} & \text{with probability } \frac{1}{3}, \quad \text{if } t \in T_L \\ \dfrac{R(t)}{\sum\limits_{s \in T} R(s)} & \text{with probability } \frac{2}{3}, \quad \text{for all } t \in T \end{cases}$$

To sample a tweet t^*, first choose a mode of selection:

- With probability $\frac{1}{3}$, sample uniformly from T_L.
- With probability $\frac{2}{3}$, sample from T using retweet counts as weights.

Once a tweet is chosen, metadata is adjusted as appropriate (see D above). If the derived tweet is a retweet then most of the intended BEND maneuvers for the derivative tweet are overwritten with the intended BEND maneuvers from the original tweet - the exceptions being back, engage, and neutralize - the determining BEND factors for derivatives. However, if the derived tweet is a reply or quote, then it keeps its intended BEND maneuvers and moves to a modified version of step D above - where the LLM is asked to comment on the tweet derived from.

F) Produce Output

Finally, the tweet, retweet, reply, or quote is complete and is added to the full set of output tweets for the hour. These tweets will be added the list of available for derivative use tweets in the next iteration. The entire process is repeated for each hour of the exercise.

6.4 SynTel

SynTel executes in a similar manner to SynX - with roughly analogous steps A-F - see Fig. 6.5. However, the Telegram platform has structural differences that introduce some changes. In SynTel, channels and user accounts are handled simultaneously, with user accounts adding original posts to their own channel, cross-posting from another channel, or posting to another channel rather than choosing an option from tweet, retweet, reply, or quote. This causes SynTel Telegram

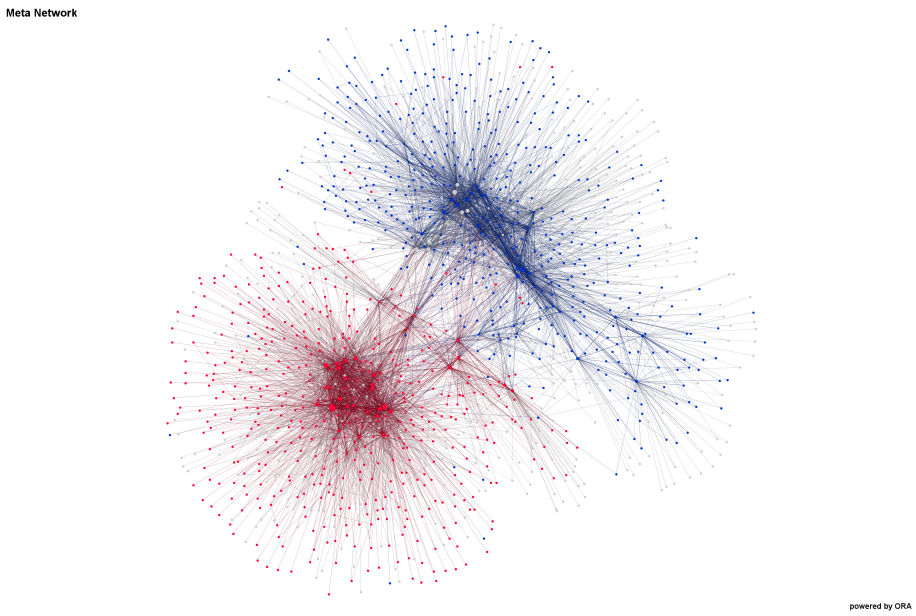


Figure 6.4: An output network from SynX with pro-US stance detection run through ORA-Pro. Blue nodes are pro-US actors and red nodes are anti-US actors with gray nodes being neutral. Nodes are sized by total degree centrality.

networks to be more condensed. Additionally, while mentions and hashtags are supported for Telegram creation in SynTel, Telegram users traditionally use these features less, and therefore shared URLs and cross-posting become more dominant in network structures. SynTel accounts for this by increasing the use of URLs in Telegram messages while reducing the likelihood of mentions and hashtags.

6.5 X/Twitter and Telegram Bots

No social network would be complete without bots. However, there is an unusual problem with bots in synthetic datasets - every actor in this fabricated information environment except the training audience is an automated persona - it is all bots. The challenge is that for the training audience, some of these automated personas need to be detectable as ”bots” and others need to remain undetected as ”humans”. Planners can enumerate bots in AESOP for SynTel/X to simulate and the simulation has agent rule sets for amplifier, news, bridging, and repeater bots. Amplifier bots boost content through retweets/posts and the SynTel/X rule-set ensures that amplifier bots have an abnormally high retweet/post to tweet/post ratio. Additionally, they target only content with a specified narrative and ignore the recency bias imposed by SynTel/X on normal actors. Repeater bots are similar to amplifier bots but repeat the same message within their in-group continuously. Both of these types of bots operate similarly to those seen by Ng and Carley in 2023[60]. News bots are news aggregators and have a rule-set that forces them to retweet/post content from a target set of news agencies. Bridging bots use mentions and retweets/posts to attempt to connect two specified narratives. The meta-data fields for bridging bots will have far

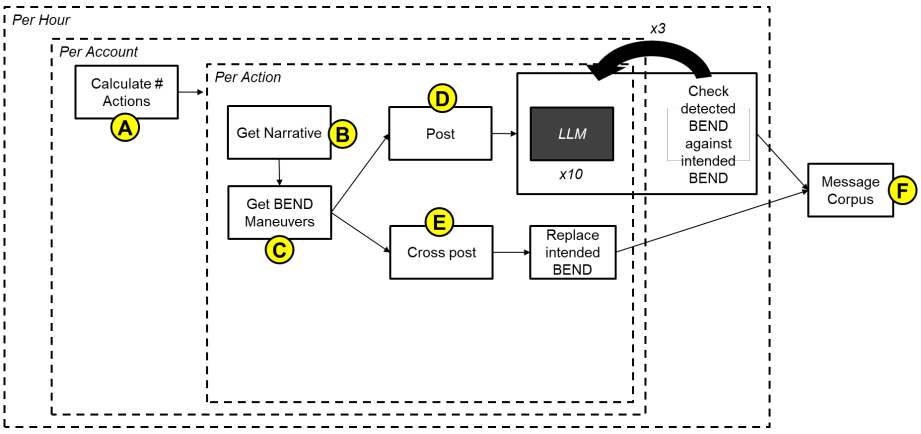


Figure 6.5: Telegram generator message creation flow. Dark gray parallelograms are synthetic templates provided by AESOP and referenced by the generator.

more mentions – and a much narrower set of mentions - than regular bridging actors. These types of bots operate similarly to those observed by Jacobs et al. in 2023 [44]

6.6 Timing and Bottlenecks

SynTel/X is currently multi-threaded. It creates a thread for every request to the LLM – intelligently bound by the user-set rate limitations so that the number of requests does not overwhelm the LLM provider. I have provided the recorded averages for execution times in Table 6.3. The execution steps that depend on the number of messages were run on both approximately 10,000 messages and 100,000 messages. As seen in the table, the current bottleneck is the LLM, with NetMapper and ORA rounding out the top three. I recommend that the programmatically called NetMapper executable be made multi-threaded and ORA batch mode be optimized first before additional optimization work within SynTel/X. SynTel/X performance priority is reducing the time it takes to find a suitable message for retweet/reply/quote (in X) or repost (in Telegram).

6.7 Validation

MOMUS, a Netanomics product, is custom made to accept the scenarios from AESOP and the output from SynTel/X and ensure that the data conforms to the scenario and network and narrative structure fall within the norms for a platform. Unfortunately, MOMUS is still in development and not fully capable of providing independent verification of the network component of the synthetic data at the time this research was being conducted. Therefore, while initial MOMUS results are able to provide analysis of the semantic, syntactic, and meta-data of the synthetic corpus, different methods were required to validate the network portion of the synthetic data. These network methods will be furnished to MOMUS for eventual inclusion in the full suite of assessments.

The purpose of the synthetic data is to enable BEND maneuver training on social media. This

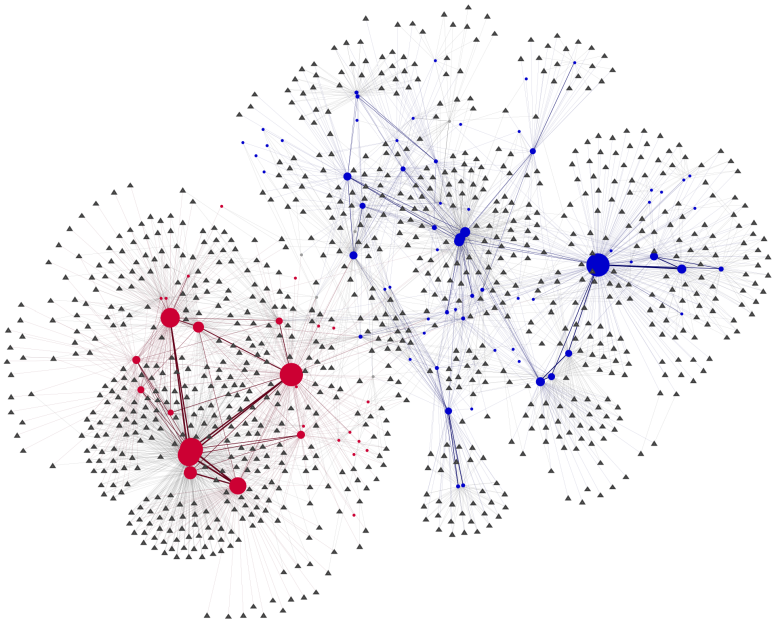


Figure 6.6: An output network from SynTel with pro-US stance detection run through ORA-Pro. Blue nodes are pro-US actors and channels. Red nodes are anti-US actors and channels Triangle shaped nodes are messages. Nodes are sized by total degree centrality.

provides the pedagogical basis for assessing validity of the synthetic dataset and suggests two axes of validation. The first axis is validity at the message level versus validity at the corpus level. The second axis is reasonableness of the data (is the data realistic) versus is the data accurate (does the data reflect what the planner intended). In this chapter and the next, I will cover all four quadrants. The corpus/reasonable and corpus/accurate quadrants are covered next. The message/reasonable and message/accuracy validation are both covered in the following chapter's experimental results.

Therefore, the overall validation takes two separate forms in order to cover the full axis of reasonable/accurate: 1) Validate Overall Reasonableness of Data - OR - Can analyst tools meaningfully run on the data?

1) Validate Overall Reasonableness of Data - OR - Can analyst tools meaningfully run on the data?

In addition to facial validity supported by the design decision alignments found in the stylized facts in Table 6.4, additional validation comes from directly comparing network metrics between the outputs of SynX - run on an AESOP generated scenario - and a real-world comparison dataset. The real-world comparison dataset is approximately 2500 tweets pulled from the X/Twitter API during the Balikatan 22 exercise in April 2022. Balikatan is a bilateral military exercise between the US and the Philippines.[54] The input scenario from AESOP is meant to be similar in topic

Table 6.3: SynTel/X Timing and Bottlenecks

Execution Description	Per Account	Per Message	Per Run (<10,000 msg)	Per Run (<100,000 messages)
Calculate # Actions	<0.001 ms			
Get Narrative		<0.001 ms		
Get BEND Maneuver		<0.001 ms		
Get Other Message		<0.1 ms		
LLM Request		Variable, 120+ ms		
JSON Creation			<1 s	<1 s
Convert to XML (DynaML)			<2 s	<5 s
NetMapper CUEs			<60 s	<120 s
Insert CUEs Into XML			<2 s	<5 s
ORA BEND Report			<5 s	<10 s
Output to JSON			<1 s	<1 s

and content.

I evaluated SynX outputs on four different network metrics against Balikatan 22. These network metrics are based on the requirements of the analysis tools that will be run against the synthetic data – a pedagogical reason for their selection; however, the validation requirement for the networks comes from real world data – specifically data that is from the same platform, over a similar time period, containing similar content. Three of these network metrics were originally suggested by Chang et al. in 2024 during their development of an LLM-based synthetic network simulation.[24] I added Degree Distribution of the Tweet x Tweet (Retweet) network because ORA-Pro's primary method for stance propagation depends upon this network being well-connected. Again, it is not necessary that SynX be precisely equivalent to the Balikatan 22 scenario but that the differences should be plausible and fit with minor changes between the like-scenarios. The four metrics are:

- Average Shortest Path of Agent x Agent (All Communication)
- Proportion of nodes in the Largest Connected Component of Agent x Agent (All Communication)
- Modularity of Agent x Agent (All Communication)
- Degree Distribution of Tweet x Tweet (Retweet)

From the results in Table 6.5 we can see that SynX falls within acceptable ranges (within 10%) for two of the three Agent x Agent network metrics when compared with the Balikatan 22 real dataset. SynX produces data sets that have agents that are too modular compared to the example set. This is likely due to the constraints placed upon SynX by adhering to the AESOP scenario which has rigidly defined narrative groups. Regardless, more work will need to be done to improve AESOP and SynX in this area.

Finally, when looking at the Tweet x Tweet (Retweet) network results we can see that Synx

Table 6.4: Stylized Facts

Summary	Effect	Source
Attentions spans limit how many users are affected	Reach is determined by leadership	Kang and Lerman, 2013. [51] Lu et al., 2014. [56]
Commonality of reposts	High level of derivative messages (50+%)	Beskow and Carley's "Agent Based Simulation of Bot Disinformation Maneuvers in Twitter" from 2019.[11]
Which messages are being reposted	Power law distribution	Lu et al., 2014. [56]
Real world likelihood of BEND maneuvers	variable-order Markov model with set-based context and non-replacement sampling based on tweets covering the Balikatan 22 exercise in APR 2022	Lepird, 2024.[54]

Table 6.5: Network Metrics Comparison for Agent x Agent Network

Metric	**Real**	**Sim Mean**	**Sim Std**	**Abs. Diff.**	**Perc. Diff.(%)**
Normalized Avg. Shortest Path	0.4158	0.4429	0.0294	-0.0272	-6.54
LCC Proportion	0.8738	0.9583	0.0123	-0.0845	-9.67
Modularity	0.5006	0.9174	0.003	-0.4169	-83.28

Table 6.6: Degree Distribution Statistics for Tweet x Tweet Network

Network	**Node Count**	**Mean Degree**	**Median Degree**	**Max Degree**	**Std Dev**
Real Data	2230	0.92	0.0	154	6.64
Simulation Avg	10457	0.88	0.0	148	4.74

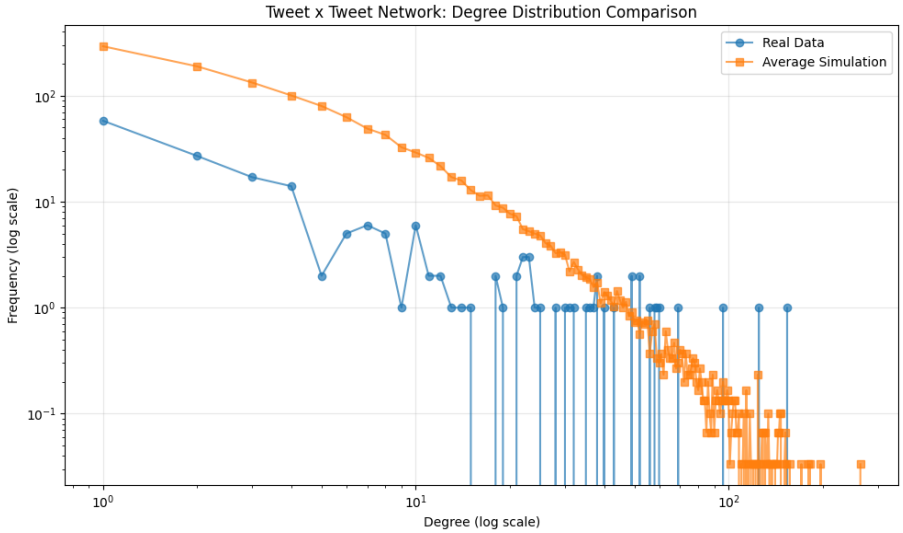


Figure 6.7: Both the real data and the SynX display appropriate power-law properties for the Tweet x Tweet (Retweet) network

faithfully recreates a scale-free network and closely mimics the Balikatan network - see Table 6.6 and Figs. 6.7 and 6.8.

The One True Omen Validation Exercise

Both AESOP and SynTel/X participated in a validation exercise hosted by the Naval Air Warfare Center Training Support Division (NAWCTSD) called The One True Omen (TOTO). This exercise occurred over two weeks – one week of training and one week of exercise. During the exercise, a mixture of public affairs personnel, intelligence analysts, and other participants analyzed the data produced by AESOP and SynTel/X, and interacted with the SynTel/X simulation.

The Good: Exercise participants felt that the dataset had the right amount of detail – conspiracy theories, regional chatter, etc. This validates that the nails to haystack mix was appropriate for the learning objectives at TOTO. This was a walk-phase exercise and therefore participants were challenged to find the critical events and actors within 15,000-20,000 messages per exercise day.

The training audience felt that the products from AESOP were excellent. AESOP produced orders for the participants every day – providing guidance and breadcrumbs for important events. AESOP also produced intelligence summaries for each of the 144 main actors and 106 significant events. The training audience made good use of these summaries and validated that the content of the data they were seeing out of SynTel/X accurately matched what AESOP had dictated for the scenario.

Finally, the exercise participants felt that the overall volume of data was correct for a daily pull and analysis. This validates the selected volume level for the exercise and that the 15,000-20,000 message range fits training audiences experience for now. Future capabilities, tools, and training will only increase their ability to parse larger amounts of data.

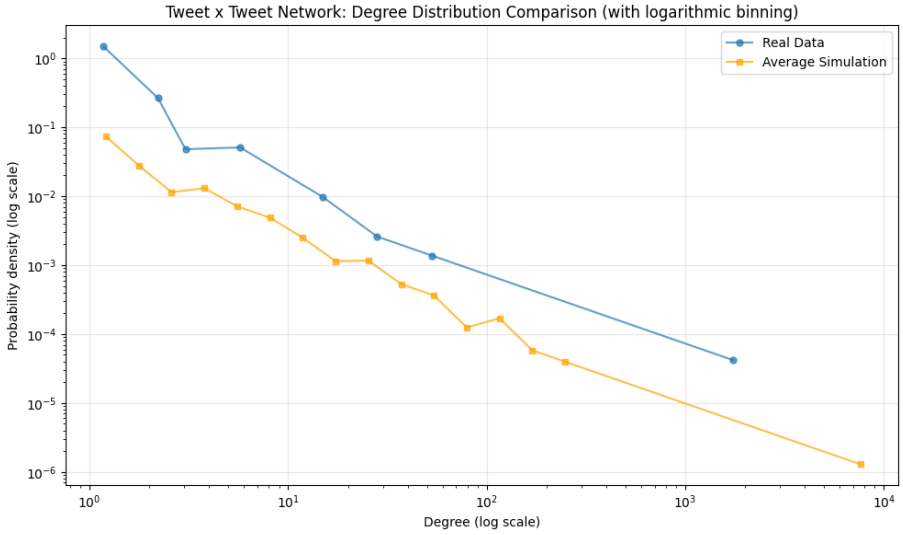


Figure 6.8: Binning is not always a good idea, but with the discontinuous data from the real data this chart helps depict the form convergence between the real and synthetic data sets

The Bad: The training audience identified that X/Twitter is a predominantly US platform and that a more complete exercise would need foreign platforms as well. In the future, SynTel/X and AESOP need to be capable of emulating additional platforms. In the short term, a non-US language batch of actors and messages can be run using existing AESOP and SynTel/X and simply re-branding the outputs as messages from an X-like foreign environment. The exercise participants noted some prompt leakage in the training week. Filtering for existing prompt leakages and the addition of more structure system and user prompts eliminated prompt leakage from the exercise week. Hallucinations did persist through both weeks, but most were limited to minor events where mistakes would occur in real-world data as well. For instance, the LLM was often unclear from message to message on whether a tropical storm was about to become a typhoon, was already typhoon, or was now a super-typhoon.

The exercise participants did note that occasionally narratives/topics would disappear and then reappear. This reflects planning errors on my part within AESOP. Both AESOP and SynTel/X fell victim to a small amount of garbage-in, garbage-out. A calendar tab was added to the events in AESOP in order to facilitate troubleshooting the continuity of events and a missing narrative report was added to SynTel/X to provide feedback on which accounts are active but do not have any narratives to choose from.

The training audience felt that user account handling was difficult. In order to input their own messages into the simulation the participants were required to write out their messages. They wanted to address a variety of narratives and crafting each message was tedious. This reflects reality and no changes to AESOP or SynTel/X are required to address this. Indeed, on the last day of the exercise, the participants were given the option of handing their accounts over to the simulation with a limited set of narratives that they selected. All of the participants were pleased with the output from the simulation and felt it did an adequate job of pretending to be them.

2) Validate Execution of Intention - OR - Is what I intended to put in the data actually found in the data?

Critical to developing a scenario and accompanying training data for a training audience is understanding the learning objective of the training. In this case, as outlined in Chapter 4, the training focuses on developing social media analysis skills for the detection and application of BEND maneuvers in the information environment. Therefore, the data should include BEND maneuvers for the training audience to find and analyze. I set out to maximize the matching between the BEND maneuvers outlined by the AESOP provided scenario and the BEND maneuvers detected in the dataset output by SynX. To do this, I conducted a virtual experiment to find the optimal method for prompt insertion - validating BEND maneuver output while doing so.

6.7.1 Experiment

For the virtual experiment, I will manipulate the presence of the BEND definitions in the prompt and whether SynX attempts to query the LLM for different text based on incorrect BEND assessments. I will be evaluating how well the presence of BEND maneuvers and their co-occurrences match a real world dataset. The real world comparison dataset is approximately 2500 tweets pulled from the X/Twitter API during the Balikatan 22 exercise in April 2022. Balikatan is a bilateral military exercise between the US and the Philippines.[54] The input scenario from AESOP is meant to be similar in topic and content.

In this experiment, I looked at how much benefit is gained by including the comprehensive BEND definitions and the NetMapper cues that ORA-Pro will be looking for when evaluating BEND in the prompt to the LLM. I consider three cases for the prompt - 1) No BEND definitions, 2) BEND definitions fit into the user prompt to the LLM, and 3) BEND definitions in the system prompt to the LLM. The user prompt is generally understood to be the prompt that asks the question, while the system prompt is the prompt that lets the LLM general context and purpose.

I also investigated iterating with the LLM multiple times to get better BEND results by letting the LLM know what BEND maneuvers were not detected in its initial responses and re-iterating the associated BEND cues with those maneuvers.

I will run SynX on one hour of the AESOP scenario (1200-1300 on Day 6 of the exercise) producing between 600-800 messages.

6.7.2 Results

For the results, we can analyze both the presence of BEND maneuvers and the mixture of these maneuvers by creating a co-occurrence matrix. Fig 6.9 gives an example of the heatmap from a single run of the experiment. Notice that it is a comparison between the intended BEND maneuvers - those requested from the LLM - and the detected BEND in the results.

It is obvious from this that SynX is not perfect - there should be ones in the diagonal such that the maneuvers we ask for the LLM returns. However, it is also important to note that where a BEND maneuver is detected as something else - everywhere else but the diagonal - this is not necessarily bad. There is some level of co-detection and co-occurrence naturally even in real data, i.e. rarely do maneuvers occur in isolation independent of one another. In order to

Table 6.7: 3x2 Virtual Experiment

Independent Variables	# Test Cases	Values Used
BEND Definitions	3	None/User_Prompt/System_Prompt
Regen Messages for BEND	2	0x/3x
Control Variables	**# Test Cases**	**Values Used**
Time Periods	1	1 hour
Messages per Hour	1	600-800
Target BEND	1	Balikatan 22
AESOP Input	1	Scenario
Dependent Variables		**Values Expected**
BEND Distribution		0-1 z-scores
3x2	8 cells	
Replications per cell	30	
180 total runs (108,000+ messages)		

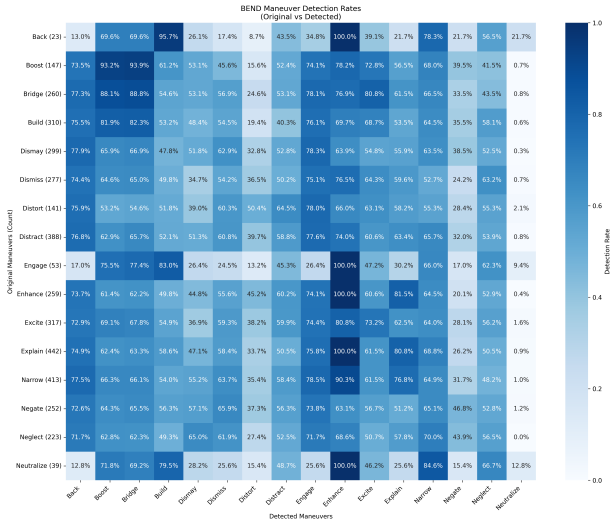


Figure 6.9: Example co-occurrence heatmap (that shows intended BEND maneuvers mapped to detected BEND maneuvers.

Table 6.8: Overall BEND Maneuver Analysis Results

Experiment	Mean Z-Score	Standard Error	CI Lower	CI Upper	p-value
No Definitions	-0.3366	0.0252	-0.3881	-0.2851	0.000000
Definitions_user	-0.4053	0.0270	-0.4605	-0.3501	0.000000
Definitions_system	-0.1053	0.0263	-0.1592	-0.0515	0.000396
Definitions_repull	-0.1257	0.0218	-0.1703	-0.0812	0.000003

Significance determined at $p < 0.05$ level.

Z-scores represent deviation from expected co-occurrence patterns in real data.

Table 6.9: BEND Maneuver Analysis - Intended/Requested (Row Means)

Maneuver	No Definitions	Definitions_user	Definitions_system	Definitions_repull
back	**0.35**$^{+}$	**-0.42**$^{-}$	**-0.26**$^{-}$	**-0.22**$^{-}$
boost	**-0.67**$^{-}$	**-0.89**$^{-}$	**-0.69**$^{-}$	**-0.66**$^{-}$
bridge	**-0.44**$^{-}$	**-0.38**$^{-}$	-0.10	-0.05
build	-0.24	-0.07	0.17	0.21
dismay	**-0.87**$^{-}$	**-0.80**$^{-}$	**-0.35**$^{-}$	**-0.50**$^{-}$
dismiss	-0.21	-0.11	**0.17**$^{+}$	0.11
distort	**-0.71**$^{-}$	**-0.65**$^{-}$	-0.29	**-0.31**$^{-}$
distract	**-0.73**$^{-}$	**-0.64**$^{-}$	**-0.31**$^{-}$	**-0.34**$^{-}$
engage	-0.12	**-0.47**$^{-}$	**-0.28**$^{-}$	**-0.24**$^{-}$
enhance	0.11	0.17	**0.45**$^{+}$	**0.39**$^{+}$
excite	**-0.64**$^{-}$	**-0.71**$^{-}$	**-0.39**$^{-}$	**-0.44**$^{-}$
explain	**-0.46**$^{-}$	**-0.46**$^{-}$	0.04	-0.06
narrow	**-0.41**$^{-}$	**-0.30**$^{-}$	0.13	0.13
negate	**-1.00**$^{-}$	**-1.08**$^{-}$	**-0.70**$^{-}$	**-0.76**$^{-}$
neglect	**0.98**$^{+}$	**0.95**$^{+}$	**1.22**$^{+}$	**1.18**$^{+}$
neutralize	**-0.33**$^{-}$	**-0.63**$^{-}$	**-0.50**$^{-}$	**-0.44**$^{-}$

account for this we need to use the same correlation matrix derived from real data - specifically the Balikatan 22 X/Twitter dataset. We take the mean co-occurrence for each day and construct a standard deviation for each combination.

This allows us to then compare a single run of results and get a distance from the mean in terms of standard deviation. We can also put the runs from a single experimental set-up together to see how well any given set-up does, as in Fig. 6.11.

We can also compare the average z-score from the runs within an experimental setup. Fig. 6.12 shows an example of these results. Finally, we can compare the overall distance from the mean across the four main configurations as in Fig. 6.13. From Fig. 6.13 we can determine that overall, SynX under-represents BEND maneuvers within the synthetic messages. Also, there was no significant difference between including the BEND definitions in the user prompt versus leaving them out entirely. This might be due to the relative proximity of extraneous definitions - i.e. those BEND maneuvers not being requested for this particular message - with the BEND maneuver requests specific to the message. However, placing the definitions in the system prompt

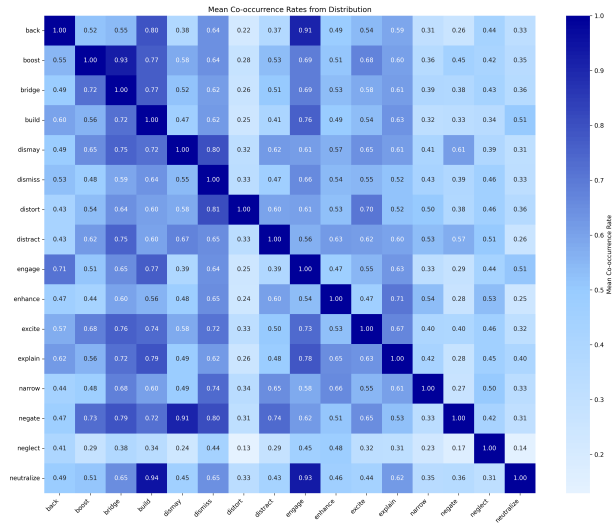


Figure 6.10: Co-occurrence heatmap of the Balikatan 22 data - note that there is no concept of intended vs detected BEND maneuvers in real data

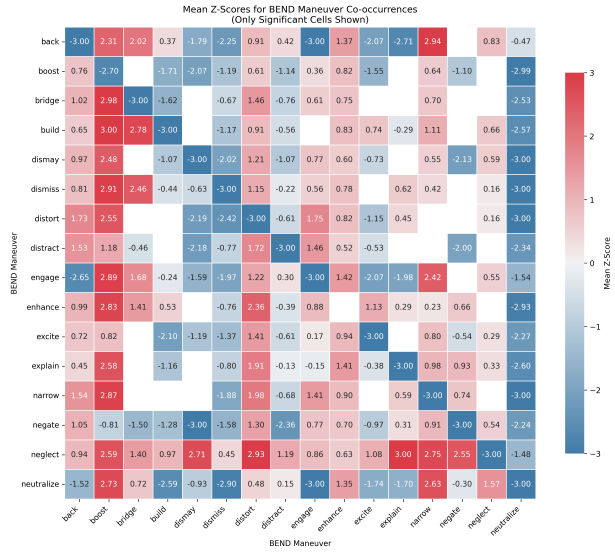


Figure 6.11: Co-occurrence matrix across all runs that had the BEND definitions in the system prompt but did not repoll the LLM

Table 6.10: BEND Maneuver Analysis - Detected (Column Means)

Maneuver	No Definitions	Definitions_user	Definitions_system	Definitions_repull
back	**0.35**$^{+}$	**0.36**$^{+}$	**0.37**$^{+}$	**0.37**$^{+}$
boost	**-1.24**$^{-}$	**1.20**$^{+}$	**1.95**$^{+}$	**1.85**$^{+}$
bridge	**-1.27**$^{-}$	**-0.55**$^{-}$	**0.51**$^{+}$	**0.43**$^{+}$
build	**-1.83**$^{-}$	**-1.34**$^{-}$	**-0.85**$^{-}$	**-0.75**$^{-}$
dismay	**-0.42**$^{-}$	**-1.47**$^{-}$	**-1.02**$^{-}$	**-1.13**$^{-}$
dismiss	**-2.35**$^{-}$	**-1.96**$^{-}$	**-1.52**$^{-}$	**-1.61**$^{-}$
distort	**1.14**$^{+}$	**1.21**$^{+}$	**1.16**$^{+}$	**1.04**$^{+}$
distract	**0.34**$^{+}$	**-0.76**$^{-}$	**-0.59**$^{-}$	**-0.56**$^{-}$
engage	-0.02	-0.01	0.02	0.02
enhance	**0.85**$^{+}$	**0.85**$^{+}$	**0.87**$^{+}$	**0.85**$^{+}$
excite	**-0.83**$^{-}$	**-1.43**$^{-}$	**-0.65**$^{-}$	-0.30
explain	**-0.41**$^{-}$	**-0.61**$^{-}$	**-0.29**$^{-}$	**-0.35**$^{-}$
narrow	0.18	**0.51**$^{+}$	**0.89**$^{+}$	**0.83**$^{+}$
negate	**1.38**$^{+}$	**-0.46**$^{-}$	-0.26	**-0.52**$^{-}$
neglect	**1.16**$^{+}$	**0.43**$^{+}$	**0.17**$^{+}$	**0.25**$^{+}$
neutralize	**-2.42**$^{-}$	**-2.43**$^{-}$	**-2.43**$^{-}$	**-2.43**$^{-}$

- increasing the distance between overall BEND definitions and the specific ones being requested - significantly increases the accuracy of the LLM returned responses. However, the methodology we take for trying to re-request the LLM for a better BEND response provided no significant improvement.

6.8 Future Work and Limitations

There are significant limitations to the current model that can be corrected in future work. First, the agents in the current model have opinions matrices that map their stance on each topic in the

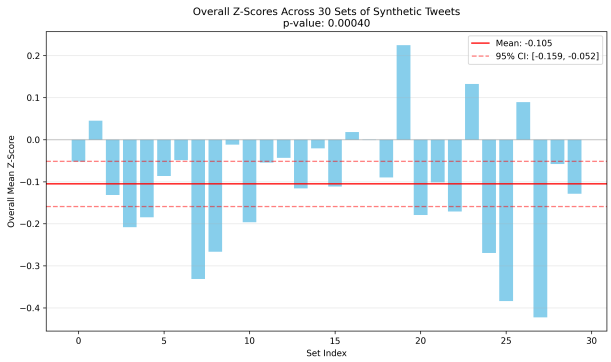


Figure 6.12: A comparison of the overall distance from the mean for all runs that had the BEND definitions in the system prompt but did not repoll the LLM

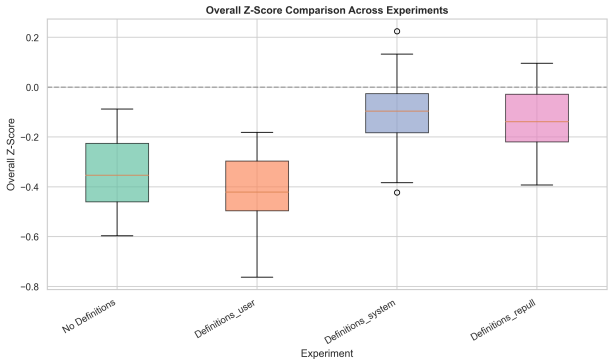


Figure 6.13: A comparison of the overall distance from the mean across all BEND maneuvers from each of the four major experiment setups

scenario; however, there is currently no population modeling implemented to feed these matrices nor is there information diffusion implemented such that theses stances change over time. Thus, while the actors respond in accordance with their opinions, the simulation is currently a perfect model of arguing on Internet forums - no one ever changes their mind.

Furthermore, more validation should be done. If the goal is simply to train on BEND maneuver detection and response, then the current validation network metrics and BEND evaluations show that SynX is sufficient. However, training and instruction on other aspects of social networks might require additional, unevaluated, network properties. This includes more research into matching the Agent x Agent modularity against real world datasets. Netanomics does have a fully featured evaluation tool for synthetic social media data sets, MOMUS. MOMUS will verify the synthetic dataset's adherence to the AESOP scenario, the semantic and syntactic content of the messages, and the overall network structure against real world data. This will provide a more thorough evaluation of the dataset. These same evaluations should be mapped to SynTel. These results should confirm what is currently only assumed - prompting for a post from an LLM told that it is to emulate a Telegram user renders similar results to prompting for a post from an LLM that is told it is to emulate an X/Twitter user.

Additional work should be done to improve the re-request methodology from the LLM. We provided the same prompt to the LLM again but added the original returned results as well as an explanation of what was present and what was missing. Other methodologies should be explored, including asking the LLM itself to improve the message.

More work is also required to fully support multi-modal data. There is currently some support for multi-modal data in SynTel/X. Specifically, planners can specify URLs in AESOP that are associated with media and assign them to narratives. SynTel/X will ensure that these URLs are included in appropriate messages – thereby embedding the media within these messages. This allows for images, sound, and video to appear in the produced corpus.

However, further work should be done to allow for fully multi-modal BEND maneuvers. This work is best done in AESOP, which should allow for the creation of media not just by narrative but also by BEND maneuver. In particular, AESOP should have the capability to leverage LLMs and diffusion/image generation models to take planner input text and create accompanying images. This is best thought of as a four-stage process: 1) Planner inputs text – including desired

narrative and BEND maneuver(s), 2) LLM parses text and creates appropriate image prompt, 3) Prompt is fed to a diffusion/image generation model, 4) Image is returned and assigned appropriate narrative and BEND maneuver for use by SynTel/X. Similar pipelines could be created in AESOP for audio-visual media as well.

Work is also required within the BEND evaluations. While the AESOP scenario comes with images and news sites, the current ORA-Pro and NetMapper BEND evaluation is done only on the meta-data and the text. Future detection should include an evaluation of the included images or referenced URLs.

As noted previously in this chapter when discussing The One True Omen validation exercise, the current scale of synthetic data and scenario are sufficient for training, as assessed by the exercise control and training audience of that exercise. A targeted, API pull for a single day of data being between 15,000 to 50,000 messages (even up to 100,000) is reasonable and possible with the current SynTel/X and AESOP architecture. However, there will be a need to increase the scale in the future to follow the inevitable march of progress. Towards this end, AESOP will need to be expanded. Events, narratives, and groups are already capable of scaling higher or facilitating additional message traffic at current quantities – i.e. more accounts added to existing groups talking on existing narratives about existing events. The largest change will need to be in accounts. Currently accounts are created individually. This process is scaffolded by automation and generative AI; however, in the future, AESOP will need to allow for the dynamic creation of actors from a population model. Additionally, those bottlenecks enumerated within SynTel/X earlier in this chapter will need to be addressed in order to accommodate the increased number of actors.

Finally, there is more work to be done with bots. As bot-detection methods advance SynTel/X must advance the bot rule-sets to match them. Narrative bots may become increasingly difficult to pick out from the crowd as LLM training and output improves; however, structural bots – such as the amplifier and bridging bots – should continue to be readily detectable and SynTel/X should continue simulate these appropriately. Additionally, both AESOP and SynTel/X will need to expand their capability to simulate bot-nets within the corpus – this is currently limited to dozens rather than the hundreds needed to accurately represent the possible effects of a large-scale coordinated bot-net effort.

6.9 Conclusions

I created an agent-based simulation, SynX, to model synthetic social media based on input scenario templates from Netanomics' AESOP tool. Validation testing shows that SynX is capable of creating highly dynamic datasets that present BEND maneuvers similar to those of real-world datasets. Additionally, I experimented with different techniques for interaction with an LLM and found that the inclusion of BEND definitions in system prompts was most effective. The validation and results show that SynX provides an effective way to create tailored social media datasets for analyst training on BEND maneuvers.

Chapter 7

BEND: Effects-based detection

Social media is organized into Topic-Oriented-Communities . Groups of actors who talk to each other about the same topic. They can be analyzed using network analysis. They can be changed at both the narrative and community level by information maneuvers.

7.1 Research Questions

ORA and NetMapper combine to provide a BEND report that automatically detects BEND maneuvers. This methodology is based on work by Blane, who laid out a framework for analysis that uses a complex method for weighting CUES to identify maneuvers.[13] CUES here refers to the linguistic cues extracted from the message text through the NetMapper software. These linguistic cues are what ORA-Pro uses to identify BEND maneuvers per message text.

In this chapter, I propose to move beyond identifying BEND maneuvers within specific messages based on derived intent. Instead of taking a source and a message and extrapolating an intended effect, I want to identify effects experienced by a target in order to determine the BEND maneuver experienced. To use an analogy from military targeting, instead of looking at the aircraft and the weapons load-out and determining that this will be a mission to destroy a tank, I want to look at the the target, in this case the tank, and determine exactly what effects it experienced. This approach is captured in Figure 7.1.

This evaluation of the damage done to the target – in this case a tank – is called a Battle Damage Assessment (BDA). BEND-effects is an attempt to replicate the BDA process within the information environment. Each of the BEND-effects is currently defined as a short-term change in a metric – bounded to a max of three days – and is a comparison between a group at time 1 and the same group at time 2. This bounded, over-time comparisons of groups must be compared to the baseline – against the same change in the entire corpus – in order to control for natural or extrinsic changes. An example of this might be a general reduction in positive sentiment after a global catastrophe – certainly the corpus has been dismayed – but if we want to find those groups that are being targeted with dismay maneuvers we need to control for the overall dismay effect in the corpus.

The strict comparison between two time periods within the same group means that long term effects may not be detected. In order to combat this issue, this chapter also introduces the notion

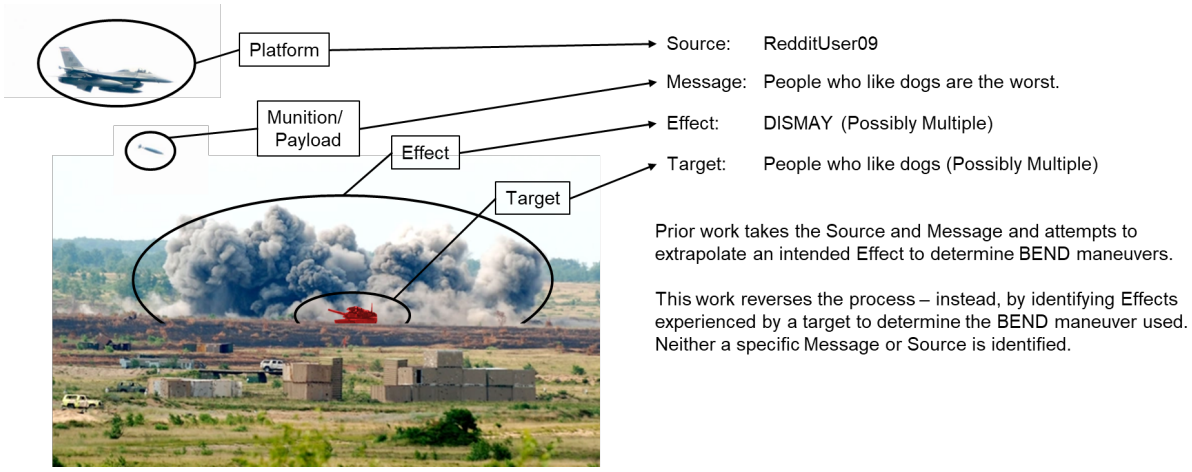


Figure 7.1: An analogy for how intent-based BEND and effects-based BEND interact

of chaining these detections through longer time periods (14+ days). This allows for these simple comparisons to be amalgamated into long-term trends that provide insight into the character of narrative campaigns that might be targeting these groups.

The key research questions for this chapter are:

- How can we detect the presence of BEND maneuvers through their effects?
- Can we match these maneuvers with narrative campaigns?

7.2 BEND-Effects Definitions

I have developed a set of network and narrative metrics to define BEND effects for X/Twitter. Generally these metrics involve changes over time above the baseline corpus - requiring a computation of the metric against both the corpus and the target/target group. Additionally, many require heterogeneous graphs - involving actors, topics, and stance. This approach requires strict definitions for the entities involved and metrics derived.

First, I define two types of topic-oriented groups (TOGs). Because the BEND framework involves maneuvers in both the network and narrative spaces, these groups need to be cohesive in both. This is what makes them topic-oriented groups. In general, grouping of agents is done in network space - here network refers to typical connections gleaned from social media corpora - retweets, quotes, replies, mentions, etc. Therefore, they are groups but I also need them to be narratively connected - they need to not just be groups but *topic-oriented* groups.

Therefore, a topic-oriented group (TOG) is a group of agents clustered in both network and narrative space. However, because all of the BEND-effects are over-time changes there is a distinction between two related topic-oriented groups. A topic-oriented cluster (TOG cluster) is a TOG found within a single time-frame. Matching multiple topic-oriented clusters through time reveals communities that stretch across the corpus in time - these are called topic-oriented communities (TOG community). Figure 7.2 shows the key I will be using for illustrations in the following sections.

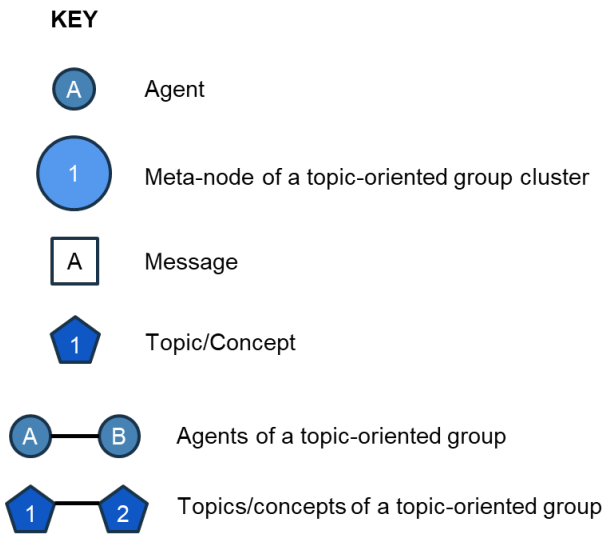


Figure 7.2: BEND-Effects key for illustrations

- Topic-Oriented Group (TOG): a group clustered in both the network and narrative space
- TOG cluster: an identified topic-oriented group in a single time frame
- TOG community: linked topic-oriented clusters through time

With these in mind I will now provide the standard BEND definitions derived from Blane[13] and pair them with their corresponding effects-based definition and metrics.

Bridge/Neutralize

> **Bridge**: Discussion or actions that establish a connection between two or more groups or create the appearance of such a connection [13]
>
> **Neutralize**: Discussion or actions that cause a group to be dismantled or appear to be dismantled [13] *[Note: This was originally titled "Nuke" in Blane's thesis but was changed to prevent confusion and amended to now translate as: Discussions or actions that cause a group to be, or appear to be, no longer of relevance, e.g. because it was dismantled.]*

Bridge maneuvers involve discussion or actions that build a connection between two or more groups or create the appearance of such a connection. To detect this, I will look at the overall connections between between any two clusters and their change over time. If the number of links between the representative meta-nodes of any two clusters increases over time then bridging is occurring. Conversely, if the number of links is decreasing then neutralization is occurring.

To calculate this, I let C_i and C_j denote two clusters of nodes identified in time period t_1. Let these same sets of nodes be examined in time period t_2.

Define:

- $L_{ij}^{(t_1)}$: the number of links between nodes in clusters C_i and C_j at time t_1
- $L_{ij}^{(t_2)}$: the number of links between the same clusters C_i and C_j at time t_2

- $L_{ij}^{\text{total}} = L_{ij}^{(t_1)} + L_{ij}^{(t_2)}$: the total number of links between the two clusters across both time periods

We normalize the inter-cluster links in each time period as follows:

$$\hat{L}_{ij}^{(t_1)} = \frac{L_{ij}^{(t_1)}}{L_{ij}^{\text{total}}}, \qquad \hat{L}_{ij}^{(t_2)} = \frac{L_{ij}^{(t_2)}}{L_{ij}^{\text{total}}}$$

Then compute the change in normalized inter-cluster connectivity:

$$\Delta_{ij} = \hat{L}_{ij}^{(t_2)} - \hat{L}_{ij}^{(t_1)}$$

Interpretation:

- If $\Delta_{ij} > 0$, bridging is **increasing**
- If $\Delta_{ij} < 0$, bridging is **decreasing** (neutralizing)
- If $\Delta_{ij} = 0$, the connection is **stable**

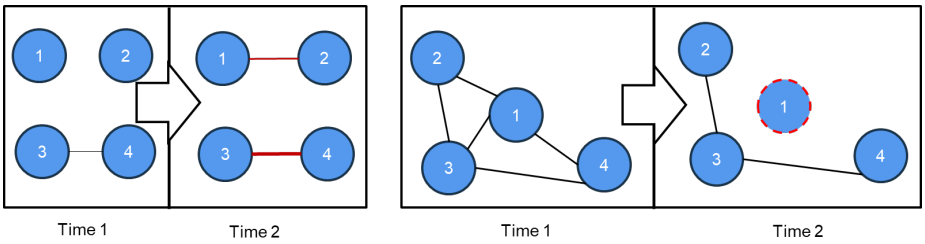


Figure 7.3: Visualization of bridge/neutralize.

Back/Negate

> **Back**: Discussion or actions that increase the actual, or the appearance of, an actor's importance or effectiveness relative to a community or topic [13]
>
> **Negate**: Discussion or actions that limit the actual, or the appearance of, an actor's importance or effectiveness relative to a community or topic [13] *[Note: This was originally "Neutralize" in Blane's thesis but "Neglect" became "Negate" and was switched with "Neutralize" for clarity purposes.]*

Backing and negation of actors within a corpus is already an important feature for most network analysis tools and ORA-Pro already provides a analytic tools for this purpose. In order to detect if an actor has been the target of a back maneuver, I will be looking for a positive change over time - above the baseline corpus - in the centrality of an actor within the actor interaction network. Inversely, for negate, I will be looking for a negative change in a target actor's centrality over time of a magnitude greater than that of the baseline corpus. ORA-Pro provides Super Spreader, Super Friend, General Influencer, and Eigenvector Centrality metrics that are used in ensemble for this maneuver. Within ORA-Pro, Super Spreaders are those agents that produce documents that are shared often by others. Super Friends are agents that often exhibit two-way communication patterns. General Influencers are agents that have high follower counts and are

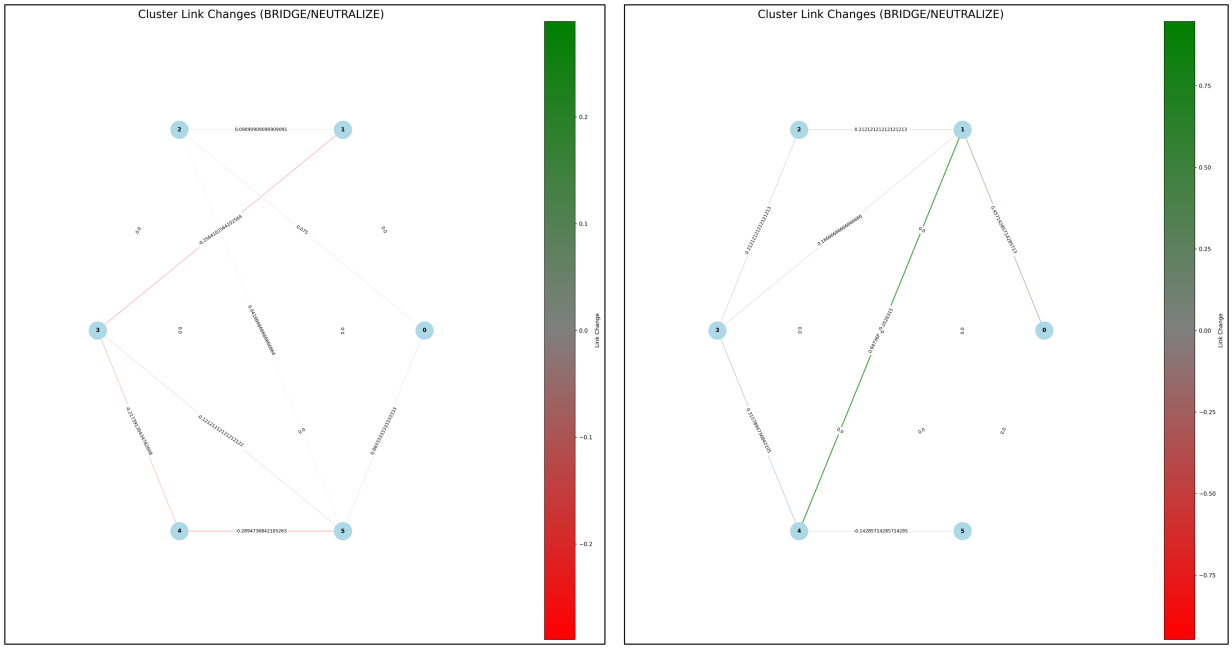


Figure 7.4: Actual results of bridge/neutralize.

retweeted/mentioned by those with high follower counts. For Eigenvector Centrality an agent's centrality is based upon the centrality of its neighbors.

Build/Narrow

> **Build**: Discussion or actions that create a community or create the appearance of a community [13]
>
> **Narrow**: Discussion or actions that lead a group to fission (or appearance of fission) into two or more distinct groups [13]

Build maneuvers are marked by discussion or actions that create a group, or the appearance of a group, where there was none before. Therefore, I will be looking for either new group emergence - specifically new Leiden-detected topic-oriented clusters under the BEND-effects construction - or multiple smaller groups forming a new, larger community.

Narrow maneuvers exhibit discussion or actions that lead a group to be, or appear to be, more specialized, and possibly to fission, or appear to fission, into two or more distinct groups. Within BEND-effects, I will be looking for a single group splitting into multiple groups or the disappearance of links on the bipartite network from meta-agent group node to topic/stance nodes.

Boost/Neglect

> **Boost**: Discussion or actions that increase the size of a group and the connections among group members or the appearance of such [13]
>
> **Neglect**: Discussion or actions that decrease the size of the group, or the connections among the members, or the appearance of these [13]

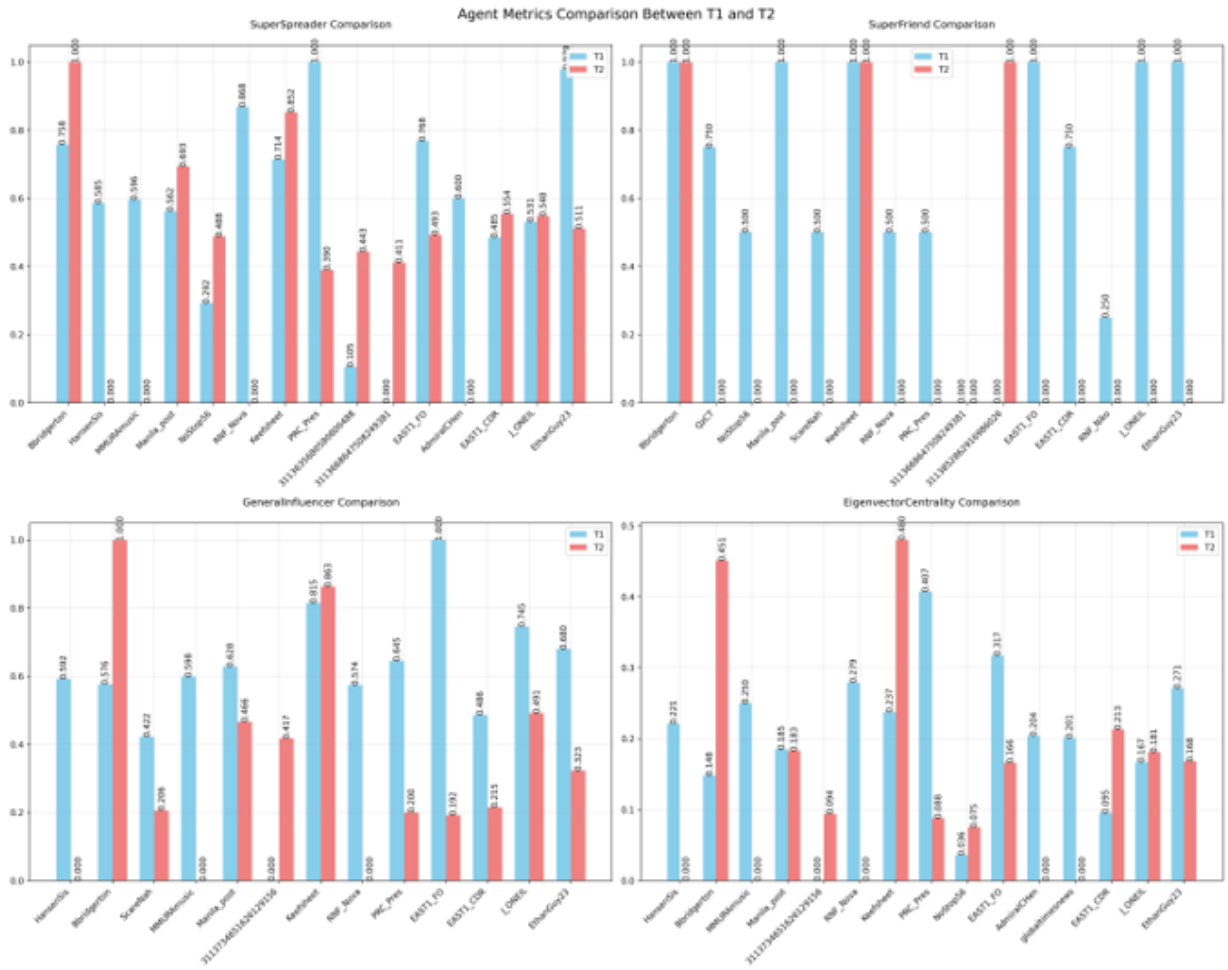


Figure 7.5: Actual results of back/negate.

Boost maneuvers require discussion or actions that increase the size of a group and/or the connections among group members, or the appearance of such. I will look at average path length in the agent x agent network in order to determine if a group is experiencing boosting - a decrease in average path length. A neglect maneuver effect would be an increased average path length.

This approach solves two significant issues. The first is the temptation to use density calculations for boost/neglect. Unfortunately, density is tied closely to network size such that a large increase in nodes in a cluster would reduce density and thereby reduce boosting even though increased node numbers would seem to be a secondary objective of the boosting maneuver. Average path length is more resistant to size changes and therefore a better metric.

The second issue is that both build and boost maneuvers allude to size changes in a topic-oriented group. In differentiating the two, I opted to look carefully at my initially framing - topic-oriented groups via Leiden grouping. Because Leiden grouping allows for singleton clusters, topic-oriented groups can be single nodes. There could not meaningfully be 'new' groups from time to time unless the agents themselves are wholly new. Instead, what we see are groups (often singleton clusters) coming together to form new larger groups - this fits the original def-

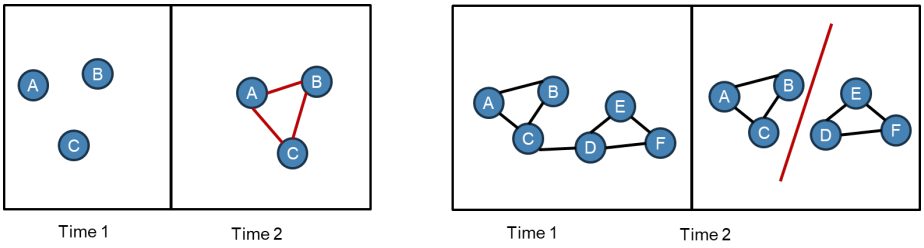


Figure 7.6: Visualization of build/narrow.

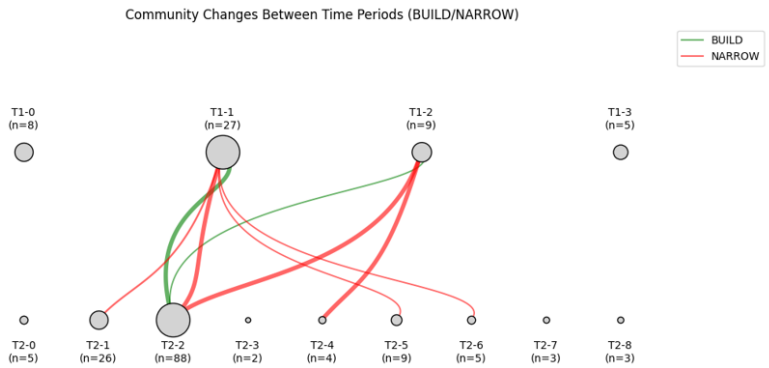


Figure 7.7: Actual results of build/narrow.

inition of 'build' - non-cohesive individuals coming together - despite it really just being a size change/amalgamation of groups under the new topic-oriented groups framing device. This is why I opted to push size solely into the build maneuver and pair its merging with the narrow maneuver's splitting. This leaves the boost maneuver with 'connections among the members' - and therefore recommends average path length as an appropriate metric.

So to calculate boost and neglect, I let C_k be a community of nodes identified in both time periods t_1 and t_2, and let $G_k^{(t)}$ be the subgraph induced by C_k at time t, using only internal links (i.e., the agent $\times$ agent network restricted to nodes in C_k).

Define:

- $\ell_k^{(t)}$: the average shortest path length in $G_k^{(t)}$

Then compute:

$$\Delta \ell_k = \ell_k^{(t_2)} - \ell_k^{(t_1)}$$

Interpretation:

- If $\Delta \ell_k < 0$, then community C_k is experiencing **boosting** (increased internal cohesion)
- If $\Delta \ell_k > 0$, then community C_k is experiencing **neglecting** (decreased internal cohesion)
- If $\Delta \ell_k = 0$, cohesion is **stable**

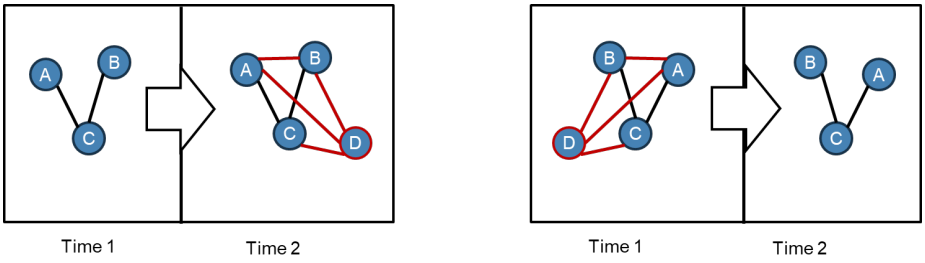


Figure 7.8: Visualization of boost/neglect.

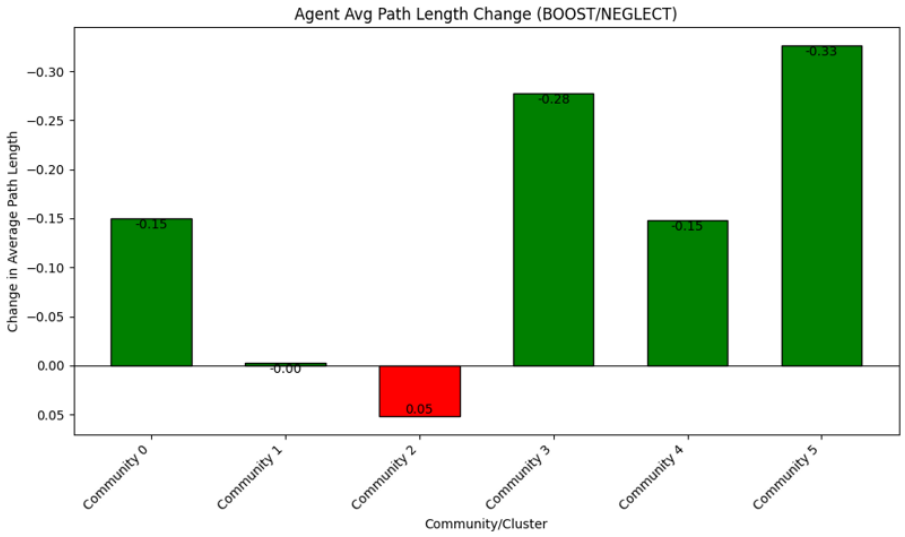


Figure 7.9: Actual results of boost/neglect.

Excite/Dismay

> **Excite**: Discussion or actions related to the topic that bring joy, happiness, cheer, enthusiasm in the targeted community or actor [13]
>
> **Dismay**: Discussion or actions related to the topic that create worry, sadness, anger, or fear in that targeted community or actor [13]

Excite maneuvers include discussion or actions related to a community or topic that cause the reader to experience a positive emotion such as joy, happiness, liking, or excitement. For excite maneuvers, I will look for target output message emotional valence to be higher in happiness over time.

Dismay maneuvers involve discussion or actions related to a community or topic that cause the reader to experience a negative emotion such as worry, sadness, disliking, anger, despair, or fear. As the inverse of excite, I will look for target message emotional valence increasing in anger, sadness, fear over time.

To calculate this, I let C_k be the tweets in a topic-oriented community, and let t_1 and t_2 denote two time periods.

Define:

- $P_k^{(t)}$: total number of **positive cues** in cluster C_k at time t
- $N_k^{(t)}$: total number of **negative cues** in cluster C_k at time t
- $T_k^{(t)} = P_k^{(t)} + N_k^{(t)}$: total sentiment cues in C_k at time t
- $R_k^{+(t)} = \frac{P_k^{(t)}}{T_k^{(t)}}$: positive cue ratio
- $R_k^{-(t)} = \frac{N_k^{(t)}}{T_k^{(t)}}$: negative cue ratio

Then compute the change in positive and negative sentiment ratios:

$$\Delta R_k^{+} = R_k^{+(t_2)} - R_k^{+(t_1)}$$
$$\Delta R_k^{-} = R_k^{-(t_2)} - R_k^{-(t_1)}$$

Interpretation:

- If $\Delta R_k^{+} > 0$, the cluster is experiencing **Excite**
- If $\Delta R_k^{-} > 0$, the cluster is experiencing **Dismay**
- If both deltas are close to zero, the emotional state is **stable**

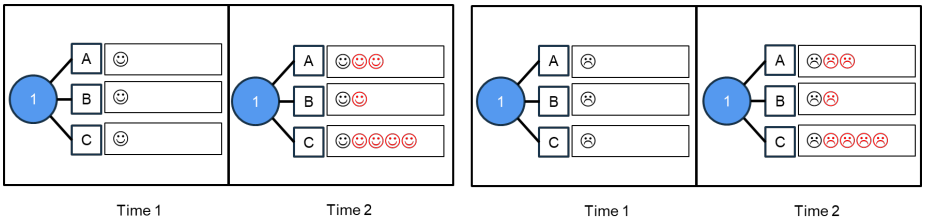


Figure 7.10: Visualization of excite/dismay.

Explain/Distort

> **Explain**: Discussion or actions that provide details on, or elaborate on, a topic to the target community or actor [13]
>
> **Distort**: Discussion or actions that provide unsupportive material that slant the topic for the targeted community or actor [13]

Explain maneuvers will exhibit discussion or actions that clarify a topic to the targeted community or actor often by providing details on, or elaborations on, the topic. For effects-based detection, explain and distort are similar to boost and neglect in the agent space. Explains will decrease the average path length of the concept x concept network of cluster - the concepts are more cohesive. A distort will increase the average path length of the concept x concept network - the concepts are less cohesive.

So to calculate explain and distort, I let C_k be a community of concept nodes identified in both time periods t_1 and t_2, and let $G_k^{(t)}$ be the subgraph induced by C_k at time t, using only internal links (i.e., the concept $\times$ concept network restricted to nodes in C_k).

Define:

- $\ell_k^{(t)}$: the average shortest path length in $G_k^{(t)}$

Then compute:

$$\Delta \ell_k = \ell_k^{(t_2)} - \ell_k^{(t_1)}$$

Interpretation:

- If $\Delta \ell_k < 0$, then group C_k is experiencing **explaining** (increased internal cohesion)
- If $\Delta \ell_k > 0$, then group C_k is experiencing **distorting** (decreased internal cohesion)
- If $\Delta \ell_k = 0$, cohesion is **stable**

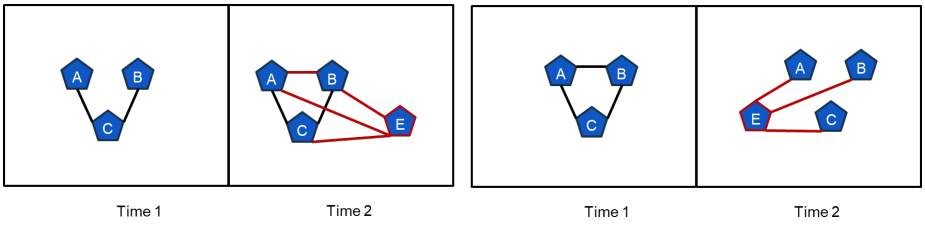


Figure 7.11: Visualization of explain/distort.

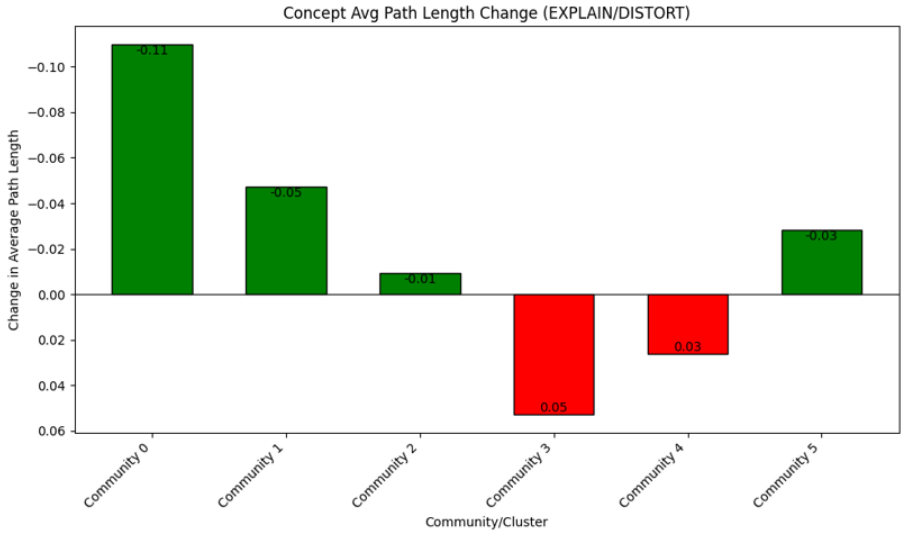


Figure 7.12: Actual results of explain/distort.

Engage/Dismiss

Engage: Discussion or actions that create a personal affinity between the target community or actor and the topic [13]

Dismiss: Discussion or actions that suggest that the topic is not important to the targeted community or actor [13]

Engage maneuvers involve discussion or actions that increase the relevance of the topic to the reader often by providing anecdotes or enabling direct participation and so suggesting that the reader can impact the topic or will be impacted by it. In order to detect the effects of engage maneuvers, I will look for a positive change over time in the proportional representation of defining topics within the group and for increased usage of 1st person pronouns. If there is a decrease in defining topic usage and a decrease in 1st person pronounces, then the group is experiencing the effects of a dismiss.

To calculate engage and dismiss, I let C_k be a set of messages associated with a group through time, and let t_1 and t_2 denote two time periods.

Let:

- $\mathcal{M}_k^{(t)}$: the set of messages associated with group C_k at time t
- $\mathcal{V}$: the set of all concepts (e.g., hashtags, URLs)
- $f_v^{(t)}$: the total frequency of concept $v \in \mathcal{V}$ in $\mathcal{M}_k^{(t)}$
- $F^{(t)} = \sum_{v \in \mathcal{V}} f_v^{(t)}$: total concept occurrences in $\mathcal{M}_k^{(t)}$
- $p_v^{(t)} = \frac{f_v^{(t)}}{F^{(t)}}$: proportional usage of concept v in time t
- $\mathcal{V}_\cap = \mathcal{V}^{(t_1)} \cap \mathcal{V}^{(t_2)}$: concepts used in both t_1 and t_2

Also, let:

- $u_1^{(t)}$: the number of 1st-person pronoun cues in $\mathcal{M}_k^{(t)}$
- $n^{(t)}$: the number of messages in $\mathcal{M}_k^{(t)}$
- $r_1^{(t)} = \frac{u_1^{(t)}}{n^{(t)}}$: average 1st-person usage per message

Now define:

$$\Delta p = \frac{1}{|\mathcal{V}_\cap|} \sum_{v \in \mathcal{V}_\cap} \left(p_v^{(t_2)} - p_v^{(t_1)} \right), \quad \Delta r_1 = r_1^{(t_2)} - r_1^{(t_1)}$$

Interpretation:

$$\begin{cases} \text{Engage} & \text{if } \Delta p > 0 \text{ and } \Delta r_1 > 0 \\ \text{Dismiss} & \text{if } \Delta p < 0 \text{ and } \Delta r_1 < 0 \\ \text{None} & \text{otherwise} \end{cases}$$

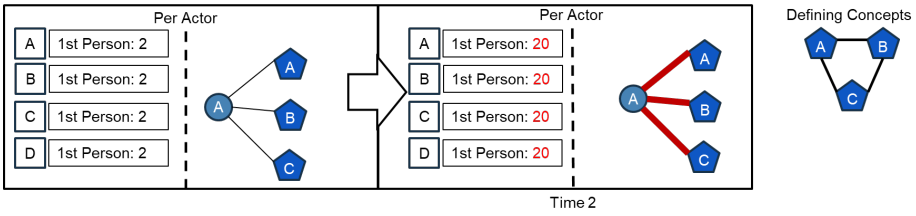


Figure 7.13: Visualization of engage/dismiss.

Enhance/Distract

> **Enhance**: Discussion or actions that provide supportive material that expands the topic for the targeted community or actor [13]
>
> **Distract**: Discussion or actions that redirect the targeted community or actor to a different topic [13]

Enhance maneuvers show discussion or actions that provide material that expands the scope of the topic for the targeted community or actor often by making the topic the master topic to which other topics are linked. To detect the effects of enhance maneuvers I will look for changes in the proportional usage of defining concepts - those concepts used in both time 1 and time 2 - and for distract I will look for a decrease in proportional usage.

To calculate this, I let C_k be a community tracked across two time periods t_1 and t_2. Let:

- $\mathcal{M}_k^{(t)}$: set of messages in cluster C_k at time t
- $\mathcal{V}_k^{(t)}$: set of concepts used in $\mathcal{M}_k^{(t)}$
- $f_v^{(t)}$: frequency of concept $v \in \mathcal{V}_k^{(t)}$
- $m_k^{(t)} = |\mathcal{M}_k^{(t)}|$: number of messages in cluster C_k at time t

We define the set of concepts used in both time periods as:

$$\mathcal{V}_\cap = \mathcal{V}_k^{(t_1)} \cap \mathcal{V}_k^{(t_2)}$$

Let the normalized usage of concept $v \in \mathcal{V}_\cap$ be:

$$p_v^{(t)} = \frac{f_v^{(t)}}{m_k^{(t)}}$$

Then define the **aggregate proportional change** across shared concepts:

$$\Delta p_k = \frac{1}{|\mathcal{V}_\cap|} \sum_{v \in \mathcal{V}_\cap} \left(p_v^{(t_2)} - p_v^{(t_1)} \right)$$

Interpretation:

$$\begin{cases} \text{Enhance} & \text{if } \Delta p_k > 0 \\ \text{Distract} & \text{if } \Delta p_k < 0 \\ \text{Stable} & \text{if } \Delta p_k = 0 \end{cases}$$

The top 10 concepts by magnitude of change (either positive or negative) from each time period are presented for context but are not used in the classification.

A summary of the maneuvers - their definitions and effects-based metrics can be found in Fig. 7.16 and Fig. 7.17.

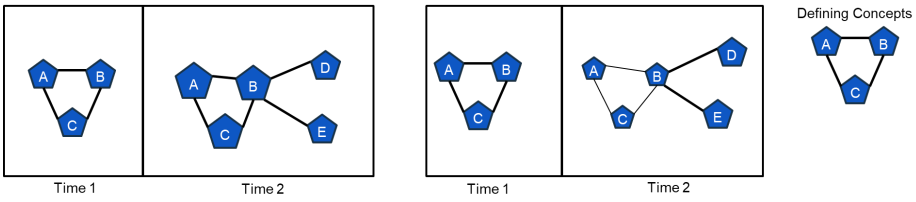


Figure 7.14: Visualization of enhance/distract.

7.3 Temporal Community Detection via Network Intersection and Clustering

In order to accomplish BEND-effects analysis, I have to first establish topic-oriented clusters and topic-oriented communities. As BEND looks at changes in both community and content, these groups must be cohesive from both a network point of view and from a narrative point of view. Therefore, I am constructing groups from agents that have high structurally modularity with surrounding agents both in the agent-interaction space and in the narrative space. To do this, I use the following steps:

Let $D = \{d_1, d_2, \ldots, d_T\}$ be the set of days in the corpus, where T is the total number of days.

1. **Daily Network Construction:**

   For each day $d_t \in D$:

   - Construct the agent-agent message network:

     $$G_t^{\text{agent/msg}} = (V_t^{\text{agent}}, E_t^{\text{msg}})$$

     where:

     - $G_t^{\text{agent/msg}}$ is a graph representing strong relation between agents based on retweets, replies, or quotes on day d_t - mentions not included.
     - V_t^{agent} is the set of agent nodes on day t.
     - E_t^{msg} is the set of edges representing agent-to-agent connections based on message interactions.

   - Construct the agent-agent concept network:

     $$G_t^{\text{agent/con}} = (V_t^{\text{agent}}, E_t^{\text{concept}})$$

     where:

     - $G_t^{\text{agent/con}}$ is a graph showing agents that exhibited the same concepts on day d_t.
     - V_t^{agent} is the set of agent nodes on day t.
     - E_t^{concept} is the set of edges showing agent-agent relationships through shared concepts (e.g., hashtags, URLs).

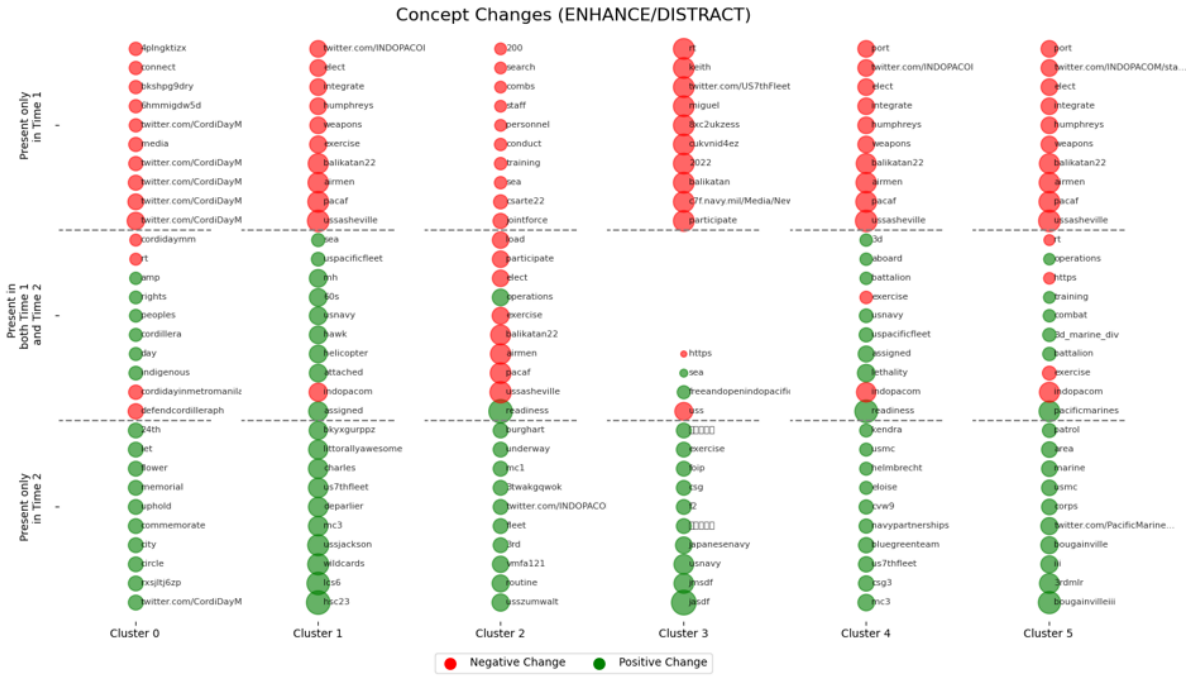


Figure 7.15: Actual results of enhance/distract. Cluster 1 is experiencing an enhance - the time 1+2 concepts are increasing (green) in proportional usage. Cluster 2 is experiencing a distract - proportional usage is decreasing (red)

.

- Compute the intersection (logical AND) of the two networks:

$$G_t^{\text{intersect}} = G_t^{\text{agent/msg}} \cap G_t^{\text{agent/con}}$$

where:

- $G_t^{\text{intersect}}$ retains only those edges that exist in both networks.

2. **Community Detection via Leiden Algorithm:**

The Leiden algorithm is an improvement over the Louvain algorithm for community detection that guarantees well-connected communities.[71] For each pair of consecutive days $(t, t+1)$, clusters are compared using the following approach:

$$\text{Leiden}(G, P) = \text{refinement}(\text{moveNodes}(G, P))$$

where:

- G is the network being analyzed.
- P is the current partition of nodes into communities.
- moveNodes(G, P) is the local moving phase that optimizes modularity by reassigning nodes to communities.
- refinement$(\cdot)$ is the key innovation that ensures well-connected communities.

Name	Definition	Effects-Based Detection
Back	Discussion or actions that increase the actual, or the appearance of, an actor's importance or effectiveness relative to a community or topic	**Measures: ORA-Pro Super Spreader, Super Friend, General Influencer and Eigenvector Centrality** **Network(s): Agent x Agent (Strong Ties)**
Negate	Discussion or actions that decrease the actual, or the appearance of, an actor's importance or effectiveness relative to a community or topic	
Build	Discussion or actions that create a group, or the appearance of a group, where there was none before	**Measures: TOG Cluster agent composition**
Narrow	Discussion or actions that lead a group to be, or appear to be, more specialized, and possibly to fission, or appear to fission, into two or more distinct groups	
Bridge	Discussion or actions that build a connection between two or more groups or create the appearance of such a connection	**Measures: Meta-node (TOG Community) ties** **Network(s): Agent x Agent (Strong Ties union Concepts)**
Neutralize	Discussion or actions that cause a group to be, or appear to be, no longer of relevance, e.g., because it was dismantled	
Boost	Discussion or actions that increase the size of a group and/or the connections among group members, or the appearance of such	**Measures: Average Path Length** **Network(s): Agent x Agent (Strong Ties)**
Neglect	Discussion or actions that decrease the size of a group and/or the connections among group members, or the appearance of such	

Figure 7.16: Narrative definitions and metrics

Name	Definition	Effects-Based Detection
Excite	Discussion or actions related to a community or topic that cause the reader to experience a positive emotion such as joy, happiness, liking, or excitement	**Measures: Messages of TOG Cluster agents in t2 and in t1 – evaluate for 4 positive/negative CUEs through NetMapper**
Dismay	Discussion or actions related to a community or topic that cause the reader to experience a negative emotion such as worry, sadness, disliking, anger, despair, or fear	
Explain	Discussion or actions that clarify a topic to the targeted community or actor often by providing details on, or elaborations on, the topic	**Measures: Average Path Length** **Network(s): Concept x Concept (Agents in TOG)**
Distort	Discussion or actions that obscure a topic to the targeted community or actor often by supporting a particular point of view or calling details into question	
Engage	Discussion or actions that increase the relevance of the topic to the reader often by providing anecdotes or enabling direct participation and so suggesting that the reader can impact the topic or will be impacted by it	**Measures: A) 1st Person pronoun usage, 2) Defining Concept usage (Defining Concepts are those concepts found in both time 1 and time 2)** **Network(s): Messages (NetMapper CUEs), Agent x Concept**
Dismiss	Discussion or actions that decrease the relevance of the topic to the reader often by providing stories or information that suggest that the reader cannot impact a topic or be impacted by it	
Enhance	Discussion or actions that provide material that expands the scope of the topic for the targeted community or actor often by making the topic the master topic to which other topics are linked	**Measures: Proportional change of concept usage of Defining Concepts (concepts found in both time 1 and time 2** **Network(s): Concept x Concept (Agents in TOG)**
Distract	Discussion or actions that redirect the targeted community or actor to a different topic often by bring up unrelated topics, and making the original topic just one of many	

Figure 7.17: Network definitions and metrics

3. **Local Node Moving Phase:** In this phase, each node i considers moving to the community of each of its neighbors j. The change in modularity ΔQ for moving node i from community c_i to community c_j is:

$$\Delta Q = \left[\frac{\Sigma_{in} + 2k_{i,in}}{2m} - \left(\frac{\Sigma_{tot} + k_i}{2m}\right)^2\right] - \left[\frac{\Sigma_{in}}{2m} - \left(\frac{\Sigma_{tot}}{2m}\right)^2 - \left(\frac{k_i}{2m}\right)^2\right]$$

where:

- Σ_{in} is the sum of weights of links inside community c_j.
- Σ_{tot} is the sum of weights of links incident to nodes in community c_j.
- k_i is the sum of weights of links incident to node i.
- $k_{i,in}$ is the sum of weights of links from node i to nodes in community c_j.
- m is the sum of weights of all links in the network.

4. **Refinement Phase:** After the local moving phase, the Leiden algorithm performs a refinement step:

$$P_{\text{refined}} = \{C_1^1, C_1^2, \ldots, C_1^{s_1}, C_2^1, \ldots, C_n^{s_n}\}$$

where:

- C_i is split into well-connected subcommunities $C_i^1, C_i^2, \ldots, C_i^{s_i}$.
- Each subcommunity is guaranteed to be connected.
- This prevents the formation of disconnected communities that can occur in the Louvain algorithm.

5. **Aggregation Phase:** The final phase creates a coarse-grained network where:

$$A_{IJ} = \sum_{i \in C_I, j \in C_J} A_{ij}$$

- A_{IJ} is the weight of the edge between communities I and J in the aggregated network.
- A_{ij} is the weight of the edge between nodes i and j in the original network.

6. **Convergence Guarantee:** The Leiden algorithm guarantees:

$$\lim_{r \to \infty} P_r \text{ is node optimal and subpartition } \gamma\text{-dense}$$

where:

- P_r is the partition after r iterations.
- Node optimal means no node can be moved to a different community to improve modularity.
- Subpartition γ-dense means all possible subsets of communities are optimally assigned.

Thankfully, the igraph package for Python [28] has an implementation for the Leiden algorithm, such that I can apply it easily to each intersected graph:

$$C_t = \text{Leiden}(G_t^{\text{intersect}})$$

where:

- $C_t = \{c_1^t, c_2^t, \ldots, c_{k_t}^t\}$ is the set of clusters (communities) detected in $G_t^{\text{intersect}}$.
- k_t is the number of clusters at time t.
- Each c_i^t is a set of nodes (agents or concepts) grouped together by structural similarity.

7. **Temporal Cluster Matching - Jaccard:**

   For each pair of consecutive days $(t, t+1)$, compare clusters across time using the Jaccard similarity index:

$$\text{Jaccard}(c_i^t, c_j^{t+1}) = \frac{|c_i^t \cap c_j^{t+1}|}{|c_i^t \cup c_j^{t+1}|}$$

   where:

   - c_i^t is a cluster at time t.
   - c_j^{t+1} is a cluster at time $t+1$.
   - The numerator counts the number of shared nodes between the two clusters.
   - The denominator counts the total number of unique nodes across both clusters.

8. **Match Criterion:**

   A pair of clusters is generally considered a match through time if their Jaccard index is at least 0.5:

$$\text{Jaccard}(c_i^t, c_j^{t+1}) \geq 0.5$$

For completeness sake, I also ran iterations that used the Adjusted Rand Index (ARI) and Normalized Mutual Information (NMI).[43] [74] Neither detected any additional communities that lasted beyond two days within any of the corpora and so I opted for the simplicity of Jaccard. BEND-effects is capable of using any of the three options for community detection.

7.4 Results

I applied the temporal clustering community detection and the subsequent BEND-effects maneuver detection to three different datasets - the Balikatan 2022 dataset, the dataset covering the Nice, France, terrorist attack in 2020 , and a synthetic scenario built with AESOP+SynTel/X. I have retained the grouping charts for each dataset and selected the most relevant other charts for discussion here. All graphs and charts for each set can be found in Appendix B.

7.4.1 Synthetic Dataset

The synthetic dataset has the cleanest results within BEND-effects, primarily due to the high modularity and consistent nodes across time - both obvious point against it when evaluating

realism. This fits well with my findings in Chapter 6, where the synthetic dataset modularity was the major failing point of the dataset when compared to the exemplar dataset.

The temporal clustering found six communities within the dataset - see Fig. 7.18. I used an LLM to get a short title for each community by asking it to summarize the collective concepts of the entire community.

There are bridging/neutralizing diagrams for every day from 02 May 2034 through 10 May 2034. The diagram from 07 May 2034, Fig. 7.19 shows significant bridging and neutralizing effects in this time period (delta from 06 May to 07 May). The Indo-Pacific Security Concepts community exhibits bridging with the Current Global Issues community and the Geopolitical Tensions and Protests community shows neutralizing with Geopolitical Tensions Overview.

Interestingly, the neutralizing effects between the Geopolitical Tensions and Protests community and the Global Tensions Overview community happen at the same time that an outflow of agents occurs from one to the other. This can be seen from our Build/Narrow diagram in Fig. 7.21. Notice the outflow of nine agents from cluster 2034-05-06_1 to cluster 2034-05-07_3. Eight of these agents return during the next time period and, as expected, the bridging occurs again - see Fig. 7.20.

Fig. 7.22 shows not only the boost and neglect effects through time but also maps the absolute number of boosts and neglects within the corpus for each time period - detected with cue-based BEND - and the proportion of all messages that are boost and neglect. The proportions appear to be relatively static - which might seem to be an affect of the synthetic dataset, but we can look at the boost neglect charts for the other two real datasets and see that all of them are relatively static. This means that the absolute maneuver count is really just a volume metric. Interestingly, but unsurprisingly, the neglect effect spiking for the Geopolitical Tensions and Protests community on this chart for the period 2034-05-07 to 2034-05-08 corresponds with their group size tripling on the build/narrow chart during the same time period.

For the synthetic dataset, the back/negate charts are somewhat mundane. Fig. 7.23 depicts the average for each of the four major scores allotted by ORA-Pro's Twitter report for the Geopolitical Tensions and Protests community. Again, their average scores dip with the influx of new community members from 2034-05-07 to 2034-05-08.

The enhance/distract charts are some of the most powerful here. Of particular interest is the enhance/distract effects chart for the time period between 2034-05-09 and 2034-05-10. During this time within synthetic scenario, a series of cyber attacks on ports is beginning to fade from the news cycle as war looms in the Pacific. In the chart, we can see that the Current Global Issues group has been distracted from the "portshudown" and "cyberattack" concepts by the new "warprep", "pacificpeace", and "worldpeace" concepts. The reduction in the defining concepts for this group - those concepts found in both time periods - suggests that they are being significantly distracted. Similarly, the Indo-Pacific Security community is shifting from the "portshutdown", "readinesss", and "ufo" concepts to discussions of a Pacific visit by UK royalty - "duchyes" and "duchess"; however, overall, their core concepts of "anti-piracy" and "freeandopendindopacific" have been enhanced by these additions.

During this same period, we can also see what engage or dismiss effects the communities are experiencing. From Fig. 7.25 we see that the Indo-Pacific Security Concepts community saw a significant increase in its net-defining concept change - this matches what we saw in the enhance/distract chart - and that there has been some increase in the usage of 1st person pronouns.

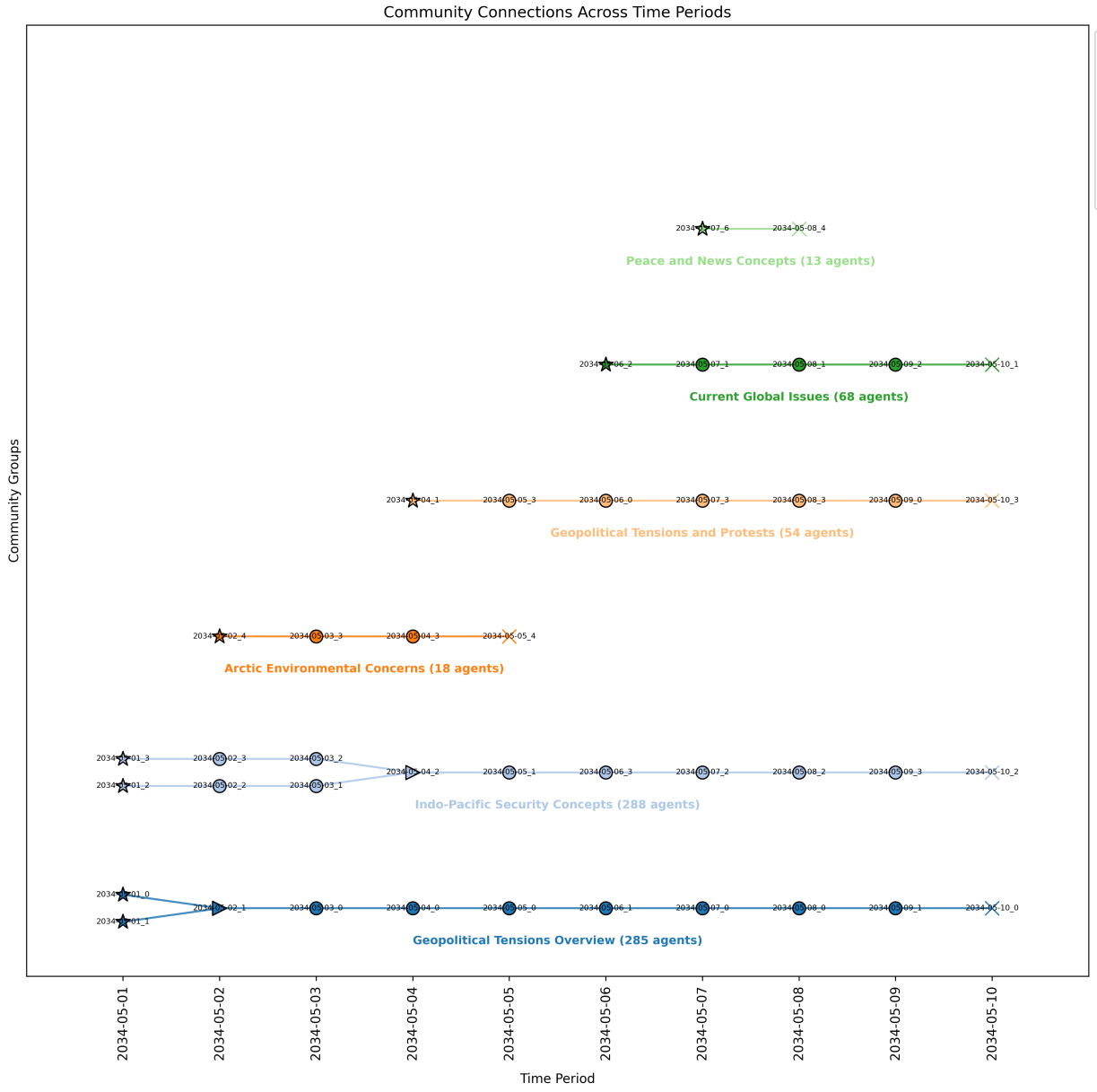


Figure 7.18: Topic-oriented communities through time in the synthetic dataset - star icons indicate a new group, triangles are merges, and an X indicates the group disappears

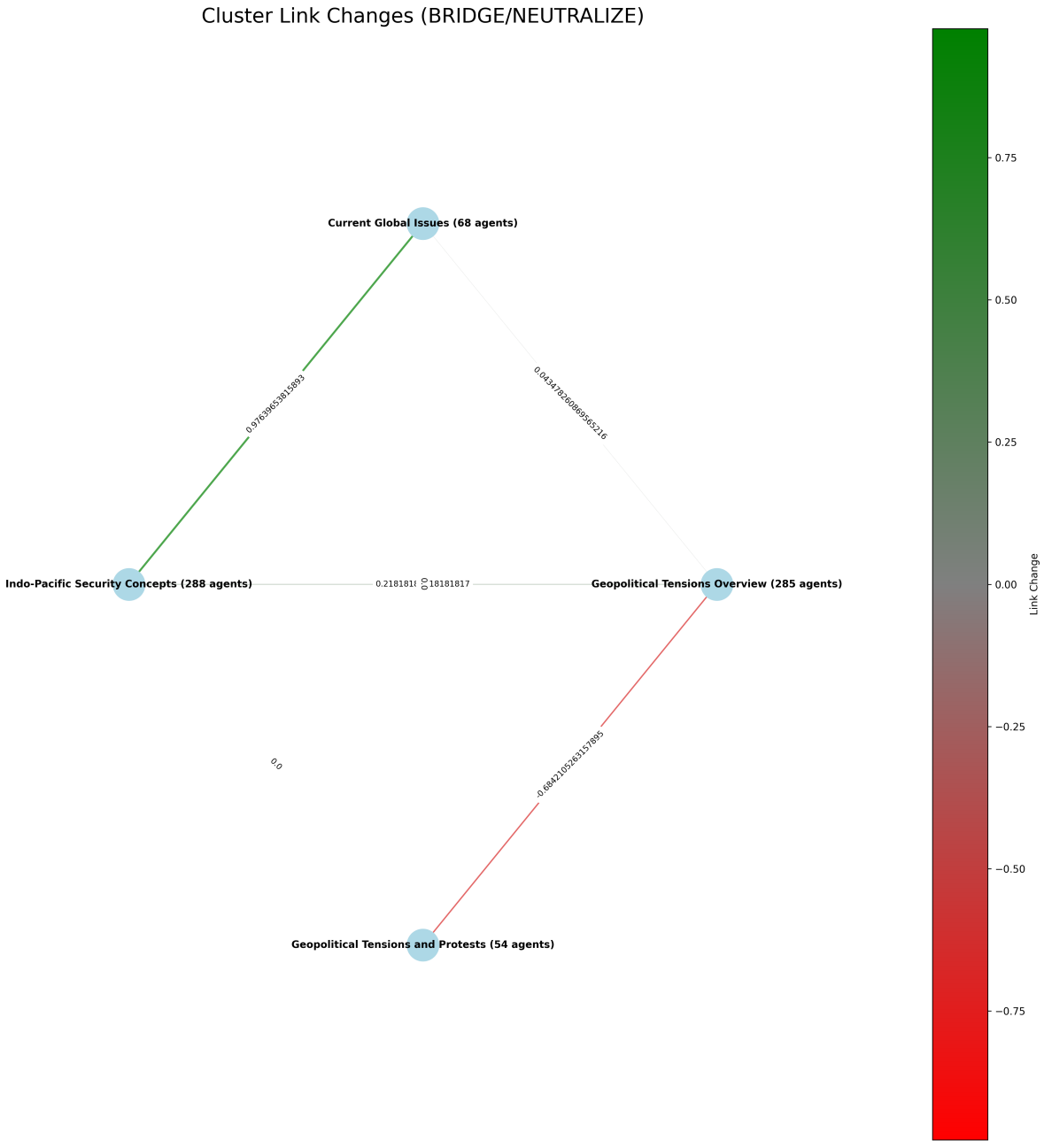


Figure 7.19: Bridge/neutralize results for 2034-05-06 to 2034-05-07. Red is a negative normalized link change and green is positive. All extant communities shown.

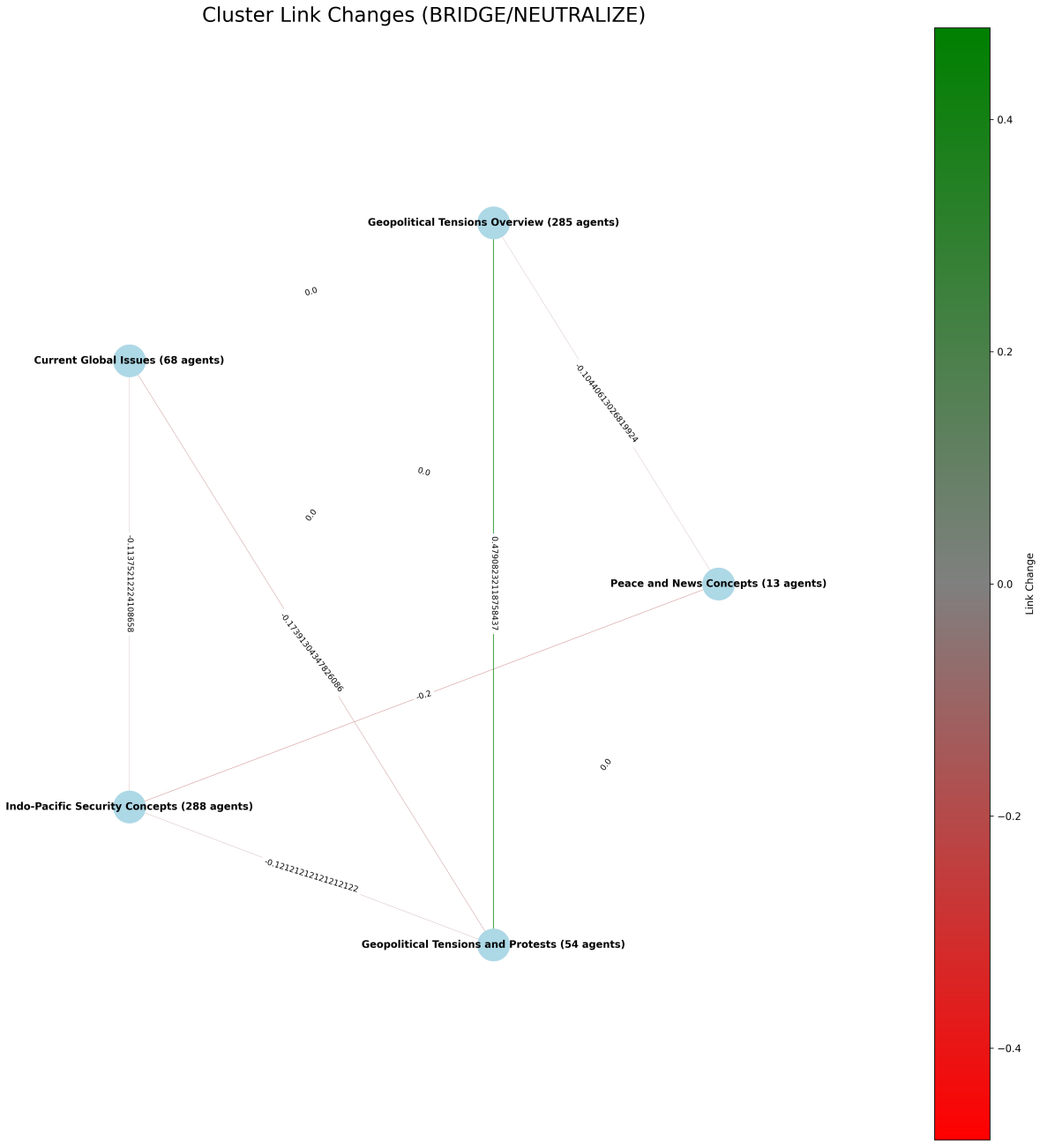


Figure 7.20: Bridge/neutralize results for 2034-05-07 to 2034-05-08. Red is a negative normalized link change and green is positive. All extant communities shown.

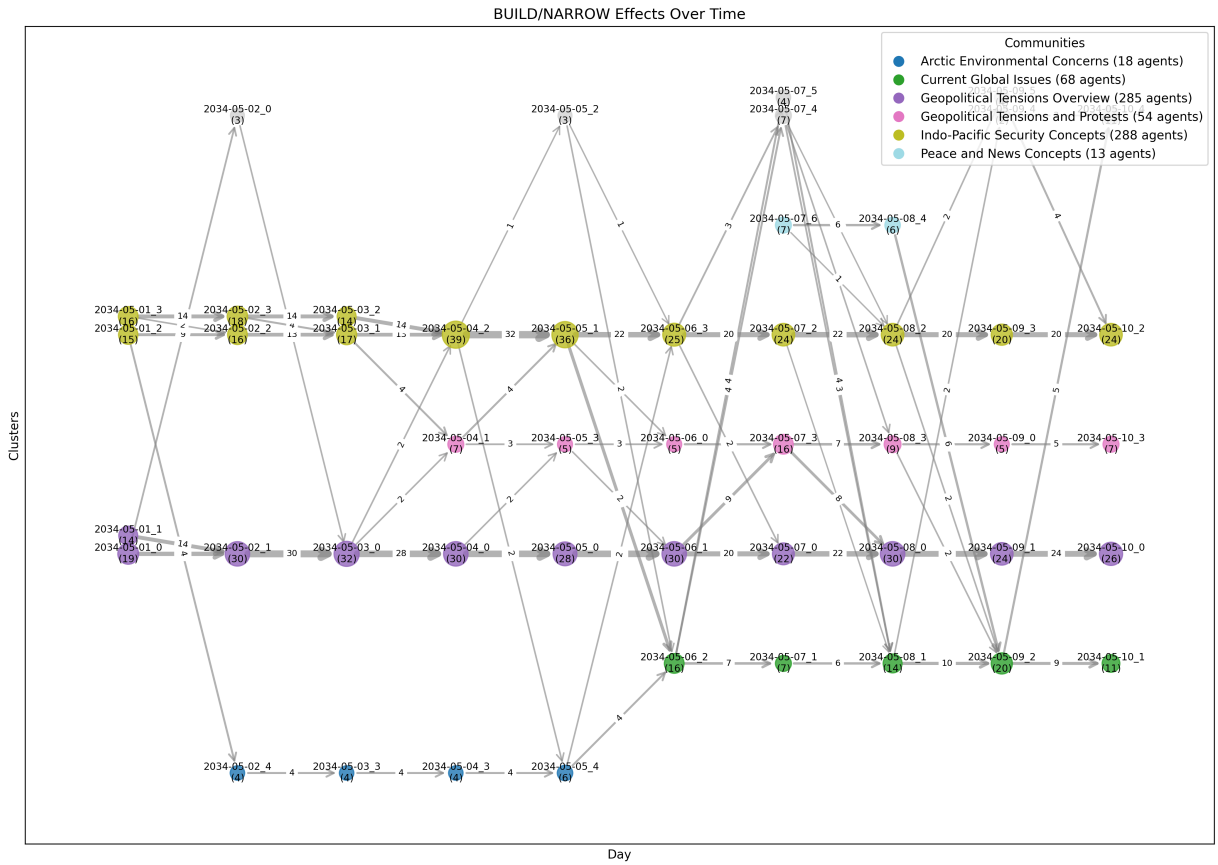


Figure 7.21: Build/Narrow results for the entirety of the synthetic data set. Arrows and numbers depict the flow of actors between clusters. Multiple clusters merging into a new cluster depicts build effects and disappearing or splitting clusters represent narrowing effects.

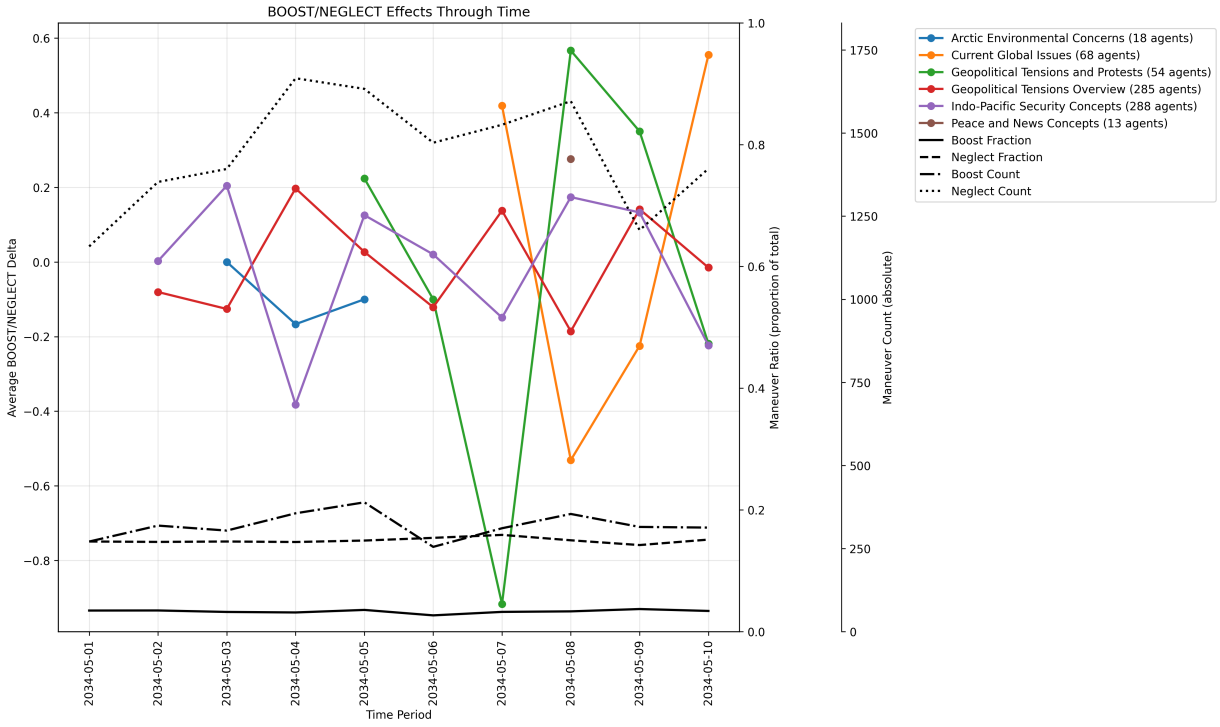


Figure 7.22: The boost and neglect effects experienced by the communities in the synthetic dataset [Note: The chart shows changes in average path length within the agent x agent network - this means that positive values indicate neglect effects and negative values indicate boost effects]

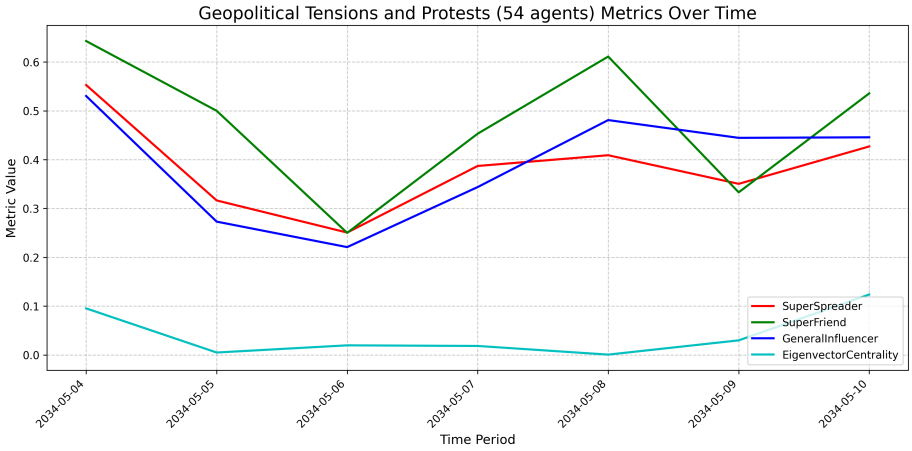


Figure 7.23: The back and negate effects experienced by the Geopolitical Tensions and Protests community in the synthetic dataset



Figure 7.24: The enhance and distract effects experienced by the communities between 2034-05-09 and 2034-05-10

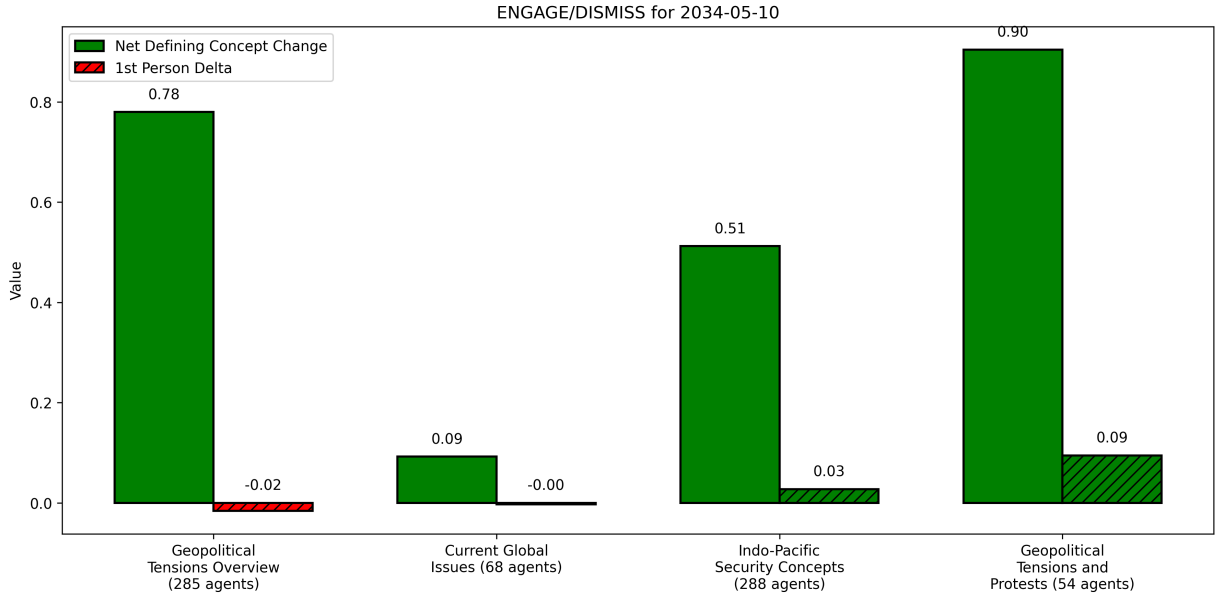


Figure 7.25: The engage and dismiss effects experienced by the communities between 2034-05-09 and 2034-05-10

This suggests that they are experiencing some level of engage effects. The Current Global Issues community also saw a small increase in the use of its defining concepts; however, we know from the enhance/distract chart that the increase in concept usage was mostly accounted for by URLs. The lack of either an increase or decrease in the 1st person usage in the group suggests that while they may be experiencing the effects of a distract, they are not showing signs of dismiss (negative delta of 1st person usage and decrease in defining concept usage).

We can also look at the explain and distort effects through time on these communities. Fig. 7.26 shows not only the change in average path length of the concept x concept network for each community, but it also maps the absolute number of explains and distorts within the corpus for each time period and the proportion of all messages that are explain and distort. Of particular note here, is that the Geopolitical Tensions and Protests group experiences large shifts in concept x concept path length within this time period - a hallmark of explain and distort effects.

This same group - the Geopolitical Tensions and Protests community - also had the most interesting reaction on the excite/dismay chart. In Fig. 7.27 we see that while all other groups show signs of significant dismay effects as the scenario spirals toward war, the Geopolitical Tensions and Protests community shows very little effects of either excite or dismay - they experience a very slight positive change.

7.4.2 Balikatan Dataset

For the Balikatan dataset, the temporal clustering found four communities within the dataset - see Fig. 7.28; however, these communities were smaller and shorter lived than those found in the synthetic dataset. This dataset was significantly smaller in size. Again, I used an LLM to get a short title for each community by asking it to summarize the collective concepts of the entire

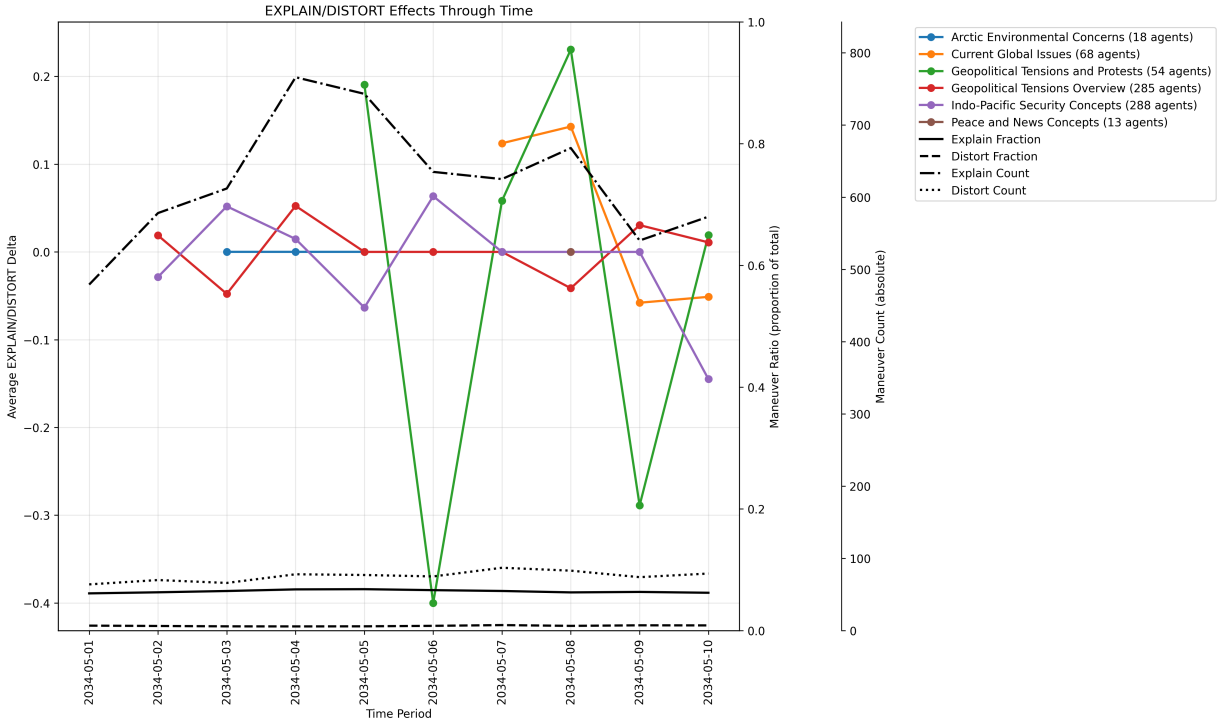


Figure 7.26: The explain and distort effects experienced by the communities in the synthetic dataset [Note: negative values represent explain effects and positives are distort effects]

community.

There are bridging/neutralizing diagrams only for 08 April 2022 through 09 April 2022 because those were the only days to have more than one community active at a time. I have included Fig. 7.20 here, but only to show that for both of these days there was no interaction between any of the three groups

The build/narrow diagram in Fig. 7.30 shows that most agents are not captured in any community. Both ARI and NMI were also unable to fully capture these nodes - see Fig. 7.31 and Fig. 7.32. The clusters are large, but they have such small agent retention between time periods that building communities over time is difficult.

Because these groups are shorter lived, the back and negate charts are less meaningful - providing just very brief snapshots of the groups. The Cordillera Day Concepts community is the longest lived and shows clear signs of backing from 2022-04-08 to 2022-04-09, see Fig. 7.33.

This same short-lived nature of the groups also makes it harder to glean information from the boost and neglect chart. Fig. 7.34 shows that the Indo-Pacific Cooperation community experienced significant boost effects on 2002-04-08 but then significant neglect effects on 2022-04-09.

The enhance/distract charts are again more interesting. In Fig. 7.35 we see that the Indo-Pacific Defense Cooperation community shows clear signs of enhance effects with their central concepts of ”lethality” and ”freeandopendindopacific” being enhanced by ”balikatan2022” and ”marine” concepts. Conversely we see that the Friendship and Alliances community has been distracted from their core ”friendsparntersallies” concept by the new ”freeandopendindopacific” and ”sidebysideat75” concepts. It is important to note that due to the way enhance and distract are

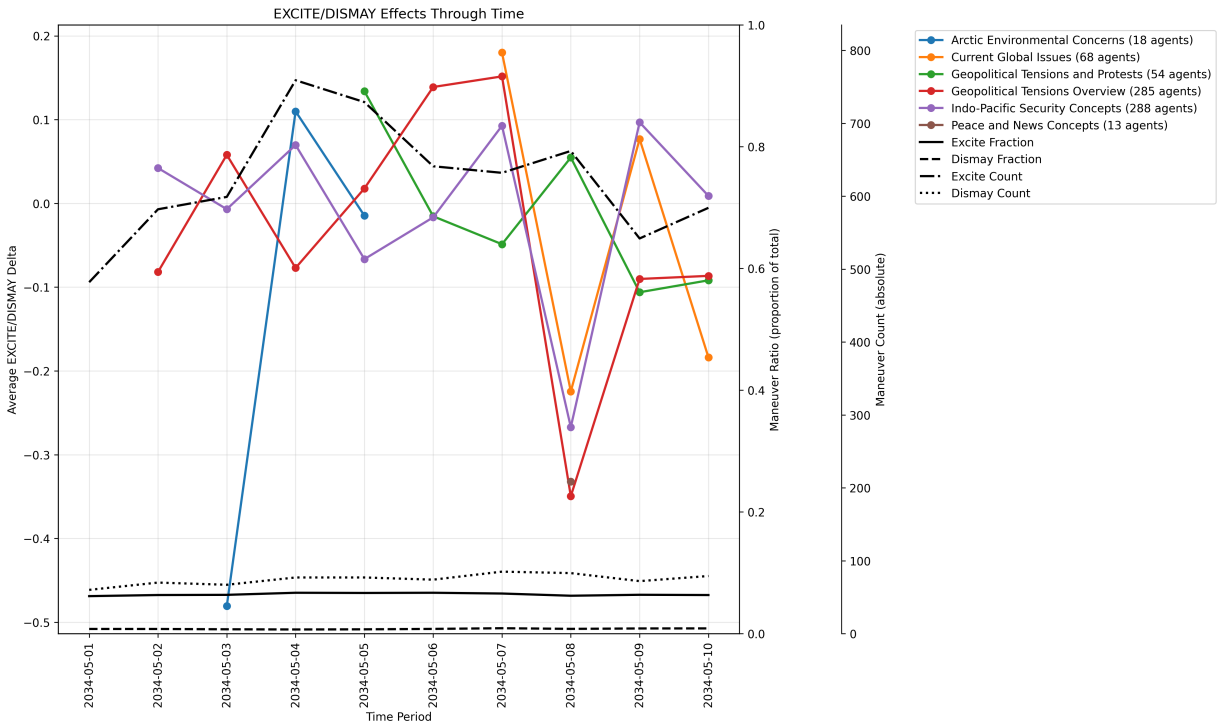


Figure 7.27: The excite and dismay effects experienced by the communities in the synthetic dataset

defined, it is common for groups to be ”distracted” when they shift around seasonal concepts or changing narratives. In this case, the 2022 Balikatan exercise marked 75 years of US-Philippine security cooperation and is ”distracting” from the more lasting ”friendspartnersallies” and we can even see the death of an earlier related concept that did not catch on - ”usphthrivingat75”.

When looking at the engage and dismiss effects, the Cordillera Day Concept community is the most interesting. The Cordillera are an indigenous people in the Philippines who commemorate the death of a tribal chieftain in 1980 with Cordillera Day each year on 24 April.[57]. As seen in Fig. 7.36, they experienced engage effects - with increased usage of their core concepts and 1st person pronouns. However, in the next time period, see Fig. 7.47, we find that while the usage of their core concepts continues to rise, they are using fewer 1st person pronouns.

The explain and distort chart for the Balikatan dataset closely mirrors the boost neglect chart with only the Indo-Pacific Defense Cooperation community spike being of interest - see Fig. **??**.

While a similar pattern for the Indo-Pacific Defense Cooperation community is seen in the excite/dismay results, it is the Friendship and Alliances community that shows the greatest dip - see Fig. **??**

7.4.3 Nice, France, Terror Attack Dataset

In the Nice Terror dataset, the temporal clustering found 47 different communities; however, only 14 lasted more than two days so those are the ones I will be looking at. The abbreviated chart of communities is in Fig. 7.40. The actual terror attack - in which three people were stabbed to

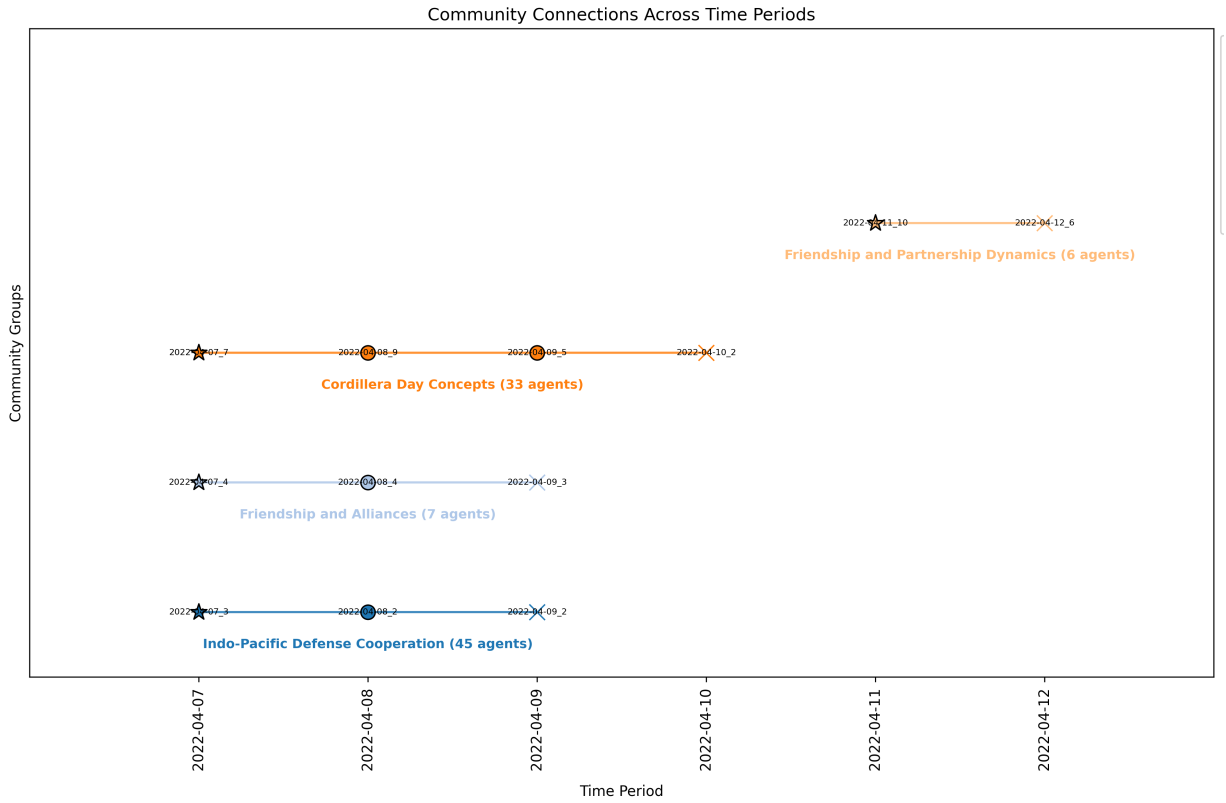


Figure 7.28: Topic-oriented communities through time in the Balikatan dataset - star icons indicate a new group, triangles are merges, and an X indicates the group disappear

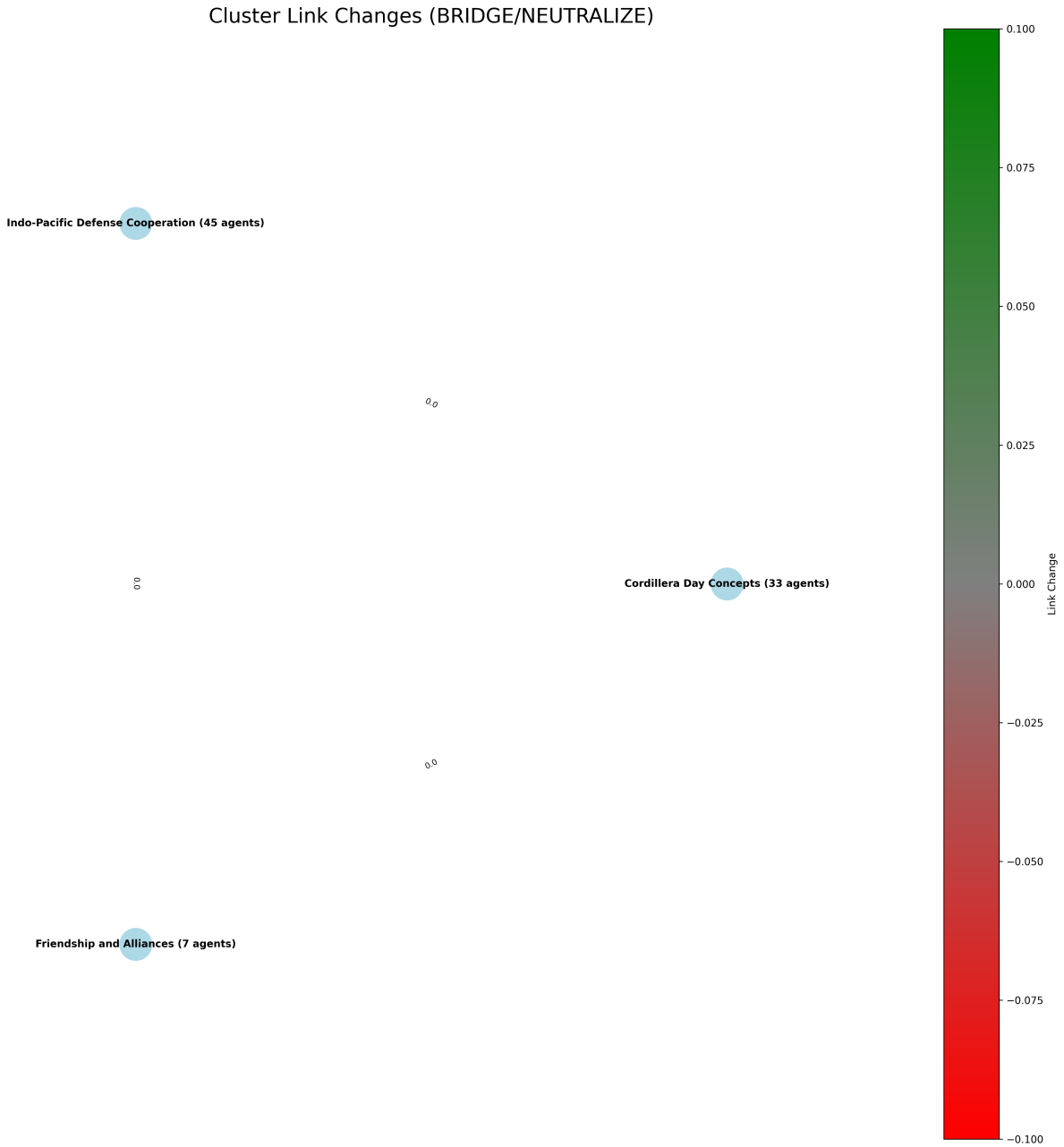


Figure 7.29: Bridge/neutralize results for 2022-04-07 to 2022-04-08. Red is a negative normalized link change and green is positive. All extant communities shown.

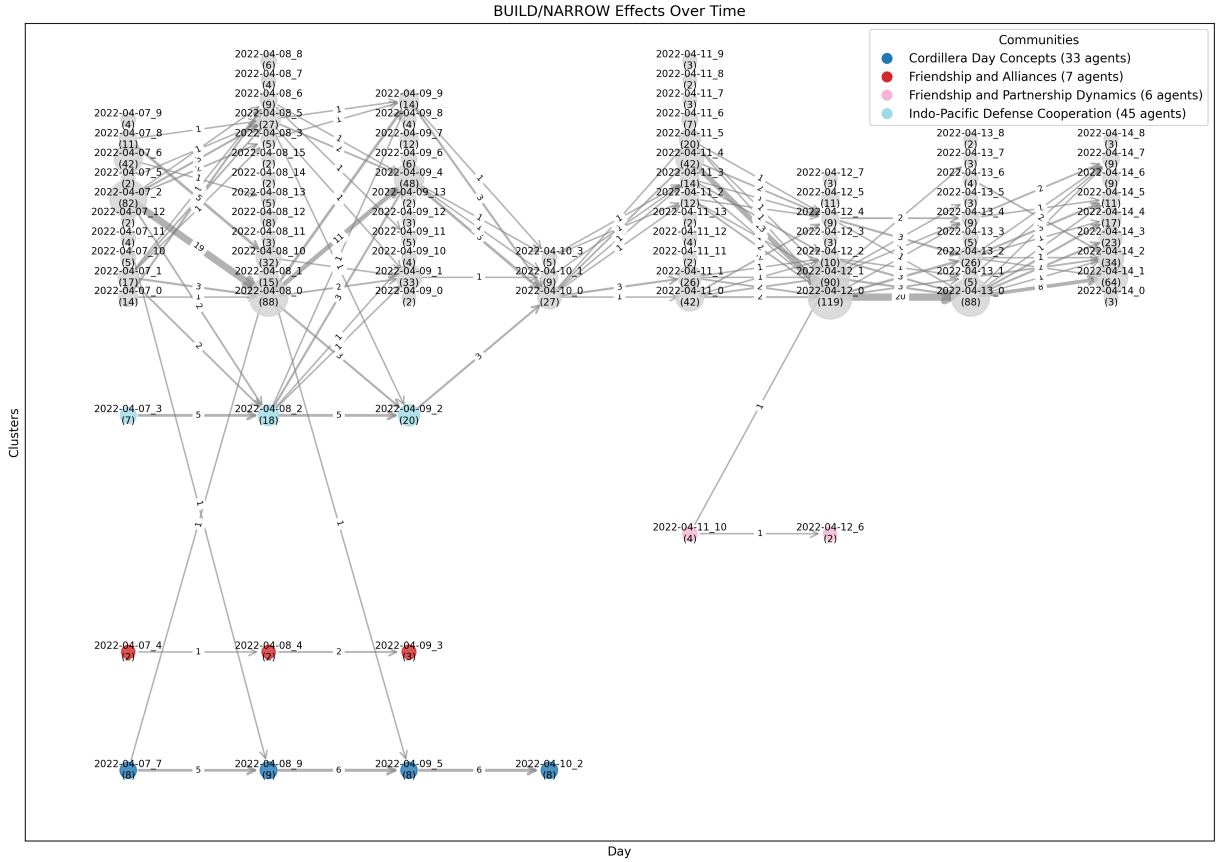


Figure 7.30: Build/Narrow results for the entirety of the Balikatan data set. Arrows and numbers depict the flow of actors between clusters. Multiple clusters merging into a new cluster depicts build effects and disappearing or splitting clusters represent narrowing effects.

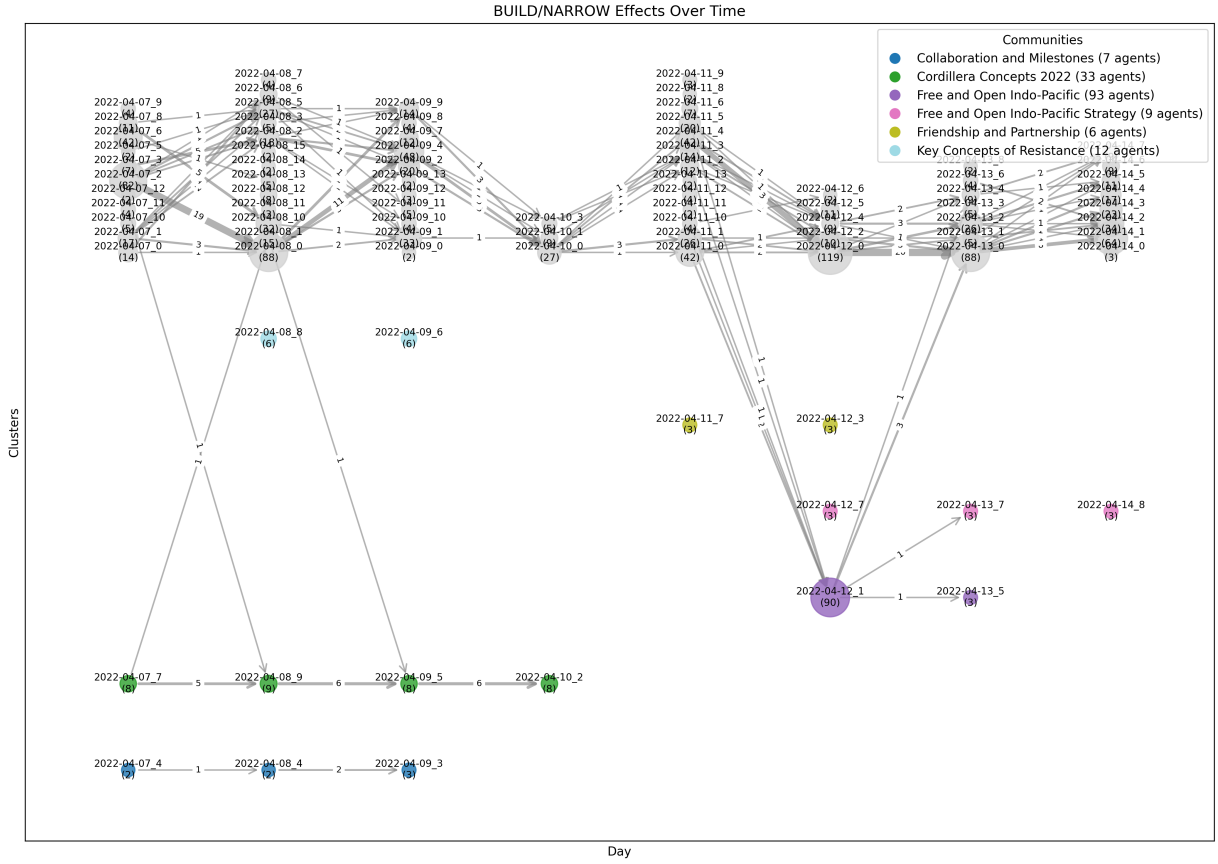


Figure 7.31: Build/Narrow results for the entirety of the Balikatan data set - communities were found using ARI. Arrows and numbers depict the flow of actors between clusters. Multiple clusters merging into a new cluster depicts build effects and disappearing or splitting clusters represent narrowing effects.

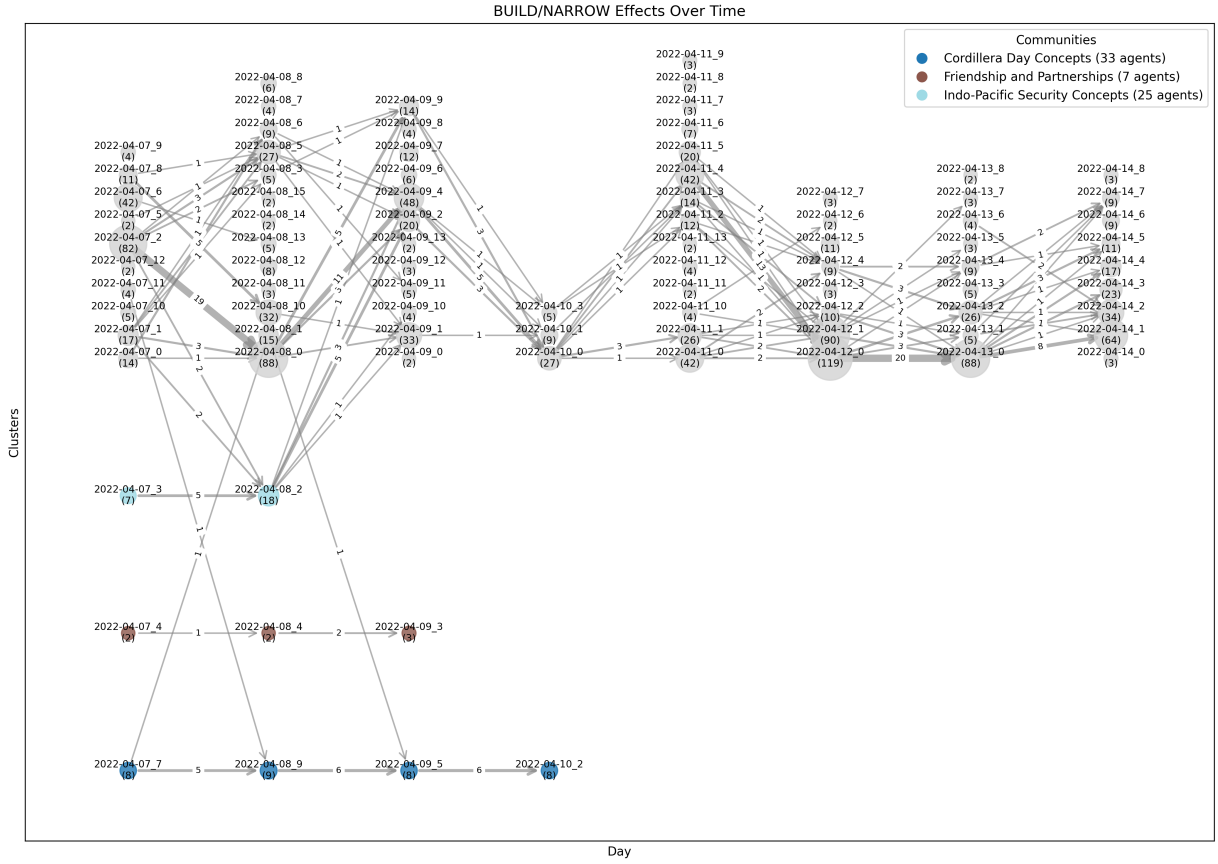


Figure 7.32: Build/Narrow results for the entirety of the Balikatan data set - communities were found using NMI. Arrows and numbers depict the flow of actors between clusters. Multiple clusters merging into a new cluster depicts build effects and disappearing or splitting clusters represent narrowing effects.

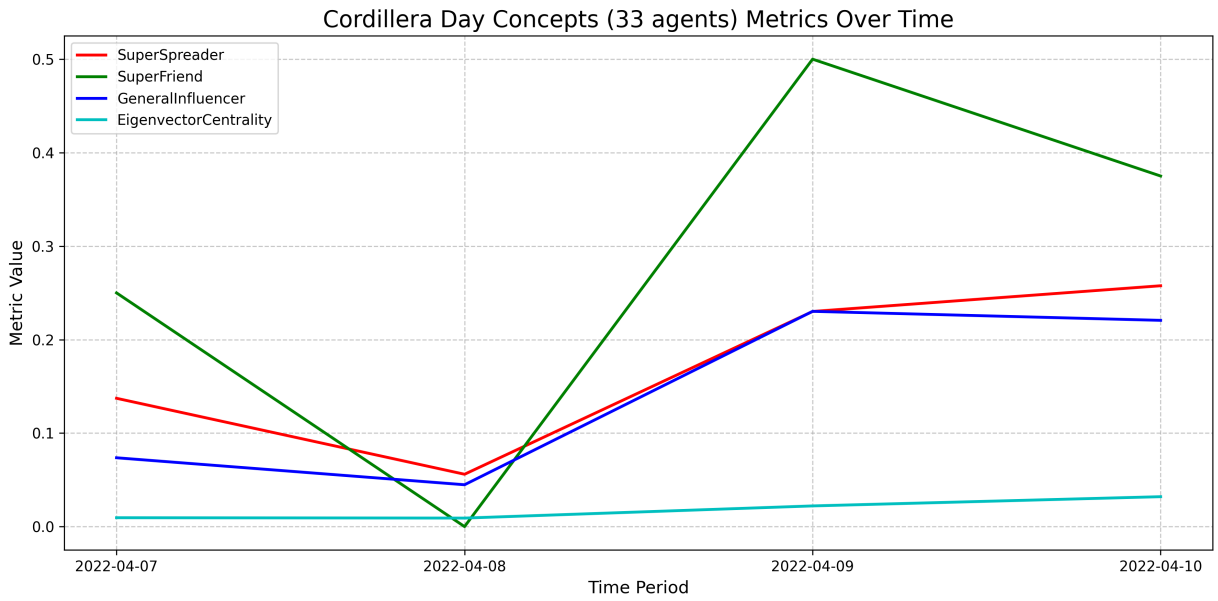


Figure 7.33: The back and negate effects experienced by the Cordillera Day Concepts community

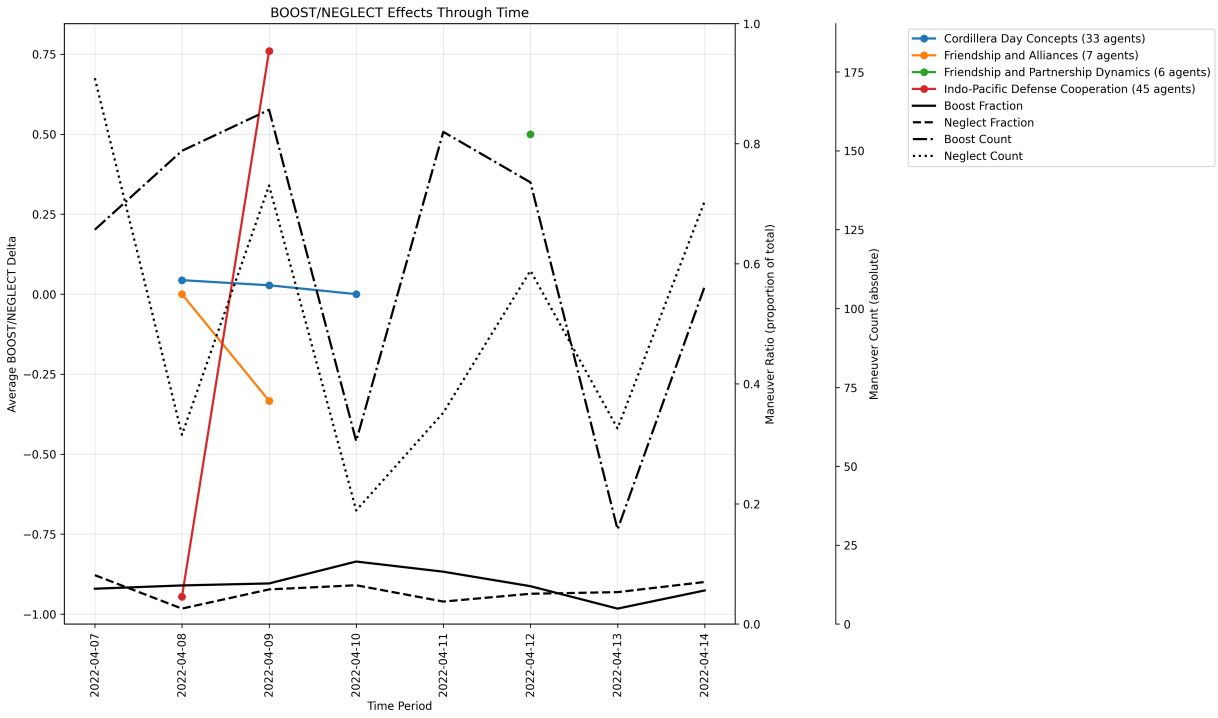


Figure 7.34: The boost and neglect effects experienced by the communities in the Balikatan dataset [Note: The chart shows changes in average path length within the agent x agent network - this means that positive values indicate neglect effects and negative values indicate boost effects]



Figure 7.35: The enhance and distract effects experienced by the communities between 2022-04-07 and 2022-04-08

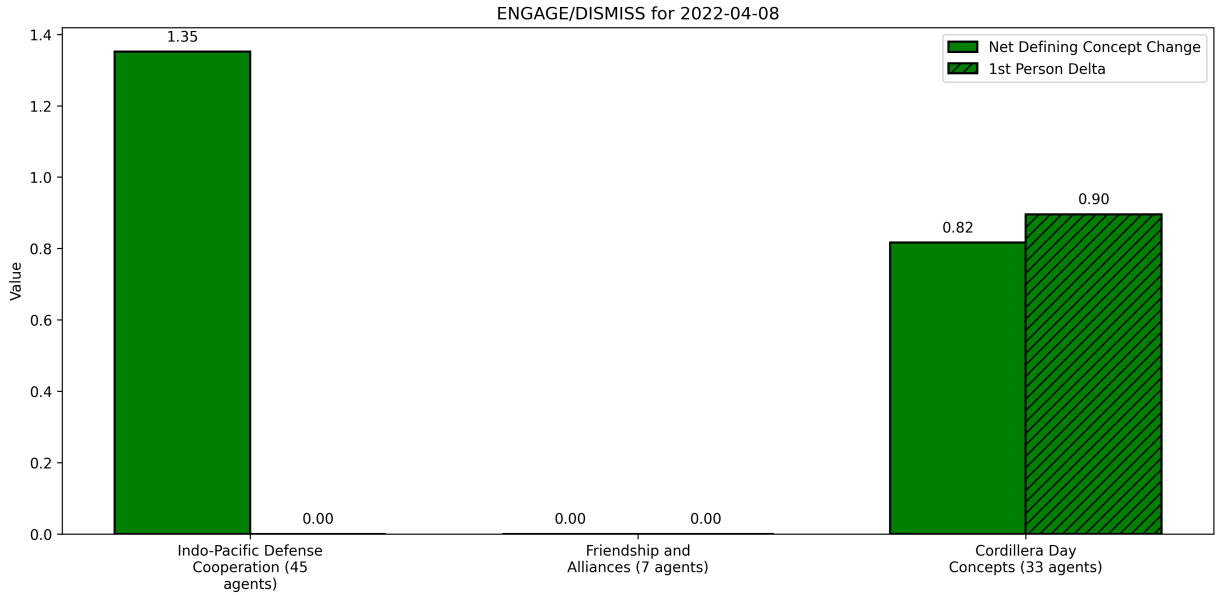


Figure 7.36: The engage and dismiss effects experienced by the communities between 2022-04-07 and 2022-04-08

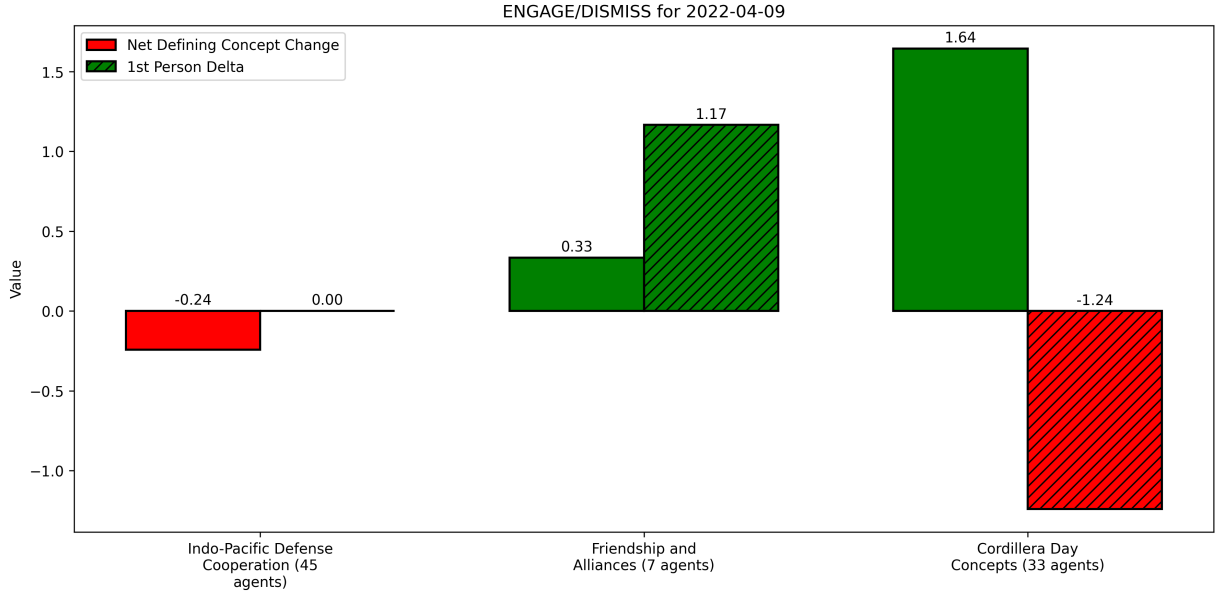


Figure 7.37: The engage and dismiss effects experienced by the communities between 2022-04-08 and 2022-04-09

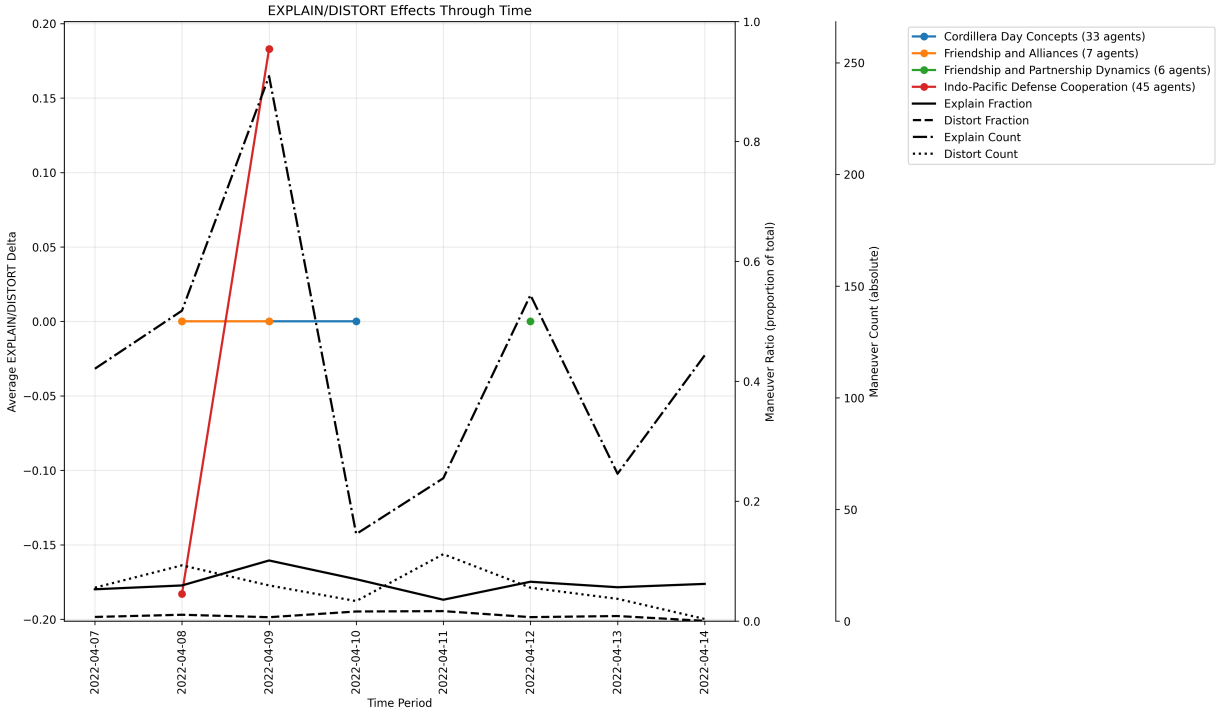


Figure 7.38: The explain and distort effects experienced by the communities in the Balikatan dataset [Note: negative values represent explain effects and positives are distort effects]

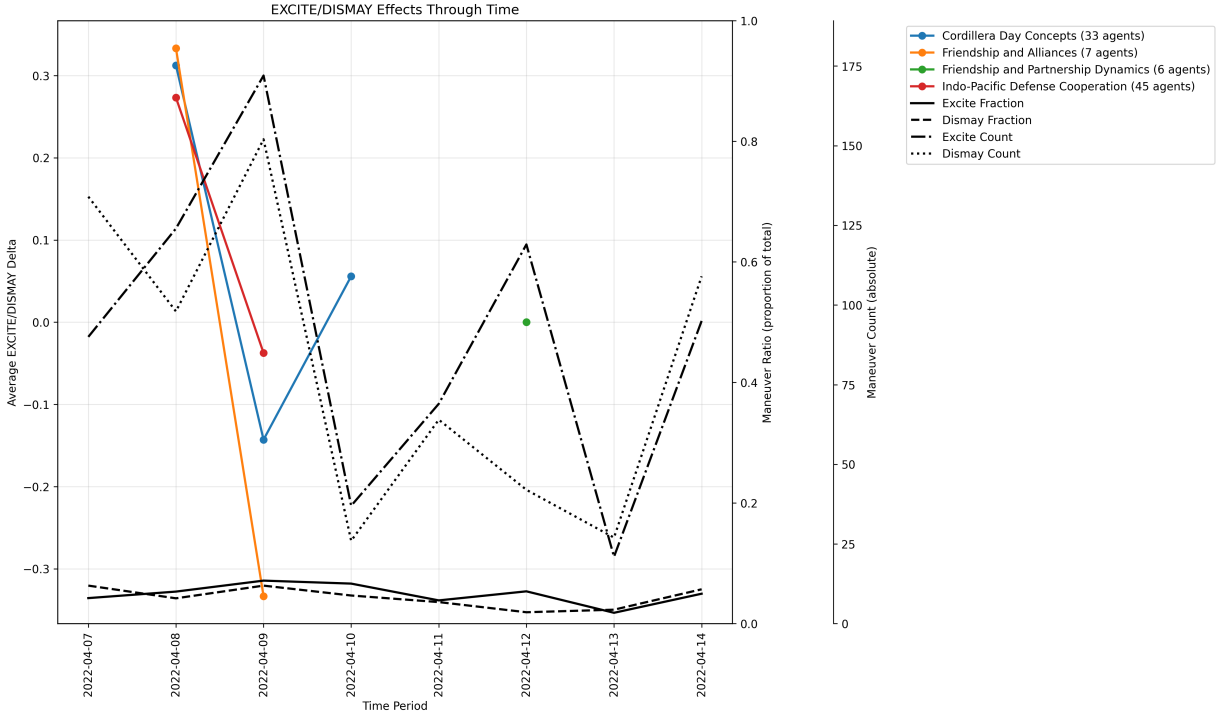


Figure 7.39: The excite and dismay effects experienced by the communities in the Balikatan dataset

death by a Tunisian man inside Notre-Dame de Nice - occurred on 29 October 2020. However, the event was surrounded by the Charlie Hebdo Terror trial (September through December 2020) and was preceded by several weeks of protests around the Muslim world, a Turkish boycott of France, and the beheading of a French history teacher on 16 October 2020.

The bridging/neutralizing diagrams show that there is zero interaction between any of the major groups - see Fig. 7.41 as an example. More accurately, the diagrams show that there is no change in the links between the communities; however, in this case, having verified it, there is no activity between them at all.

The build/narrow diagram in Fig. 7.42, just as in the Balikatan dataset, is dominated by the clusters that do not match across time into a community.

The back/negate chart for the largest French Product Boycott community is interesting in that it shows signs of backing on the date of the terror incident, 2020-10-29 and again three days later. **??**

This short-lived nature of the groups muddies the boost and neglect chart. Fig. 7.44 highlights the boosting of the Charlie Hebdo Incident community followed by its neglect a day later when the Nice church stabbing occurs.

The enhance/distract charts are once again interesting to investigate. In Fig. 7.45 we see general enhancement across the board with many enhancing concepts being tied to Macron - ostensibly in response to Macron's comments after the terror incident.

For that same period, when looking at the engage and dismiss effects, we see that while the usage of the defining concepts has for the most part increased the usage of first person pronouns has really only risen in the one of the boycott movement communities and the more general France and Related Concepts community. See Fig. 7.46

The explain and distort chart for the Nice Terror dataset appears similar to the boost and neglect chart - similar to the Balikatan mirroring. We see in Fig. **??** that the Charlie Hebdo Concept community had the widest range of explains and distorts throughout the period.

Finally, the excite/dismay chart - see Fig. **??** displays wild variations in the effects experienced by the communities during this time period.

7.5 Future Work

BEND-effects is immediately useful for evaluating the effects of social cyber maneuver campaigns within a corpus. However, significant improvements should still be made in the near future.

Back/Negate, Excite/Dismay, and Engage/Dismiss all have ensemble approaches to define topic-oriented group effects. These ensemble approaches provide additional nuance that might be missing from the single metric definitions of the other BEND effects. Future work should explore how additional metrics might improve performance or explainability for these other BEND maneuver effects.

However, the current chosen metrics reflect a desire to be as simple as possible while meeting the common definition of the BEND maneuver in order to be both performative on large datasets and leverage network science progress. The translation of narrative space – as defined in BEND - into well-ordered networks allows us to perform like-calculations for both network and narrative

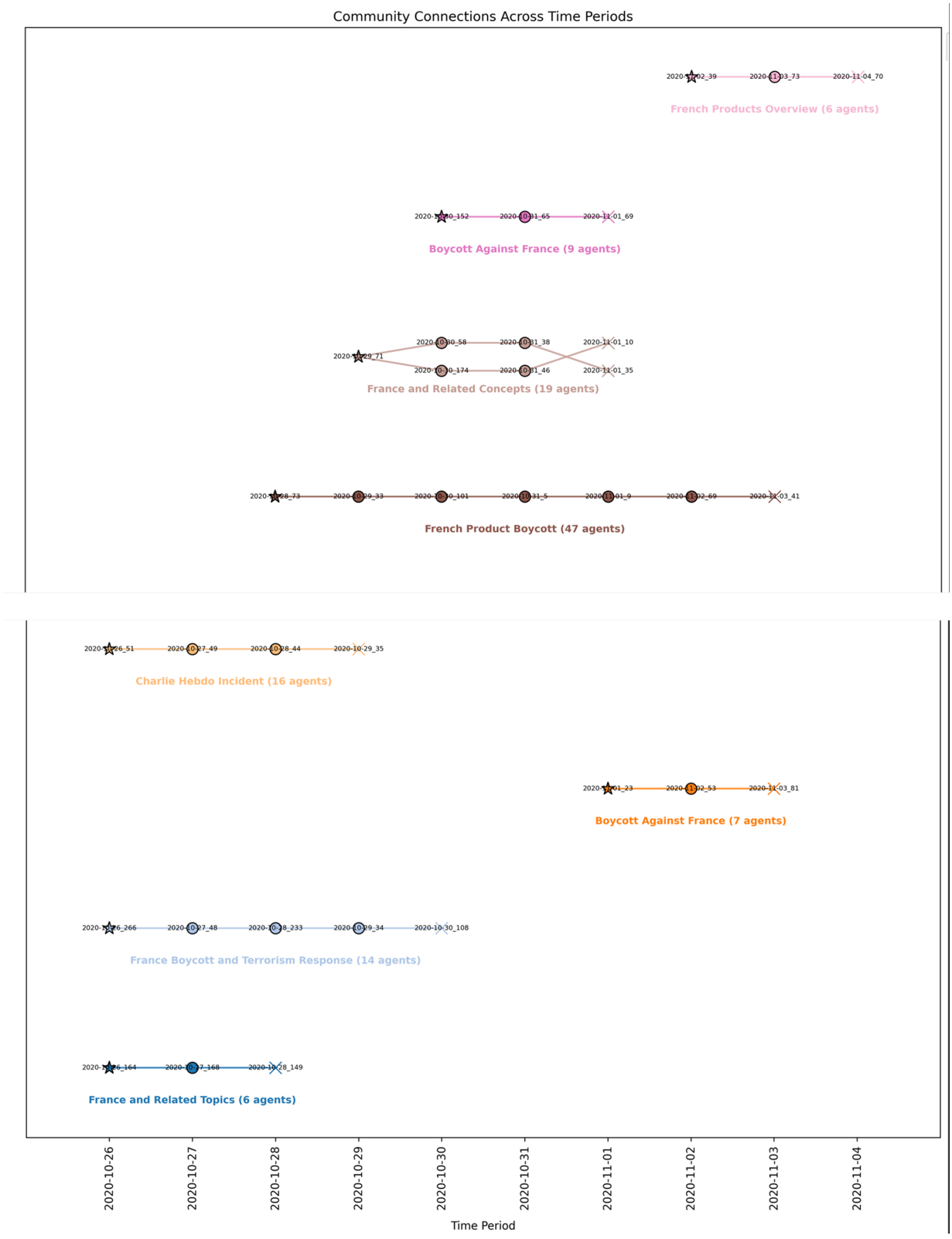


Figure 7.40: Abbreviated chart of topic-oriented communities through time in the Nice Terror dataset - star icons indicate a new group, triangles are merges, and an X indicates the group disappear

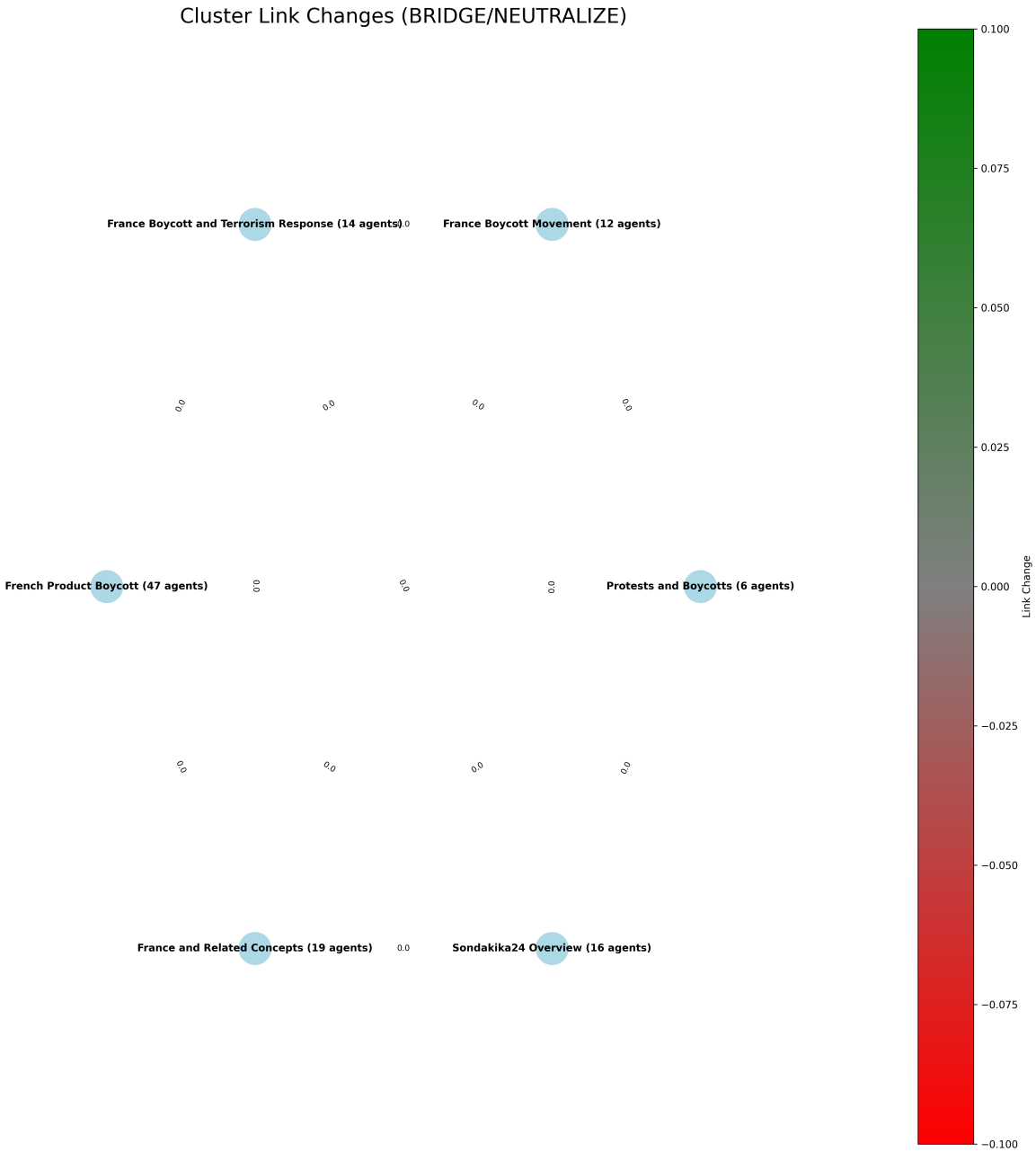


Figure 7.41: Bridge/neutralize results for 2020-10-29 to 2020-10-30. Red is a negative normalized link change and green is positive. All extant communities shown.

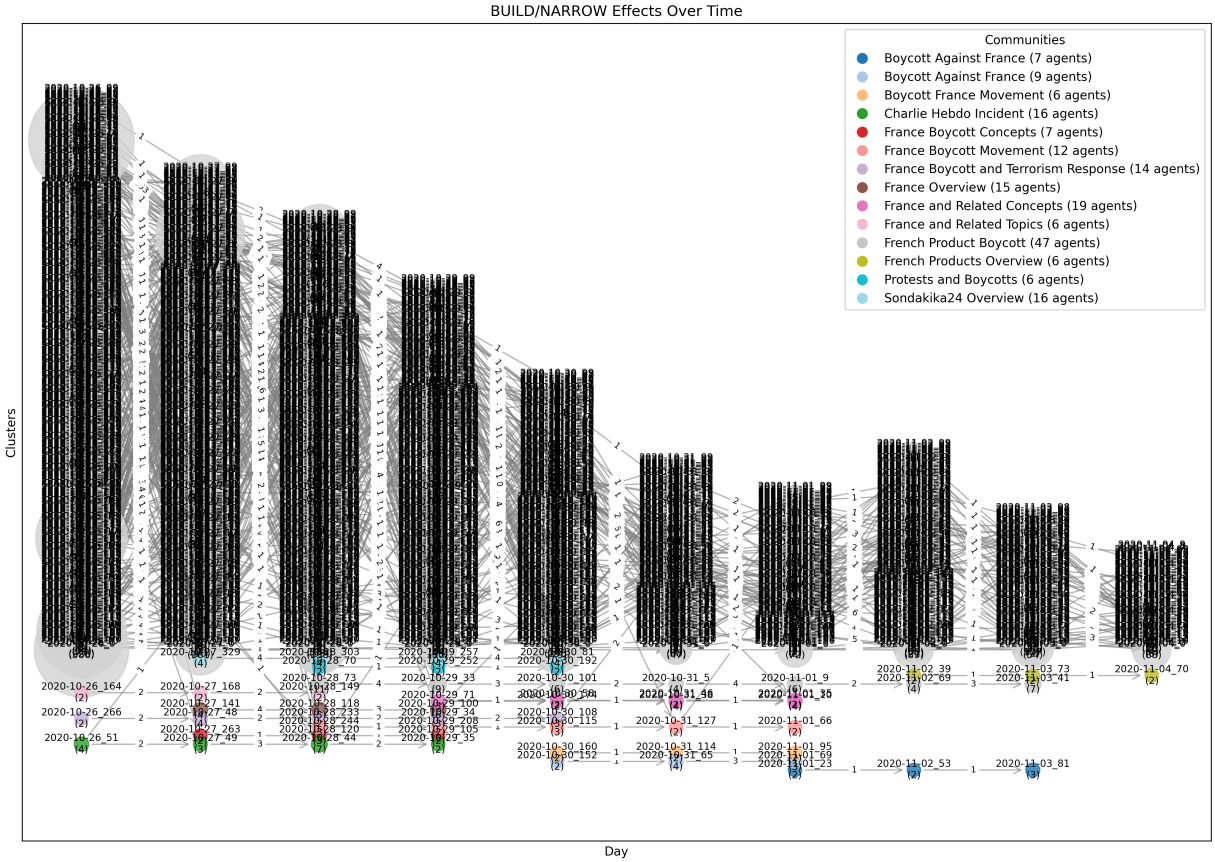


Figure 7.42: Build/Narrow results for the entirety of the Nice Terror data set. Arrows and numbers depict the flow of actors between clusters. Multiple clusters merging into a new cluster depicts build effects and disappearing or splitting clusters represent narrowing effects.

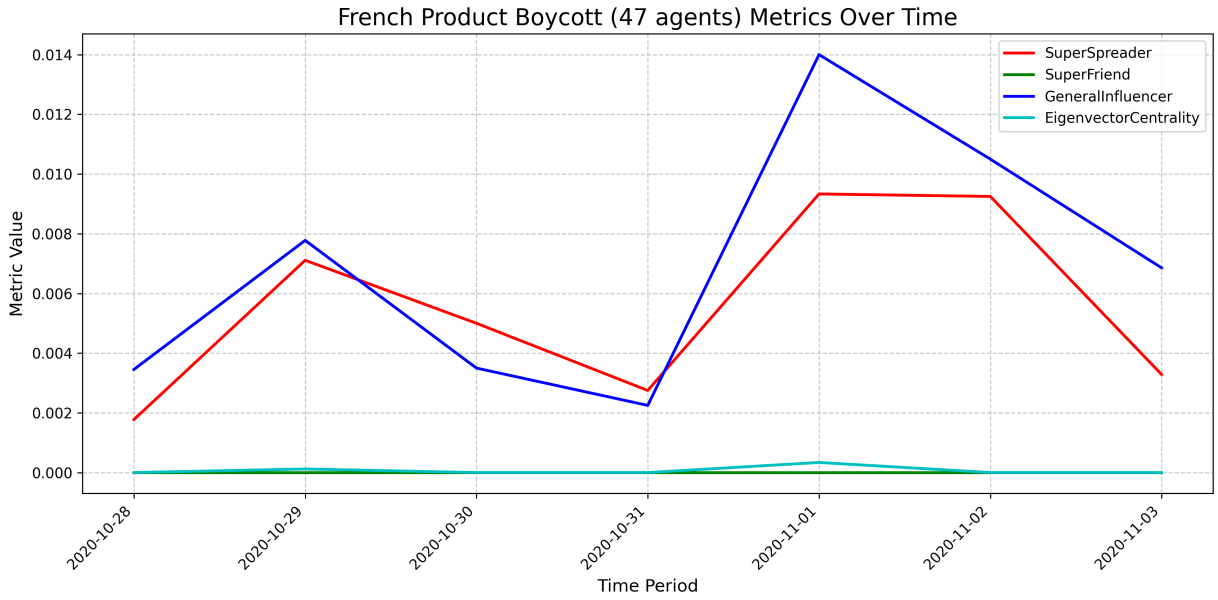


Figure 7.43: The back and negate effects experienced by the 47 member French Product Boycott community

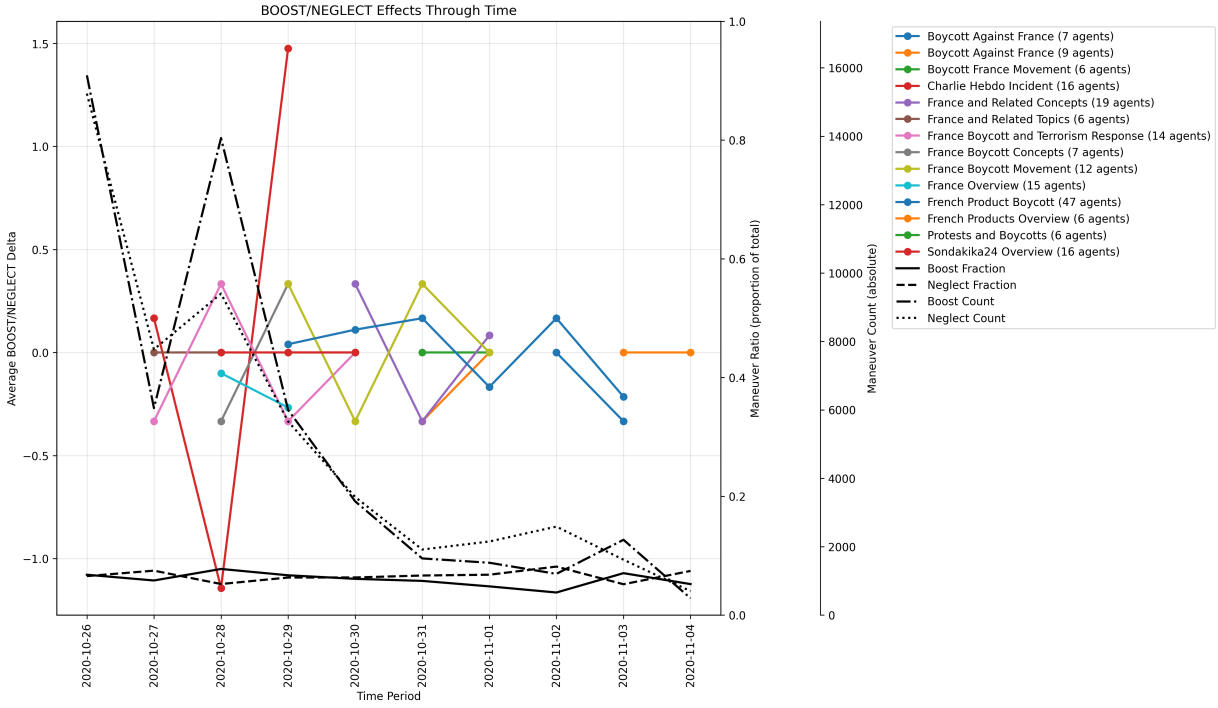


Figure 7.44: The boost and neglect effects experienced by the communities in the Nice Terror dataset [Note: The chart shows changes in average path length within the agent x agent network - this means that positive values indicate neglect effects and negative values indicate boost effects]



Figure 7.45: The enhance and distract effects experienced by the communities between 2020-10-29 and 2020-10-30

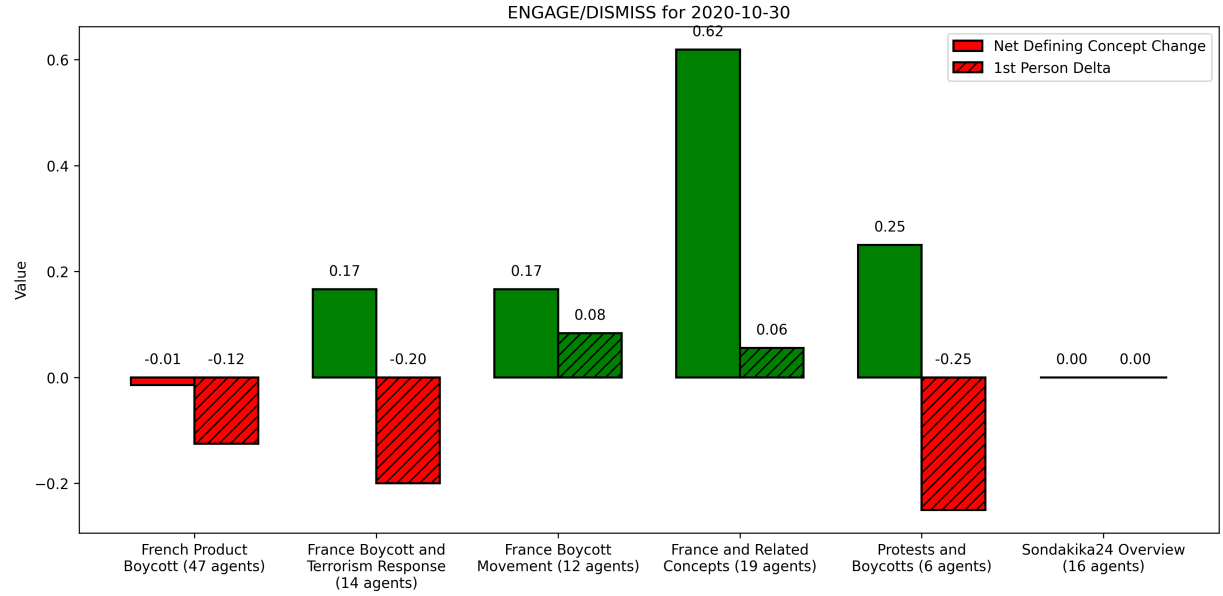


Figure 7.46: The engage and dismiss effects experienced by the communities between 2020-10-29 and 2020-10-30

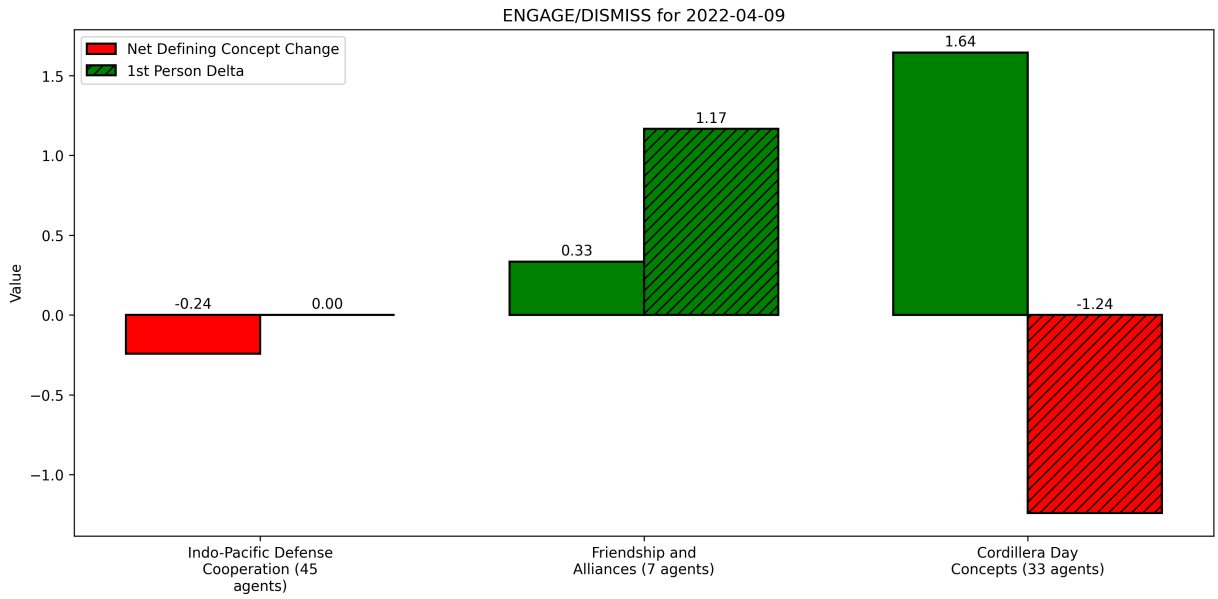


Figure 7.47: The engage and dismiss effects experienced by the communities between 2022-04-08 and 2022-04-09

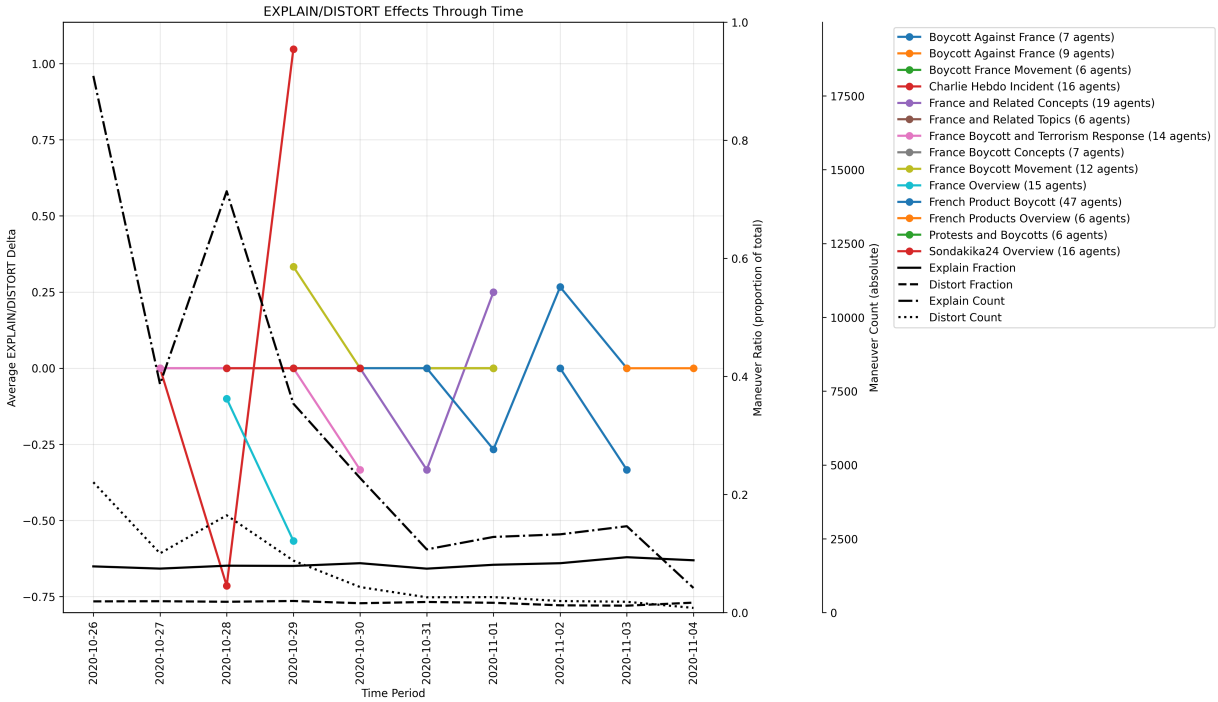


Figure 7.48: The explain and distort effects experienced by the communities in the Nice Terror dataset [Note: negative values represent explain effects and positives are distort effects]

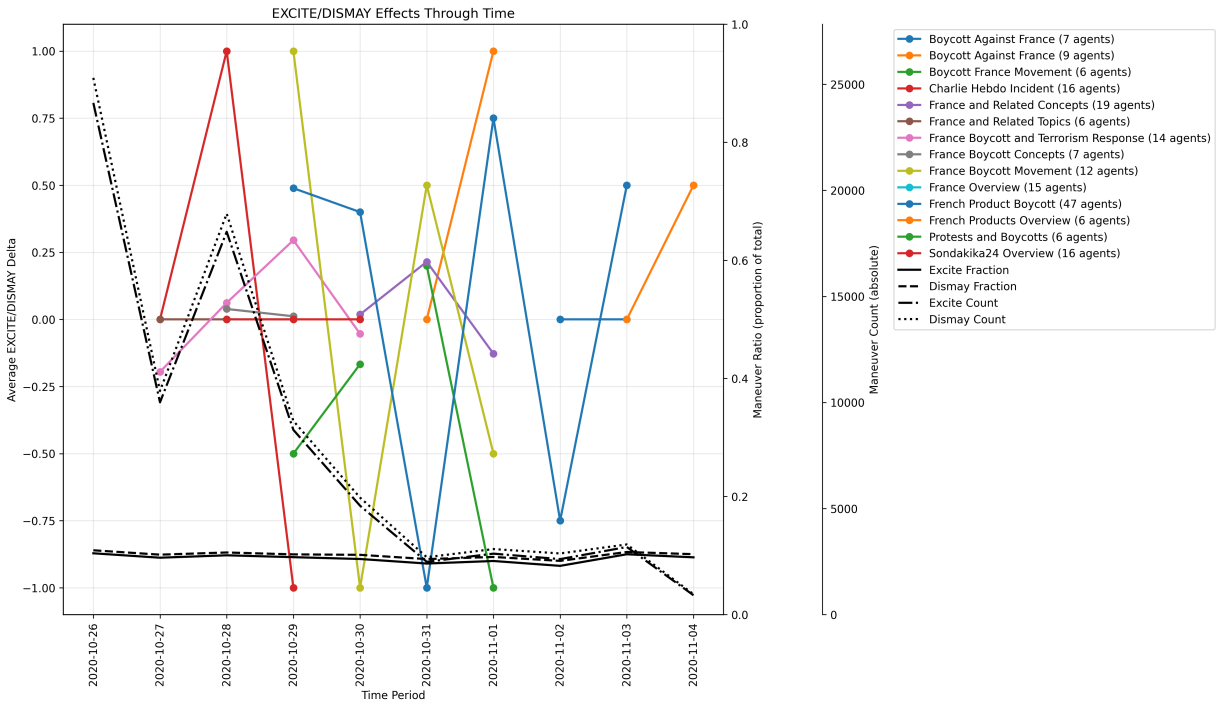


Figure 7.49: The excite and dismay effects experienced by the communities in the Nice Terror dataset

space. Deviating from this will come with performance issues and also a reliance upon natural language processing progress instead of network science. However, as a starting point for future work on the narrative maneuvers: both Enhance/Distract and Explain/Distort might benefit from a concept translation into topic-space and then a nearness calculation to supplement the detection of a change or shift in topic.

Each of the maneuver metrics for BEND-effects currently lacks proper thresholding and significance measures. While the existence of maneuver effects is firmly established, their degree of importance remains left to the interpretation of the analyst. This is the difference between evidence of bridging and evidence of bridging that we care about.

The Jaccard index was used because of performance reasons, but the Adjusted Rand Index (ARI) or Normalized Mutual Information (NMI) methods might produce better results for other datesets.[43] [74] Jaccard does not account for true negatives - ARI and NMI would - while ARI would help correct for chance and NMI would handle the size changes among clusters better. Additionally, alternatives to Leiden should be explored as finding topic-oriented groups is not a solved problem.

The BEND-effects calculations could also be better expressed by first calculating a baseline of the entire corpus at each time period of the given metric and then expressing and individual clusters change over time as a residual above and beyond the baseline. This would help ensure the BEND-effect measurement for a cluster is greater than chance and is not a byproduct of a global effect.

Finally, with BEND-effects we know what effects were felt by communities and with the

traditional cue-based BEND detection we can predict what communities intended to do - the logical next step is to map the one to the other. We can plot each community's experienced effect against the intended effects of all other community and in this way attempt to draw conclusions about which intended maneuver campaigns were effective.

7.6 Conclusions

BEND-effects is the only automated methodology for evaluating the effectiveness of executed BEND maneuvers and the only comprehensive method for detecting the effects of BEND maneuvers. It relies upon well-established network metrics that align with the contemporary definitions of the BEND maneuvers. Indeed, these network metrics are of such importance that even if BEND is not used as a framework, using the automated detection of the network metrics can serve as a starting point for conducting non-BEND related network and narrative group evaluation.

Chapter 8

Conclusion

This dissertation presents a set of novel theoretical and methodological contributions that advance the field of social cybersecurity, particularly in the detection and simulation of influence maneuvers on social media. By integrating military doctrine with computational frameworks and enabling AI-driven scenario generation, this work offers foundational elements for both academic inquiry and applied defense training.

8.1 Theoretical Contributions

A core theoretical contribution of this thesis is the reconceptualization of BEND maneuver detection. While BEND maneuvers have always been effects-based — defined by their impact rather than the intent of their executors — prior detection efforts relied heavily on inferring intent through cues, language, and network signals. This thesis challenges that approach and introduces a framework for effects-based detection of BEND maneuvers. By focusing on observable outcomes rather than inferred motivations, this shift aligns BEND detection with the empirical rigor of other academic and intelligence assessments.

A second theoretical contribution is the refinement of military doctrinal tools to better accommodate social media analysis. Current U.S. military Information Operations doctrine does not apply the same level of analytical precision to social media as it does to other operational environments. This thesis introduces a Social Media MCOO/CSO (Cyber-Social Overlay), providing a structured framework to assess social-cyber terrain and integrate it more effectively into operational planning. This refinement helps bridge the gap between doctrine and the realities of modern information warfare.

8.2 Methodological Contributions

This dissertation also presents several original methodological contributions, advancing both detection capabilities and synthetic scenario generation tools for influence operations.

8.2.1 Effects-Based Detection of BEND Maneuvers

A major methodological advancement of this thesis is the development of an effects-based approach to detecting BEND maneuvers. Unlike previous detection methods that sought to infer intent from content and contextual signals (e.g., CUE+), this approach directly measures the observable effects of a maneuver within a social network or narrative ecosystem. This methodological shift enables:

- More objective and replicable assessments of maneuver effectiveness
- Better integration with automated systems, reducing reliance on subjective human judgment
- Improved post hoc analysis, allowing planners to evaluate whether an observed maneuver actually achieved its intended influence

This framework, in conjunction with CUE+ methods, enables comprehensive detection and empirical assessment of influence maneuvers.

8.2.2 SynTel and SynX: Agent-Based Social Media Generators

This thesis also introduces SynTel and SynX, two agent-based social media generators developed for Telegram and Twitter/X respectively. These tools provide:

- Traditional simulation logic, which models agent behaviors and interactions
- LLM-powered message construction, generating realistic, contextually appropriate content
- Enhanced scenario realism, ensuring that generated training exercises reflect real-world influence dynamics
- Scalable dataset creation, reducing the manual effort required for scenario design

By integrating these capabilities, SynTel and SynX enable the creation of synthetic social media datasets that reflect real-world influence dynamics. These tools provide researchers and practitioners with a controlled yet flexible means of simulating social media influence campaigns in a training or analytical environment.

8.2.3 AESOP: AI-Enabled Scenario Orchestration and Planning

A final methodological innovation is AESOP (AI-Enabled Scenario Orchestration and Planning). AESOP is a planning tool that allows Information Environment planners to:

- Develop social-cyber exercise scenarios from scratch
- Integrate social-cyber vignettes into existing scenarios
- Rapidly generate narrative-driven influence operations training material

8.3 Application Contributions

Beyond its theoretical and methodological impact, this research also contributes practical applications:

- AI-enabled social media scenario development, allowing exercise designers to generate realistic social media narratives from existing datasets or training material
- A draft data standard for social media-based scenario exchange, providing structured interoperability for synthetic data sharing
- Synthetic social media generation for X/Twitter and Telegram, enabling automated creation of training datasets for influence operations exercises

8.4 Limitations

US Military Doctrinal Synthesis US Information Operations doctrine is evolving and changing rapidly. Many of the referenced Joint and Service Publications are already out of date and the replacement publications are all held at a classified level or have distribution restrictions that prohibit their academic study. Additionally, Information Operations remains a complex issue with authority and titling problems that cannot be resolved in theory and require policy reforms.

Effects-Based BEND Detection There is currently no way to directly associate observed BEND effects with any single message BEND maneuver - we are not yet in the precision munitions phase of information environment maneuvers. Also, better methods for measuring BEND maneuvers above baseline are required as residual statistics will be more important than net maneuver counts. Standard ORA-Pro reports do not reflect this need.

BEND Scenario Development Without an overarching simulation, training scenario data will be static and unresponsive to training audience feedback. However, AESOP could be used to alter the scenario based upon training audience decisions and new templates could then drive additional synthetic data to get after a highly incremented simulation. Daily static training data is reasonable and appropriate since collection and attribution methods through the social media APIs do not allow for pulling all possible data instantly and continuously.

Bibliography

[1] *U. S. Const. amend. IV*. URL https://www.senate.gov/about/origins-foundations/senate-and-constitution/constitution.htm. 4.2

[2] *Privacy Act of 1974, 5 U.S. Code Title 5, section 552a*. URL https://www.govinfo.gov/content/pkg/USCODE-2018-title5/pdf/USCODE-2018-title5-partI-chap5-subchapII-sec552a.pdf. 4.2

[3] *Posse Comitatus Act, U.S. Code Title 18, section 1305*. URL https://www.law.cornell.edu/uscode/text/18/1385. 4.2

[4] *USAF Doctrine Update on Domains and Organizing for Joint Operations*. URL https://www.doctrine.af.mil/Portals/61/documents/doctrine_updates/du_13_09.pdf. 4.2

[5] *Summary of the Joint All-Domain Command and Control (JADC2) Strategy*. URL https://www.doctrine.af.mil/Portals/61/documents/doctrine_updates/du_13_09.pdf. 4.2

[6] mistralai/mixtral-8x7b-v0.1 · hugging face. URL https://huggingface.co/mistralai/Mixtral-8x7B-v0.1. 2.2.1

[7] Alexander E. Aguilastratt and Matthew S. Updike. The information domain and social media. *Infantry*, 111(1):31–34, 2022. URL https://www.moore.army.mil/infantry/magazine/issues/2022/Spring/PDF/6_ProfessionalForum.pdf. 4.2

[8] Alexandre Alaphilippe. Adding a d to the ABC disinformation framework. URL https://policycommons.net/artifacts/4139892/adding-a-d-to-the-abc-disinformation-framework/4948112/. Publisher: Brookings Institution. 3.1

[9] Iuliia Alieva, J. D. Moffitt, and Kathleen M. Carley. How disinformation operations against russian opposition leader alexei navalny influence the international audience on twitter. 12 (1):80. ISSN 1869-5450, 1869-5469. doi: 10.1007/s13278-022-00908-6. URL https://link.springer.com/10.1007/s13278-022-00908-6. 3.1

[10] Adam Badawy, Aseel Addawood, Kristina Lerman, and Emilio Ferrara. Characterizing the 2016 russian IRA influence campaign. 9(1):31. ISSN 1869-5450, 1869-5469. doi: 10.1007/s13278-019-0578-6. URL http://link.springer.com/10.1007/s13278-019-0578-6. 1.1

[11] David M. Beskow and Kathleen M. Carley. Agent based simulation of bot disinformation maneuvers in twitter. In *2019 Winter Simulation Conference (WSC)*, pages 750–761. IEEE, . ISBN 978-1-72813-283-9. doi: 10.1109/WSC40007.2019.9004942. URL https://ieeexplore.ieee.org/document/9004942/. 6.4

[12] David M. Beskow and Kathleen M. Carley. Social cybersecurity: an emerging national security requirement, . URL https://apps.dtic.mil/sti/citations/AD1108494. 3.1

[13] Janice Blane. Social-cyber maneuvers for analyzing online influence operations. page 13152760 Bytes. doi: 10.1184/R1/22825112.V1. URL https://kilthub.cmu.edu/articles/thesis/Social-Cyber_Maneuvers_for_Analyzing_Online_Influence_Operations/22825112/1. (document), 2.1, 3.1, 3.1, 7.1, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2

[14] Janice T Blane, Daniele Bellutta, and Kathleen M Carley. Social-cyber maneuvers during the COVID-19 vaccine initial rollout: Content analysis of tweets. 24(3):e34040, . ISSN 1438-8871. doi: 10.2196/34040. URL https://www.jmir.org/2022/3/e34040. 2.1, 3.1

[15] Janice T. Blane, J. D. Moffitt, and Kathleen M. Carley. Simulating social-cyber maneuvers to deter disinformation campaigns. In Robert Thomson, Muhammad Nihal Hussain, Christopher Dancy, and Aryn Pyke, editors, *Social, Cultural, and Behavioral Modeling*, volume 12720, pages 153–163. Springer International Publishing, . ISBN 978-3-030-80386-5 978-3-030-80387-2. doi: 10.1007/978-3-030-80387-2_15. URL https://link.springer.com/10.1007/978-3-030-80387-2_15. 6.2

[16] Sam Blazek. SCOTCH: A framework for rapidly assessing influence operations. URL https://www.atlanticcouncil.org/blogs/geotech-cues/scotch-a-framework-for-rapidly-assessing-influence-operations/. 3.1

[17] David M Blei, Andrew Y Ng, and Michael I Jordan. Latent dirichlet allocation. 3:993–1022. 5.3

[18] John G. Breslin, Uldis Bojārs, and Stefan Decker. Sioc - semantically-interlinked online communities. https://web.archive.org/web/20220331224416/http://sioc-project.org/. Accessed: 2025-03-13. 5.4

[19] Dan Brickley and Libby Miller. Foaf vocabulary specification 0.99. http://xmlns.com/foaf/spec/, 2014. Accessed: 2025-03-13. 5.4

[20] Kathleen M. Carley. Social cybersecurity: an emerging science. 26(4):365–381. ISSN 1572-9346. doi: 10.1007/s10588-020-09322-9. URL https://doi.org/10.1007/s10588-020-09322-9. 3.1

[21] Kathleen M. Carley, Guido Cervone, Nitin Agarwal, and Huan Liu. Social cybersecurity. In Robert Thomson, Christopher Dancy, Ayaz Hyder, and Halil Bisgin, editors, *Social, Cultural, and Behavioral Modeling*, volume 10899, pages 389–394. Springer International Publishing, . ISBN 978-3-319-93371-9 978-3-319-93372-6. doi: 10.1007/978-3-319-93372-6_42. URL http://link.springer.com/10.1007/978-3-319-93372-6_42. 3.1

[22] L Richard Carley, Jeff Reminga, and Kathleen M Carley. Ora & netmapper. In *International conference on social computing, behavioral-cultural modeling and prediction and behavior representation in modeling and simulation. Springer*, volume 3, page 7, . Issue: 3.3. 2.2.1, 2.2.1, 3.1

[23] *Joint Information Operations Proponent*. Chairmain of the Joint Chiefs of Staff, Washington, DC, USA, 2014. URL https://www.jcs.mil/Portals/36/Documents/

Library/Instructions/3210_01.pdf. 4.2

[24] Serina Chang, Alicja Chaszczewicz, Emma Wang, Maya Josifovska, Emma Pierson, and Jure Leskovec. Llms generate structurally realistic social networks but overestimate political homophily, 2024. URL https://arxiv.org/abs/2408.16629. These authors contributed equally: Serina Chang, Alicja Chaszczewicz. 6.2, 6.3, 6.7

[25] Bastien Chopard and Michel Droz. Cellular automata: Modelling of physical systems. In *Cellular Automata Modeling of Physical Systems*, pages 6–13. Cambridge University Press, Cambridge, MA, 1998. URL https://doi.org/10.1017/CBO9780511549755. 6.2

[26] Fred Cohen. Simulating cyber attacks, defences, and consequences. 18(6):479–518. ISSN 01674048. doi: 10.1016/S0167-4048(99)80115-1. URL https://linkinghub.elsevier.com/retrieve/pii/S0167404899801151. 3.1

[27] Robert Cordray III and Marc J. Romanych. Mapping the information environment. pages 7–10. URL https://www.quantico.marines.mil/Portals/147/Docs/MCIOC/IORecruiting/MappingtheInformationEnvironmentIOSphereSummer2005.pdf. 4.2

[28] Gabor Csardi and Tamas Nepusz. The igraph software package for complex network research. *InterJournal*, Complex Systems:1695, 2006. URL https://igraph.org. 6

[29] *Information Operations (IO)*. Department of Defense, Washington, DC, USA, 2017. URL https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/360001p.pdf. 4.2

[30] *Information in Air Force Operations*. Department of the Air Force, Washington, DC, USA, 2018. URL https://www.doctrine.af.mil/Portals/61/documents/AFDP_3-13/3-13-AFDP-INFO-OPS.pdf. 3.1, 4.2

[31] *The Operations Process*. Department of the Army, Washington, DC, USA, 2019. URL https://armypubs.army.mil/epubs/DR_pubs/DR_a/ARN18126-ADP_5-0-000-WEB-3.pdf. 4.2

[32] *Intelligence Preparation of the Battlefield*. Department of the Army, Washington, DC, USA, 2019. URL https://irp.fas.org/doddir/army/atp2-01-3.pdf. 3.1, 4.2

[33] *Army Information*. Department of the Army, Washington, DC, USA, 2023. URL https://irp.fas.org/doddir/army/adp3-13.pdf. 4.2

[34] *Navy Information Operations*. Department of the Navy, Washington, DC, USA, 2014. URL https://www.usna.edu/Training/_files/documents/References/3C%20MQS%20References/2015-2016%203C%20MQS%20References/NWP%203-13_Information%20Operations_FEB2014.pdf. 4.2

[35] Stephen Dipple and Kathleen M. Carley. *Construct User Guide*. URL https://www.cmu.edu/casos-center/publications/cmu-s3d-23-104.pdf. 6.2

[36] Geoffrey B. Dobson and Kathleen M. Carley. Cyber-FIT: An agent-based modelling approach to simulating cyber warfare. In Dongwon Lee, Yu-Ru Lin, Nathaniel Osgood, and

Robert Thomson, editors, *Social, Cultural, and Behavioral Modeling*, volume 10354, pages 139–148. Springer International Publishing. ISBN 978-3-319-60239-4 978-3-319-60240-0. doi: 10.1007/978-3-319-60240-0_18. URL https://link.springer.com/10.1007/978-3-319-60240-0_18. 3.1

[37] Netherlands General Intelligence Federal Bureau of Investigation (FBI), Cyber National Mission Force (CMNF), Netherlands Military Intelligence Security Service (AIVD), the Netherlands Police (DNP) Security Service (MIVD), and the Canadian Center for Cyber Security (CCCS). State-sponsored russian media leverages meliorator software for foreign malign influence activity. Technical Report CSA-2024-0709, Federal Bureau of Investigation (FBI), Cyber National Mission Force (CMNF), Netherlands General Intelligence and Security Service (AIVD), Netherlands Military Intelligence and Security Service (MIVD), the Netherlands Police (DNP), and the Canadian Center for Cyber Security (CCCS), July 2024. URL https://www.ic3.gov/CSA/2024/240709.pdf. Joint Cybersecurity Advisory. 5.4

[38] Camille François. Actors, behaviors, content: A disinformation ABC. URL http://cdn.annenbergpublicpolicycenter.org/wp-content/uploads/2020/05/ABC_Framework_TWG_Francois_Sept_2019.pdf. 3.1

[39] Xu Guo and Yiqiang Chen. Generative ai for synthetic data generation: Methods, challenges and the future. *arXiv preprint arXiv:2403.04190*, 2024. URL https://arxiv.org/pdf/2403.04190v1. 5.1, 6.2

[40] Perttu Hämäläinen, Mikke Tavast, and Anton Kunnari. Evaluating large language models in generating synthetic hci research data: a case study. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, CHI '23, New York, NY, USA, 2023. Association for Computing Machinery. ISBN 9781450394215. doi: 10.1145/3544548.3580688. URL https://doi.org/10.1145/3544548.3580688. 6.2

[41] *Marine Air-Ground Task Force Information Operations*. Headquarters United States Marine Corps, Department of the Navy, Washington, DC, USA, 2018. URL https://www.marines.mil/Portals/1/Publications/MCWP%203-32.pdf. 4.2

[42] Edward J. Hu, Yelong Shen, Phillip Wallis, Zeyuan Allen-Zhu, Yuanzhi Li, Shean Wang, Lu Wang, and Weizhu Chen. Lora: Low-rank adaptation of large language models. *arXiv preprint arXiv:2106.09685*, 2021. URL https://arxiv.org/abs/2106.09685. 5.5

[43] Lawrence Hubert and Phipps Arabie. Comparing partitions. *Journal of Classification*, 2 (1):193–218, 1985. doi: 10.1007/BF01908075. 7.3, 7.5

[44] Charity S. Jacobs, Lynnette Hui Xian Ng, and Kathleen M. Carley. Tracking china's cross-strait bot networks against taiwan. In *Social, Cultural, and Behavioral Modeling (SBP-BRiMS 2023)*, pages 115–125, New York, NY, 2023. Springer. doi: 10.1007/978-3-031-43129-6_12. URL https://link.springer.com/chapter/10.1007/978-3-031-43129-6_12. 6.5

[45] *Joint Targeting*. Joint Chiefs of Staff, Washington, DC, USA, 2013. URL

https://jfsc.ndu.edu/Portals/72/Documents/JC2IOS/Additional_Reading/1F4_jp3-60.pdf. 4.2, 4.2

[46] *Joint Intelligence Preparation of the Operational Environment*. Joint Chiefs of Staff, Washington, DC, USA, 2014. URL https://irp.fas.org/doddir/dod/jp2-01-3.pdf. 4.2, 4.2

[47] *Information Operations*. Joint Chiefs of Staff, Washington, DC, USA, 2014. URL https://irp.fas.org/doddir/dod/jp3_13.pdf. 3.1, 4.2

[48] *Public Affairs*. Joint Chiefs of Staff, Washington, DC, USA, 2016. URL https://irp.fas.org/doddir/dod/jp3_61.pdf. 4.2

[49] *Doctrine for the Armed Forces of the United States*. Joint Chiefs of Staff, Washington, DC, USA, 2017. URL https://fas.org/irp/doddir/dod/jp1.pdf. 4.2

[50] *Joint Operations*. Joint Chiefs of Staff, Washington, DC, USA, 2017. URL https://irp.fas.org/doddir/dod/jp3_0.pdf. 4.2

[51] Jeon-Hyung Kang and Kristina Lerman. LA-CTR: A limited attention collaborative topic regression for social media. 27(1):1128–1134. ISSN 2374-3468, 2159-5399. doi: 10.1609/aaai.v27i1.8451. URL https://ojs.aaai.org/index.php/AAAI/article/view/8451. 6.4

[52] Catherine King, Christine Sowa Lepird, and Kathleen M. Carley. Project OMEN: Designing a training game to fight misinformation on social media. 3. URL http://reports-archive.adm.cs.cmu.edu/anon/anon/usr0/ftp/home/ftp/isr2021/CMU-ISR-21-110.pdf. 4.2, 5.2

[53] Santosh Kulkarni, Joyanta Banerjee, and Mallik Panchumarthy. Generate synthetic counterparty (cr) risk data with generative ai using amazon bedrock llms and rag, February 2025. URL https://aws.amazon.com/blogs/machine-learning/generate-synthetic-counterparty-cr-risk-data-with-generative-ai-using-a Amazon Web Services Machine Learning Blog. 6.2

[54] Christine Sowa Lepird. *Pink Slime: Measuring, Finding, and Countering Online Threats to Local News*. PhD thesis, Carnegie Mellon University, October 2024. URL https://christine-lepird.github.io/Lepird_Thesis_Oct2024.pdf. 6.7, 6.4, 6.7.1

[55] Patrick Lewis, Ethan Perez, Aleksandra Piktus, Fabio Petroni, Vladimir Karpukhin, Naman Goyal, Heinrich Küttler, Nils Reimers, Mohammad Shoeybi, Mostafa Dehghani, Sebastian Borgeaud, Sean Welleck, and Sebastian Riedel. Retrieval-augmented generation for knowledge-intensive nlp tasks. In *Advances in Neural Information Processing Systems (NeurIPS)*, volume 33, pages 9459–9474, 2020. URL https://arxiv.org/abs/2005.11401. 5.5

[56] Yao Lu, Peng Zhang, Yanan Cao, Yue Hu, and Li Guo. On the frequency distribution of retweets. 31:747–753. ISSN 18770509. doi: 10.1016/j.procs.2014.05.323. URL https://linkinghub.elsevier.com/retrieve/pii/S1877050914005006. 6.4

[57] Luchie Maranan. Cordillera day and the iskolar ng bayan, April 2024. URL https:

//up.edu.ph/cordillera-day-and-the-iskolar-ng-bayan/. Accessed: 2025-04-19. 7.4.2

[58] Dennis L. Meadows, William W. Behrens, Donella H. Meadows, Roger F. Naill, Jørgen Randers, and Erich Zahn. *Dynamics of Growth in a Finite World*. Wright-Allen Press, Cambridge, MA, 1974. URL https://elmoukrie.com/wp-content/uploads/2020/12/dynamics-of-growth-in-a-finite-world_nodrm.pdf. 6.2

[59] Randall Munroe. Standards. https://xkcd.com/927/, 2011. Accessed: 2025-03-13. 5.4

[60] Lynnette Hui Xian Ng and Kathleen M. Carley. Deflating the chinese balloon: types of twitter bots in us-china balloon incident. *EPJ Data Science*, 12(1):63, 2023. doi: 10.1140/epjds/s13688-023-00440-3. URL https://epjdatascience.springeropen.com/articles/10.1140/epjds/s13688-023-00440-3. 6.5

[61] Ben Nimmo. Anatomy of an info-war: How russia's propaganda machine works, and how to counter it. 15:1–16. URL https://www.stopfake.org/en/anatomy-of-an-info-war-how-russia-s-propaganda-machine-works-and-how-t
3.1

[62] OASIS Open. Cti documentation. https://oasis-open.github.io/cti-documentation/. Accessed: 2025-03-13. 5.4

[63] Office of the Director of National Intelligence. Information resource metadata. https://www.dni.gov/index.php/who-we-are/organizations/ic-cio/ic-technical-specifications/information-resource-metadata. Accessed: 2025-03-13. 5.4

[64] oobabooga. A gradio web UI for large language models: oobabooga/text-generation-webui. URL https://github.com/oobabooga/text-generation-webui. original-date: 2022-12-21T04:17:37Z. 5.3

[65] *The official Python library for the OpenAI API*. OpeanAI. URL https://github.com/openai/openai-python. original-date: 2020-10-25T23:23:54Z. 2.2.1, 5.3

[66] James Pamment. *The EU's Role in Fighting Disinformation: Crafting A Disinformation Framework*. Carnegie Endowment for International Peace. URL https://carnegieendowment.org/files/Pamment_-_Crafting_Disinformation_1.pdf. 3.1

[67] Joon Sung Park, Joseph C. O'Brien, Carrie J. Cai, Meredith Ringel Morris, Percy Liang, and Michael S. Bernstein. Generative agents: Interactive simulacra of human behavior, 2023. URL https://arxiv.org/pdf/2304.03442. 6.2

[68] Cesar Augusto Rodriguez, Timothy C. Walton, and Chu Hyong. Putting the "FIL" into "DIME": growing joint understanding of the instruments of power. 97(8). URL https://apps.dtic.mil/sti/citations/tr/AD1099537. 4.2

[69] James Snell, Evan Prodromou, and Sarven Capadisli. Activitystreams 2.0 core vocabulary. https://www.w3.org/TR/activitystreams-core/, 2017. W3C Recommendation, Accessed: 2025-03-13. 5.4

[70] Qt for Python Team. PySide6: Python bindings for the qt cross-platform application and UI framework. URL https://pyside.org. 2.2.2, 5.3

[71] V. A. Traag, L. Waltman, and N. J. van Eck. From Louvain to Leiden: guaranteeing well-connected communities. *Scientific Reports*, 9(1):5233, 2019. doi: 10.1038/s41598-019-41695-z. 2

[72] Joshua Uyheng, Thomas Magelinski, Ramon Villa-Cox, Christine Sowa, and Kathleen M. Carley. Interoperable pipelines for social cyber-security: assessing twitter information operations during NATO trident juncture 2018. 26(4):465–483. ISSN 1381-298X, 1572-9346. doi: 10.1007/s10588-019-09298-1. URL http://link.springer.com/10.1007/s10588-019-09298-1. 3.1

[73] Veniamin Veselovsky, Manoel Horta Ribeiro, Akhil Arora, Martin Josifoski, Ashton Anderson, and Robert West. Generating faithful synthetic data with large language models: A case study in computational social science. *arXiv preprint arXiv:2305.15041*, 2023. URL https://arxiv.org/pdf/2305.15041. 6.2

[74] Nguyen Xuan Vinh, Julien Epps, and James Bailey. Information theoretic measures for clusterings comparison: Variants, properties, normalization and correction for chance. In *Journal of Machine Learning Research*, volume 11, pages 2837–2854, 2010. URL https://jmlr.csail.mit.edu/papers/volume11/vinh10a/vinh10a.pdf. 7.3, 7.5

[75] Kritin Vongthongsri. Using llms for synthetic data generation: The definitive guide. https://www.confident-ai.com/blog/the-definitive-guide-to-synthetic-data-generation-using-llms, 2023. Confident AI Blog, Accessed: 2025-03-14. 6.2

[76] X. X ids overview, 2023. URL https://docs.x.com/resources/fundamentals/x-ids. Describes the structure and generation of Snowflake-based unique identifiers used by X (formerly Twitter). 5.3

Appendix A

AESOP Products

The following are raw outputs from AESOP based on a synthetic scenario.

Scenario Summary

SYNTHETIC_SCENARIO

General Info

Date Range: 2034-05-01 to 2034-05-14

Countries of Interest:
United States

Regions of Interest:
South-eastern Asia

Other Locations of Interest:

Primary Training Audience:
JTF Information Operations Coordination Cell

Primary Training Audience's Higher Headquarters' Mission:
To deter aggression, enhance regional stability, and safeguard US and allied interests within the Pacific theater, the JTF will conduct integrated military operations in response to any emerging crises. The JTF will prioritize defense of key strategic partners, ensure freedom of navigation, and enhance interoperability among US forces and regional allies to preserve security and stability across the Indo-Pacific

Primary Training Audience's Mission:
To plan, synchronize, and execute information operations that support Joint Task Force objectives by shaping the information environment, countering adversary disinformation, and reinforcing US and allied narratives. The IOCC will ensure timely dissemination of truthful information to influence key audiences, protect friendly information systems, and degrade adversarial information campaigns across the Pacific theater. The cell will focus on countering disinformation related to ongoing crisis, strengthening US-ally relations during exercise, and mitigating the influence of adversaries in the Pacific.

Strategic Communication Guidance and Objectives:
Strategic Communication Guidance
o Reinforce US Commitment to Regional Allies and Partners: Emphasize USINDOPACOM's commitment to defending allies. Highlight the US as a steadfast partner, ready to uphold international law and stability in the region.

o Promote Legitimacy and Transparency: Maintain credibility by providing truthful, transparent, and consistent communication. Ensure that all messaging adheres to international norms and reinforces the legitimate nature of US and allied actions, particularly in responding to humanitarian crises and protecting regional sovereignty.

EXERCISE // UNCLASSIFIED // EXERCISE
All material contained is confidential and proprietary
to Netanomics and the CASOS center at CMU.

o Counter Adversary Disinformation: Actively identify, expose, and counter false narratives from adversaries. Use both defensive (disproving false claims) and offensive (undermining the adversary's credibility) communication strategies.

o Amplify Humanitarian Assistance and Disaster Relief (HADR) Efforts: Leverage the JTF's response to disasters to highlight US and allied humanitarian efforts, enhancing regional perception of the US as a force for good and stability. Showcase coordination with allies

o Strengthen Public Confidence in Exercises: Publicize the importance of US-Ally cooperation through exercises, emphasizing the role of these exercises in improving readiness, interoperability, and regional defense capabilities.

o Focus on Shared Values and Collective Security: Highlight shared values such as democracy, sovereignty, and freedom of navigation. Underscore the importance of collective security arrangements in preserving peace and stability in the Indo-Pacific region.

o Enhance Operational Security (OPSEC): Ensure that messaging balances the need for transparency with the need to protect sensitive operational details. Avoid revealing critical information that could be exploited by adversaries.

Strategic Communication Objectives
o Deter Aggression: Use strategic messaging to signal the US's resolve and capability to defend allies and other regional interests, creating uncertainty in the minds of adversaries about the costs of aggression. The objective is to prevent escalation by demonstrating readiness and resolve.

o Undermine Adversary Morale and Unity: Undermine adversary military cohesion and legitimacy in joint exercises by exposing potential weaknesses, inconsistencies in messaging, or highlighting tensions within their alliance. Promote doubt in the efficacy of their operations and decision-making processes.

o Influence Regional and Global Audiences: Shape perceptions among regional allies, neutral states, and global audiences by framing the JTF's actions as defensive and stabilizing. Encourage regional actors to align with US and allied positions rather than adopting a neutral or adversarial stance.

o Promote US and Allied Strength and Unity: Strengthen the perception of US military strength, technological superiority, and the unity of the JTF and its allies. Convey a sense of overwhelming capability and preparedness to respond to any crisis.

o Build Trust in US-Led Humanitarian and Stability Operations: Build trust in US-led disaster relief operations by showcasing swift and effective humanitarian assistance.

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Increase confidence in US leadership and response capabilities during natural disasters and crises.

o Support Public Opinion and Morale in the US and Allied Nations: Ensure domestic and allied public support for the JTF's operations by emphasizing the necessity of US presence and actions in maintaining regional stability, protecting trade routes, and upholding international law.

o Expose Adversary Malign Activities: Publicize any malign activities or violations of international law by adversaries, such as posturing in joint exercises or disinformation campaigns, to paint these adversaries as destabilizing forces in the region.

Key Messaging Themes
o Peace and Stability: US and allied actions are aimed at preserving peace and maintaining regional stability.
o Humanitarian Response: Highlight the US's role as a provider of humanitarian aid, particularly in Japan.
o International Norms and Rules: Emphasize adherence to international law and the importance of sovereignty and self-determination for regional partners.
o US Resolve and Strength: Underscore the capability and commitment of US forces to defend allies and protect shared interests.
o Collective Security: Promote regional cooperation and multilateral partnerships as essential for maintaining stability against shared threats.

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Actor/Organization Example

United Nations



General Info

Type: Government
Organizational Leader: Anna Virtanen
Main Account Handle: UN
Other Associated Handles:

Handle:
Screen Name:
URL:

Description:
The United Nations acts as a global forum for addressing pressing international issues and promoting dialogue and cooperation among nations. It provides a platform for member states to work together on matters such as socioeconomic development, human rights, climate change, peacekeeping, and disarmament. The organization is guided by the principles of sovereign equality, impartiality, and non-interference in the domestic affairs of its member states.

Throughout its history, the UN has played a significant role in fostering international peace and stability. One of its earliest successes came with the establishment of the United Nations Partition Plan for Palestine in 1947, which aimed to address the ongoing conflict in the region. Over the years, the UN has continued to deploy peacekeeping missions to various parts of the world, including in Cyprus, the Democratic Republic of Congo, and South Sudan, among others.

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The UN has also been instrumental in promoting human rights and advancing global development. It has been at the forefront of efforts to combat poverty, hunger, and disease, and has spearheaded initiatives such as the Millennium Development Goals and the Sustainable Development Goals. Additionally, the organization has played a pivotal role in addressing global health crises, such as the HIV/AIDS epidemic and the recent COVID-19 pandemic.

The UN is composed of several principal organs, including the General Assembly, the Security Council, the Economic and Social Council, the Secretariat, and the International Court of Justice. These organs work together to carry out the organization's mandate, with member states contributing to decision-making through their participation in the General Assembly and the Security Council.

Overall, the United Nations continues to serve as a vital platform for international cooperation and diplomacy. As the global challenges facing our world become increasingly complex, the UN plays an essential role in fostering dialogue, promoting collaboration, and working towards a more peaceful and equitable world for all.

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Actor/Person Example

Kory Hills

General Info



Name: Kory Hills
Leader Type: Other
Title: Vlogger
Organization:
Gender: Male
Age: 45
Race: Belisian
Nationality: Belisian

Biography

Character Name: Kory Hills
Age: 45
Gender: Male
Occupation: Vlogger
Agenda: Alarmist, protectionist

Background:
Kory Hills is a 45-year-old male who has made a name for himself as a political vlogger. His content is known for its alarmist and protectionist agenda, often focusing on spreading fear and advocating for strict measures to protect what he believes is under threat.

Hailing from a background in journalism, Kory transitioned to vlogging as a means to reach a wider audience and express his views more freely. His style is characterized by passionate rants and sensationalist headlines, driving engagement and controversy among his followers.

Kory's content frequently features anti-Olvana material, as he perceives the Olvana group as a threat to the values and interests he holds dear. He often exaggerates or misrepresents information to reinforce his narrative and stoke fear among his viewers.

Despite facing backlash and criticism from opposing factions, Kory remains steadfast in his beliefs and continues to use his platform to influence public opinion. Off-camera, Kory is a dedicated individual who believes he is fighting for what is right, even if it means being branded as a divisive figure.

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Press Release Example

FOR IMMEDIATE RELEASE

US EMBASSY ACKNOWLEDGES STUDENT PROTESTS FOR PEACEFUL RESOLUTION IN SOUTHERN OLVANA SEA CRISIS

On 30 July, a wave of student protests swept across various countries, with demonstrators gathering outside US embassies to advocate for a peaceful resolution to the conflict in the South Olvana Sea. These protests highlight the mounting anti-war sentiment among the younger generation and their deep concerns about the consequences of violence and conflict.

The escalating conflict in the South Olvana Sea had caused growing unease worldwide, prompting students to take to the streets and denounce the use of military force. The protests brought attention to the urgent need for de-escalation and the exploration of peaceful solutions to the crisis.

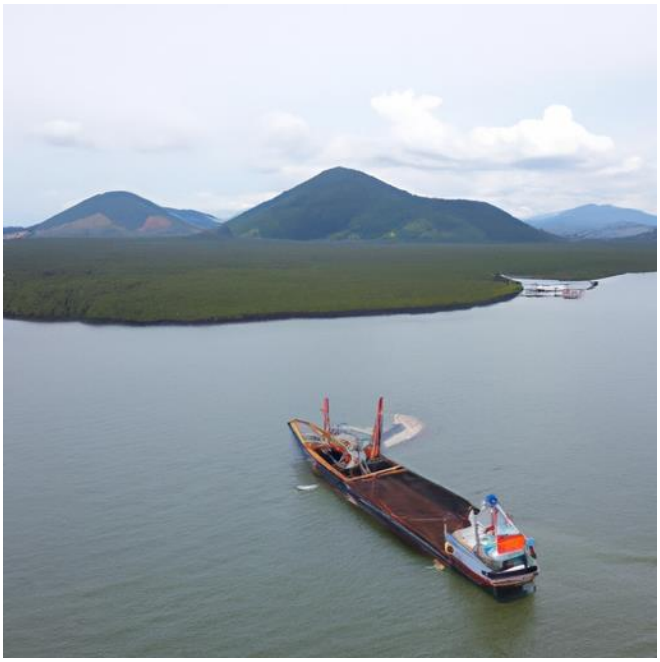
In response to the protests, we acknowledge the students' concerns and assure them that their voices are heard. The demonstrations highlighted the younger generations' keen awareness of global issues and their determination to shape a peaceful future. Through their actions, their messages resonated on social media platforms, attracting international attention to the cause. Their calls for a peaceful resolution, free from military intervention, embody their aspiration for a harmonious global community.

We share their desire for peace. We reiterate that Olvana is the aggressor in this matter, having invaded Belesia's Barstow Island, and the US must act in concert with its allies to counter such naked aggression.

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Event Example

Belesian Navy attempts to arrest Olvana fisherman, Olvan dispatched CG and militia to prevent the arrest



General Info

Type: Other
Start Date: 2025-05-03
End Date: 2025-05-04
Other Countries Involved: Belesia, Olvana
Cities:
Other Areas:
Event Leader:
Leader's Job Title:
Leader's Home Country:
Positive Hashtags: #OlvanaOvereach
Negative Hashtags: #OlvanaDidNothingWrong

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Description

On June 17, 2024, tensions escalated between Belesia and Olvana as the Belesian Navy attempted to arrest 11 Olvana fishermen at the Hasa-Hasa Shoal. The fishermen were caught onboard their vessel with a haul of over 500 sea turtles, many of which were endangered species. This incident took place within the Belesias' exclusive economic zone, leading to the arrest on charges of poaching and illegal possession of protected marine wildlife by the Belesia National Police Maritime Group.

The arrest sparked a diplomatic crisis between the two countries, as both Belesia and Olvana lay claim to the waters surrounding the shoal. Olvana strongly denounced the arrest and demanded the immediate release of their fishermen, citing their right to fish in the area. In contrast, Belesia maintained that the fishermen had violated its national laws designed to protect its marine resources and biodiversity.

Following the arrest, the 11 Olvana fishermen were detained and their fishing vessel was impounded. Legal proceedings were initiated, underscoring Belesia's commitment to upholding its maritime rights and preserving the environmental integrity of its waters. The case quickly became a focal point in diplomatic discussions between the two nations, with negotiations aimed at resolving the dispute.

After several months of diplomatic negotiations, the detained Olvana fishermen were eventually released and deported back to Olvana. This resolution came about through bilateral talks that sought to address the complex issues surrounding the incident. The release of the fishermen marked a tentative step towards easing tensions between Belesia and Olvana, illustrating the importance of diplomacy in resolving maritime disputes and environmental conservation issues in the region.

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Group Example

US (Gov't)

Full Members of Group:

Organizations

25th Infantry Division
US Marine Forces Pacific (MARFORPAC)
Indo-Pacific Command (INDOPACOM)
US Army Pacific (USARPAC)
US Pacific Fleet (USPACFLT)
US Navy

Sources drawn from by the group (Not Full Members):

Narratives:

2025-05-03 to 2025-08-01
They (Olvana) only care about their own economy.
Anti, Belesian-Olvana Prosperity Relations
Related Event: Olvana military units vic Ancient Statues

Description:
Connecting Olvanan actions to the Olvanan domestic economy in a one-sided exchange.

Example:
Olvana crows about building ports and roads abroad, but buyer beware! Studies show that Olvana makes 10 times the return on infrastructure compared to the host nation. The old saying "You spend money to make money" is true here. Anything Olvana does is calculated to benefit them, first and foremost.

2025-05-03 to 2025-08-01
Trading slavery for cash.
Anti, Belesian-Olvana Prosperity Relations
Related Event: Olvana Barstow Island occupation

Description:
Equating Olvanan economic outreach to subjugation.

EXERCISE // UNCLASSIFIED // EXERCISE
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Example:
The old empires sent troops to seize land and then sent the riches back to their home country. Olvana has taken a savvy new approach to classic imperialism -- they send money to buy up the land and calm the natives, and then send their troops to finish the conquest. Make no mistake, though -- the outcome is the same. When Olvana is done, the nation "benefitted" by their money is just another vassal state in a growing empire.

2025-05-03 to 2025-08-01
The US respects individual rights and autonomy
Anti, Accusations that US is using Belesia as a proxy against Olvana
Related Event: Olvana military units vic Ancient Statues

Description:
Claims that the US enshrines human rights as sacred, and recognizing that democracy is difficult but the Belisian government and people can overcome outside influence.

Example:
America's success is built on disagreement. Our democracy is strong not in spite of our differences, but because of them -- they force us to be creative, inclusive, honest with ourselves, and dedicated to something greater than any individual. The US honors this same commitment in our Belisian partners, and we are proud to stand beside them as they find strength in true debate -- and not in obviously false outside influence.

News Site Example

AB News

< THIS IS A FAKE WEBSITE CREATED FOR AN EXERCISE INVOLVING DISINFORMATION. >

Home Weather Contact



International Community Calls for Restraint in Olvana-Belesia Dispute

2025-05-04 Gerry Stoneman

International Community Calls for Restraint in Olvana-Belesia Dispute

In a bid to mitigate the escalating tensions between Olvana and Belesia over the sovereignty of Barstow Island, the international community has united in calling for both nations to exercise restraint and pursue a peaceful resolution. The dispute has raised concerns worldwide, as military forces are being mobilized, and the potential for a prolonged military engagement has the potential to destabilize the delicate global balance of power.

At the heart of the dispute is the strategic importance of Barstow Island, which lies in the heart of the coveted Targo Sea. The island possesses rich natural resources and serves as a crucial maritime gateway for trade between several regions. Both Olvana and Belesia claim historical rights to the island, citing ancient maps and treaties as evidence of their rightful ownership.

The tension between the two nations has been simmering for months, but recently escalated when Olvana dispatched a naval fleet to reinforce its military presence on Barstow Island. In response, Belesia promptly deployed its own naval forces, sparking fears of an all-out conflict in the region. The international community, alarmed by the rapid escalation, fears that any military engagement could have far-reaching consequences and ignite a wider conflagration.

In a joint statement issued by various global leaders, nations with Center Left leanings have appealed to Olvana and Belesia to prioritize diplomacy over aggression. The statement underlines the importance of dialogue, urging both parties to engage in peaceful negotiations mediated by neutral parties to arrive at a mutually agreeable solution.

Experts and analysts emphasize that a military confrontation between Olvana and Belesia could have severe economic and geopolitical ramifications. The global economy remains fragile due to the ongoing pandemic, and any disruption to trade routes in the Targo Sea could exacerbate existing challenges. Moreover, the region surrounding Barstow Island is also home to several other nations, who fear being dragged into the conflict should tensions escalate further.



Olvana Maritime Militia Vessel Rams Belesian Naval Ship

2025-05-05 Victor Crause

Article_Name: Escalation of Tensions as Olvana Maritime Militia Collides with Belesian Naval Ship

In a tense and concerning turn of events, tensions have escalated in the disputed waters around Barstow Island as an Olvana maritime militia vessel collided with a Belesian naval ship today. The incident marks a significant escalation in hostilities as the long-standing territorial dispute between the two nations takes an increasingly dangerous turn.

Eyewitness accounts indicate that the Olvana maritime militia vessel intentionally rammed into the Belesian naval ship, causing significant damage and heightening concerns among regional security experts. The collision occurred in close proximity to Barstow Island, which has been at the center of the ongoing dispute between the Olvana Republic and the Republic of Belesia.

This latest incident follows a series of recent confrontations between the Olvana and Belesian forces in the disputed waters. Both nations have claimed sovereignty over the strategic area, which is known for its rich resources and strategic importance. Tensions have been simmering for months, with occasional reports of skirmishes and aggressive actions by both sides.

The collision today has further ratcheted up the tension between the two nations, prompting fears of an all-out armed conflict. Diplomatic channels have been intensively engaged by international mediators, who are desperately attempting to diffuse the situation and prevent further escalation. The United Nations, regional powers, and neighboring countries have condemned the maritime incident and called for restraint from both Olvana and Belesia.

Experts warn that the maritime militia vessel's deliberate act of ramming the Belesian naval ship not only risks the lives of those involved but also raises concerns about the potential use of force beyond diplomatic resolutions. With an already volatile situation, this incident threatens to divide the international community and create further instability in the region.

Despite the calls for calm, both Olvana and Belesia have so far shown little willingness to back down. Recent rhetoric from both sides has been bellicose, further raising concerns about the potential for a peaceful resolution. The international community continues to monitor the situation closely and has offered support in facilitating negotiations, emphasizing that a peaceful resolution stands as the most viable option for all parties involved.

It remains to be seen whether Olvana and Belesia will heed the calls for restraint and opt for diplomacy over war. The fate of Barstow Island and the stability of the entire Targo Sea region hang in the balance, with the international community anxiously awaiting a resolution that avoids a devastating military engagement.



Olvana Invasion Sparks International Outcry

2025-05-06 Bob Gibson

Olvana Invasion Sparks International Outcry

Barstow Island - The international community has erupted in alarm over the unprecedented invasion of Barstow Island by Olvana, sparking widespread condemnation and urgent calls for a withdrawal of forces. The military aggression has raised concerns among global leaders, who are urging both sides to immediately resume negotiations in order to find a peaceful resolution to the escalating conflict.

The invasion, which caught many by surprise, has further strained the already tense relations between Olvana and the international community. Leaders from neighboring countries and international organizations have swiftly responded with unified outrage, accusing Olvana of disregarding diplomatic efforts and resorting to aggression.

In addition, global organizations, such as the World Trade Organization and Amnesty International, have voiced their concern over the invasion. They have appealed to Olvana to prioritize diplomatic solutions and avoid further escalation, emphasizing the need for a peaceful resolution that respects the rights of the Barstow Island inhabitants.

The invasion has sparked protests and demonstrations across major cities, with citizens and activists demanding immediate action and a halt to the violence. Humanitarian organizations have also raised the alarm, highlighting the risk of civilian casualties and the urgent need to ensure the safety of the local population.

The Olvana Republic and the Republic of Belesia both possess formidable military capabilities, and any direct confrontation between their forces could have severe consequences for neighboring countries and international trade routes. The collision serves as a stark reminder of the urgent need for diplomatic efforts and dialogue to peacefully resolve the territorial dispute in the disputed waters around Barstow Island.

As tensions continue to rise, the international community anxiously follows developments in the disputed waters. Global leaders are urging both Olvana and Belesia to exercise restraint and pursue diplomatic negotiations, emphasizing the necessity of de-escalation to ensure regional stability and prevent any further unfortunate incidents that could potentially spark a larger conflict.



UN Calls for Immediate Ceasefire in Barstow Island Conflict

2025-05-07 Ulmer Fretner

UN Calls for Immediate Ceasefire in Barstow Island Conflict

The United Nations (UN) has issued a strong plea for an immediate ceasefire in the ongoing conflict between the nations of Olvana and Belesia over the disputed territory of Barstow Island. In an increasingly tense geopolitical theater, the UN has taken the lead in urging both parties to exercise restraint and seek peaceful means of resolution.

The conflict, which has claimed numerous lives and caused significant damage to infrastructure on Barstow Island, has shown no sign of abating. The UN's call for a ceasefire comes as a glimmer of hope in what has been a protracted and devastating series of military engagements.

Secretary-General Maria Fuentes delivered a firm statement at a press conference held at the international body's headquarters in New York, emphasizing the urgent need for de-escalation. Fuentes stated that the conflict had reached a critical juncture, with both Olvana and Belesia having suffered substantial losses and the fighting having spilled beyond the confines of Barstow Island.

"The UN is deeply concerned about the toll this conflict is taking on both nations and the surrounding region," Fuentes expressed. "We call upon Olvana and Belesia to halt all military operations immediately and engage in meaningful dialogue to find a peaceful solution to the dispute over Barstow Island."

However, Olvana has remained resolute in its stance, justifying the invasion as a necessary measure to protect its national interests and ensure regional stability. The Olvanian government maintains that it is committed to restoring peace and security in Barstow Island, but critics argue that their actions only serve to heighten tensions and exacerbate the situation.

As the international outcry intensifies, the world holds its breath, hoping that diplomatic efforts will prevail and that the invasion will come to an end. The urgency to restore peace and stability to Barstow Island continues to mount, as pressure mounts on Olvana to heed the international community's demands and return to the negotiating table.

The international community has widely regarded Barstow Island as a strategic location due to its natural resources and advantageous geographical positioning. While both Olvana and Belesia lay claim to the island, it is crucial for global stability that a peaceful resolution is found. The UN's intervention highlights the centrality of finding a diplomatic solution that ensures the long-term stability of the region.

Center-left nations, including influential powers such as Mirentis and Solundor, have echoed the UN's call for a ceasefire and expressed their commitment to facilitating dialogue between Olvana and Belesia. The escalating conflict has been a cause for concern for these nations, with fears of wider regional destabilization and potential economic repercussions.

It is crucial for all parties involved to heed the UN's plea and work towards a peaceful resolution. The international community must come together to support negotiations and engage in diplomacy, rather than relying on military force. The hopes for a swift end to the violence in Barstow Island rest on the ability of nations to set aside their differences and prioritize dialogue over further escalation.

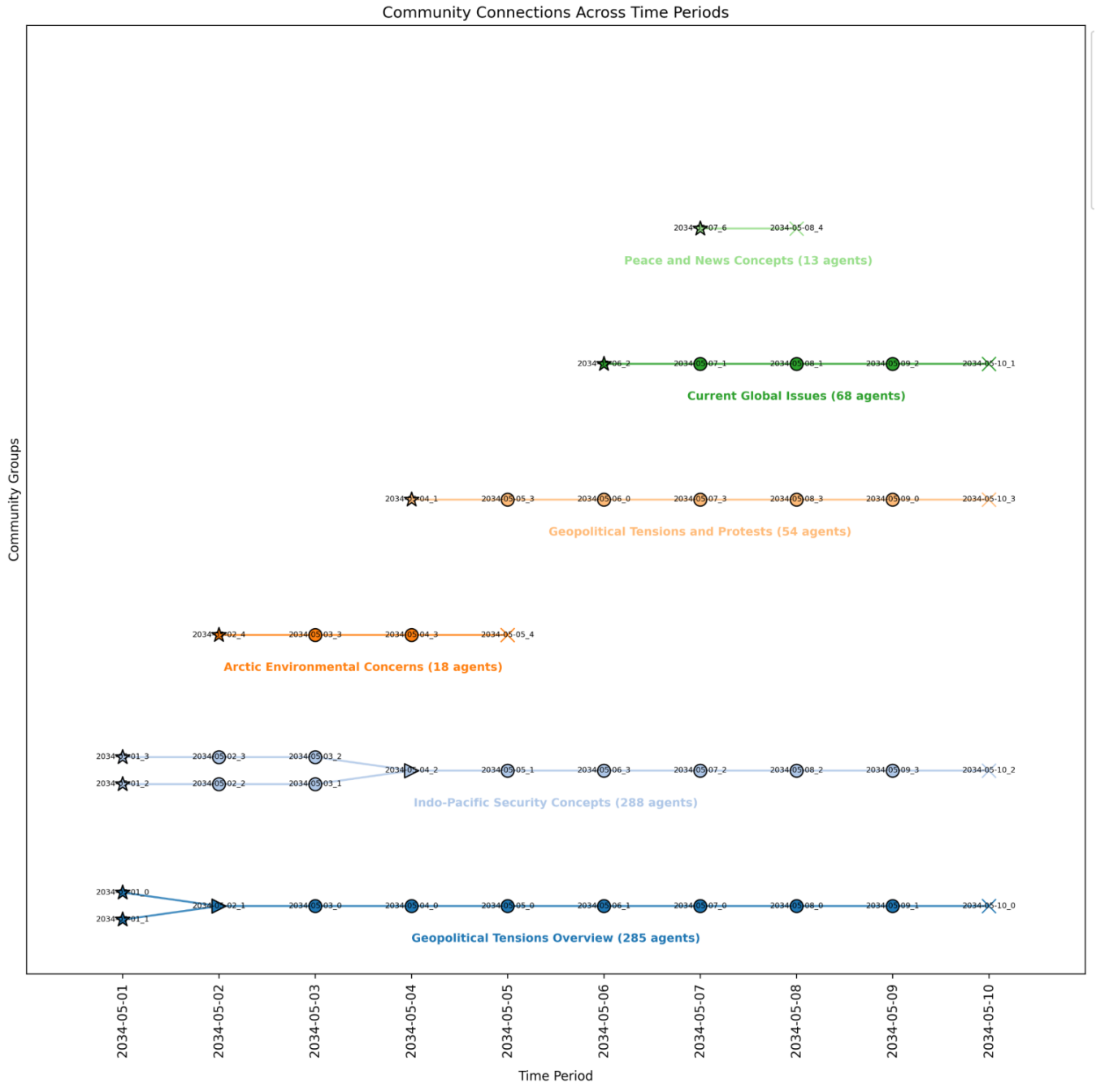
As the UN exerts pressure on Olvana and Belesia to embrace the path of peace, the world watches with bated breath, hoping for a breakthrough that would spare innocent lives and pave the way for a stable and prosperous future for Barstow Island and the region at large. The crisis serves as a crucial test for the international community to prove its commitment to preventing armed conflicts and fostering responsible diplomacy in a changing world.

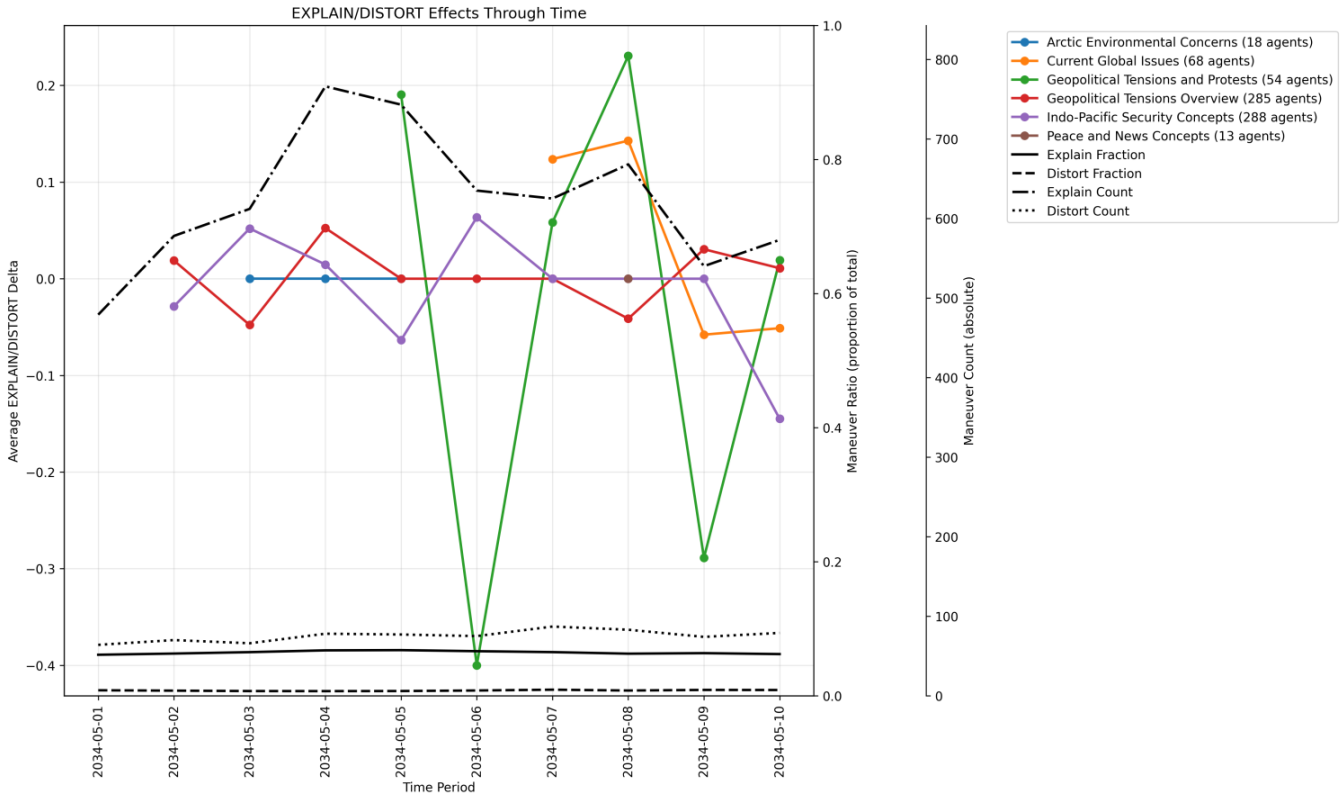
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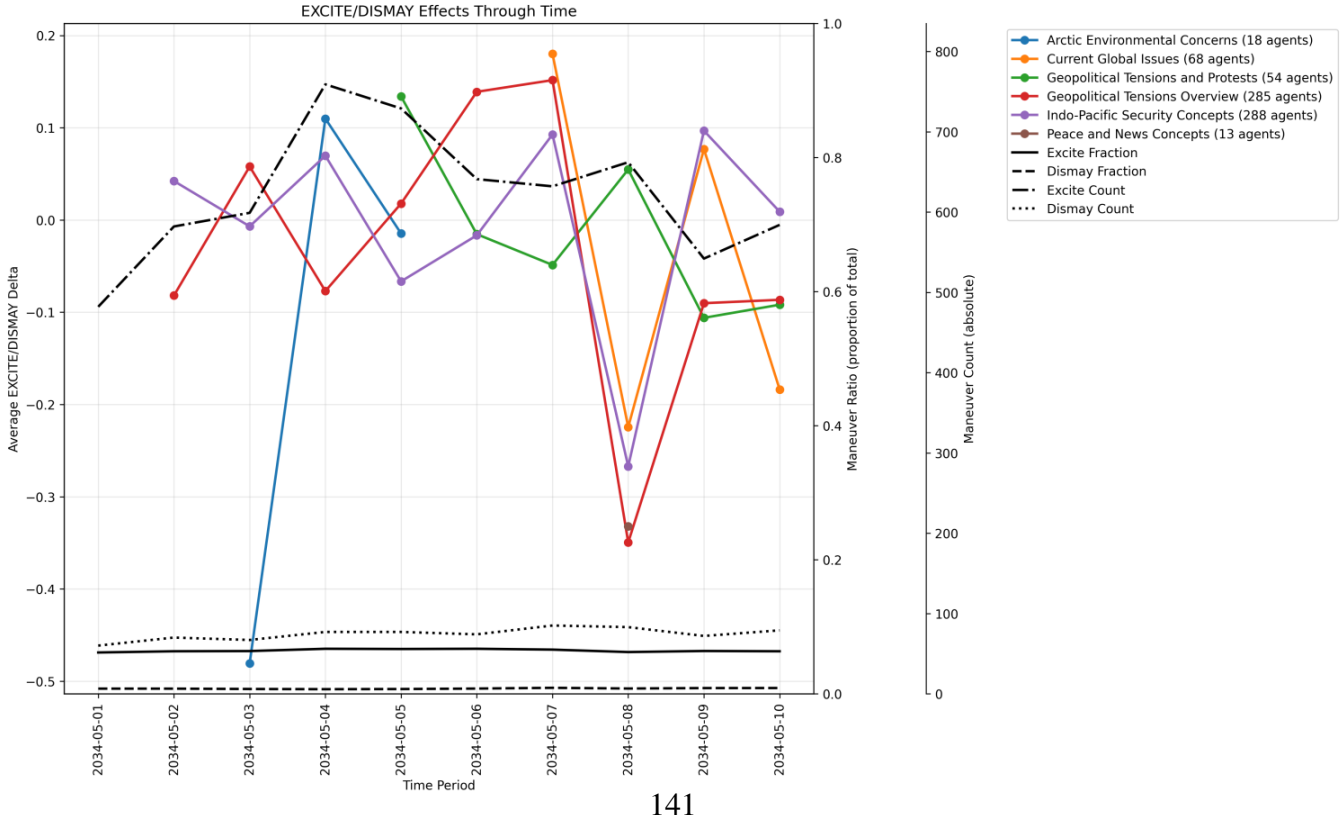
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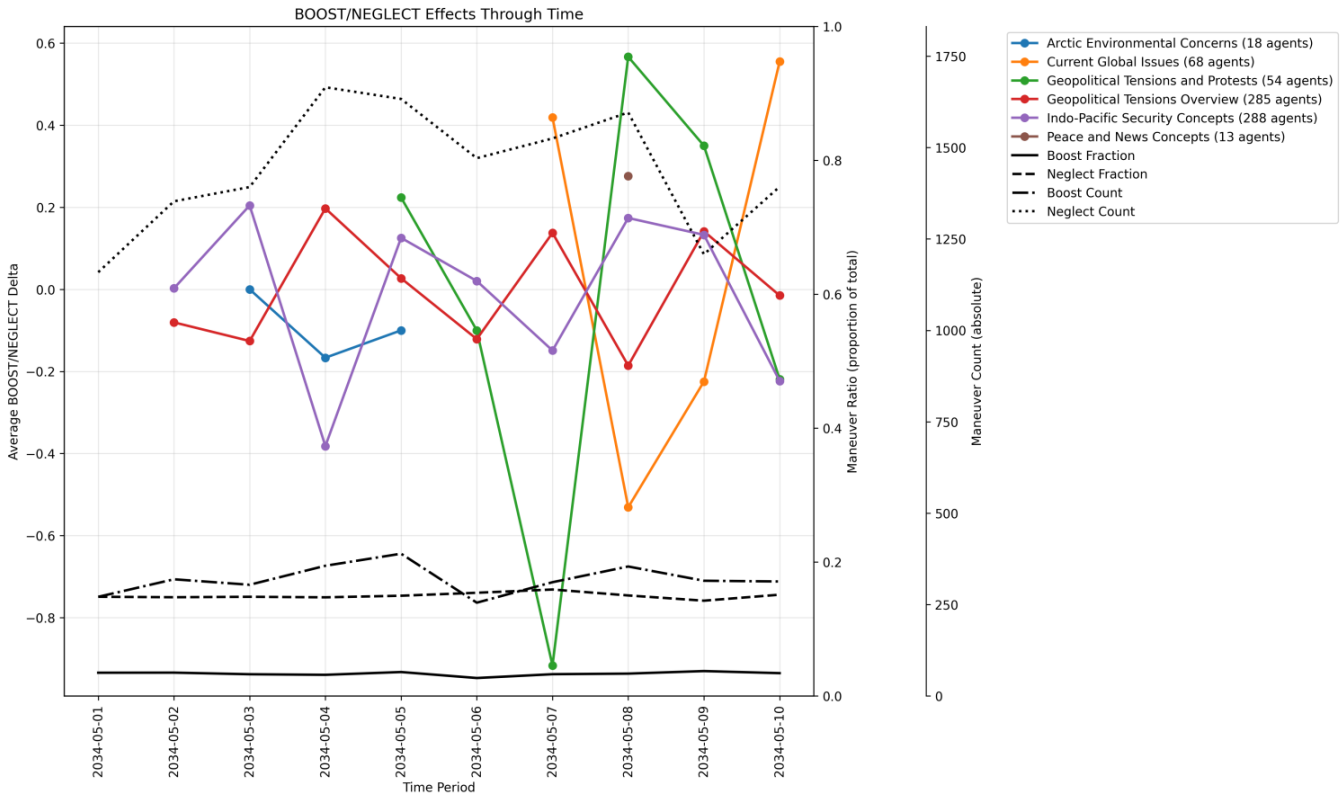
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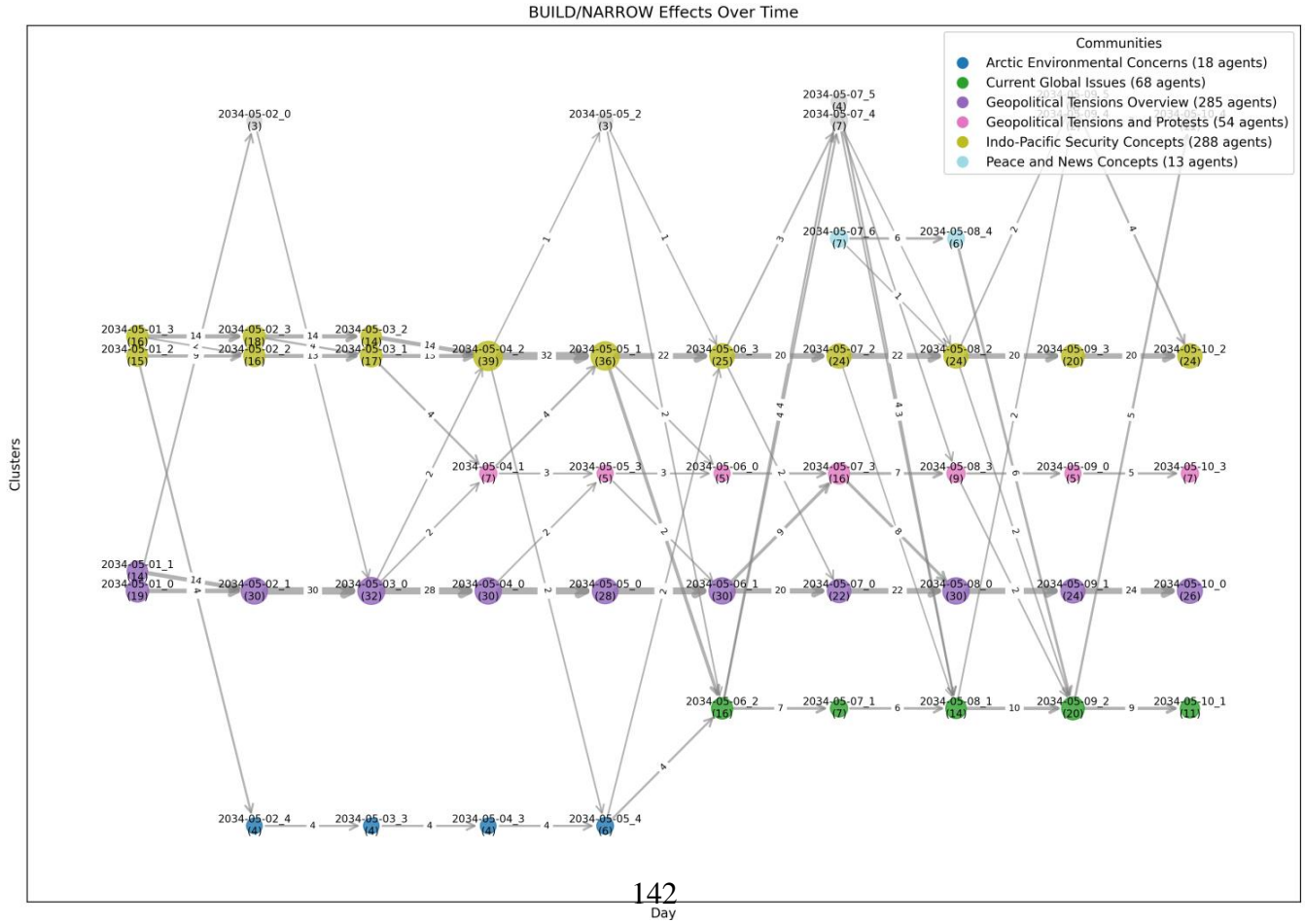
Synthetic Scenario Dataset



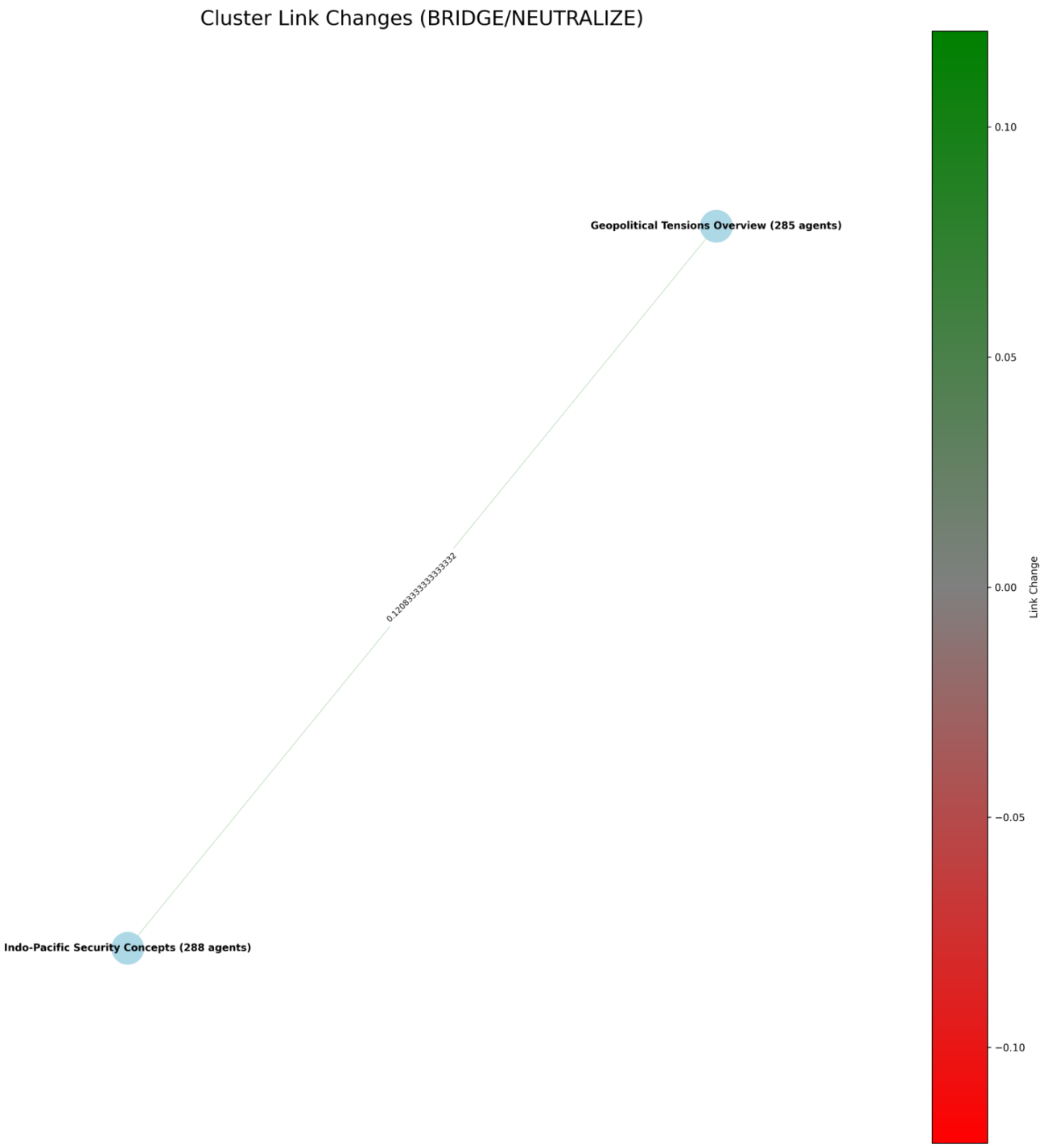

EXPLAIN/DISTORT Effects Through Time
Average EXPLAIN/DISTORT Delta
Maneuver Ratio (proportion of total)
Maneuver Count (absolute)
Time Period
2034-05-01
2034-05-02
2034-05-03
2034-05-04
2034-05-05
2034-05-06
2034-05-07
2034-05-08
2034-05-09
2034-05-10
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Current Global Issues (68 agents)
Geopolitical Tensions and Protests (54 agents)
Geopolitical Tensions Overview (285 agents)
Indo-Pacific Security Concepts (288 agents)
Peace and News Concepts (13 agents)
Explain Fraction
Distort Fraction
Explain Count
Distort Count


EXCITE/DISMAY Effects Through Time
Average EXCITE/DISMAY Delta
Maneuver Ratio (proportion of total)
Maneuver Count (absolute)
Time Period
2034-05-01
2034-05-02
2034-05-03
2034-05-04
2034-05-05
2034-05-06
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2034-05-10
Arctic Environmental Concerns (18 agents)
Current Global Issues (68 agents)
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Dismay Count

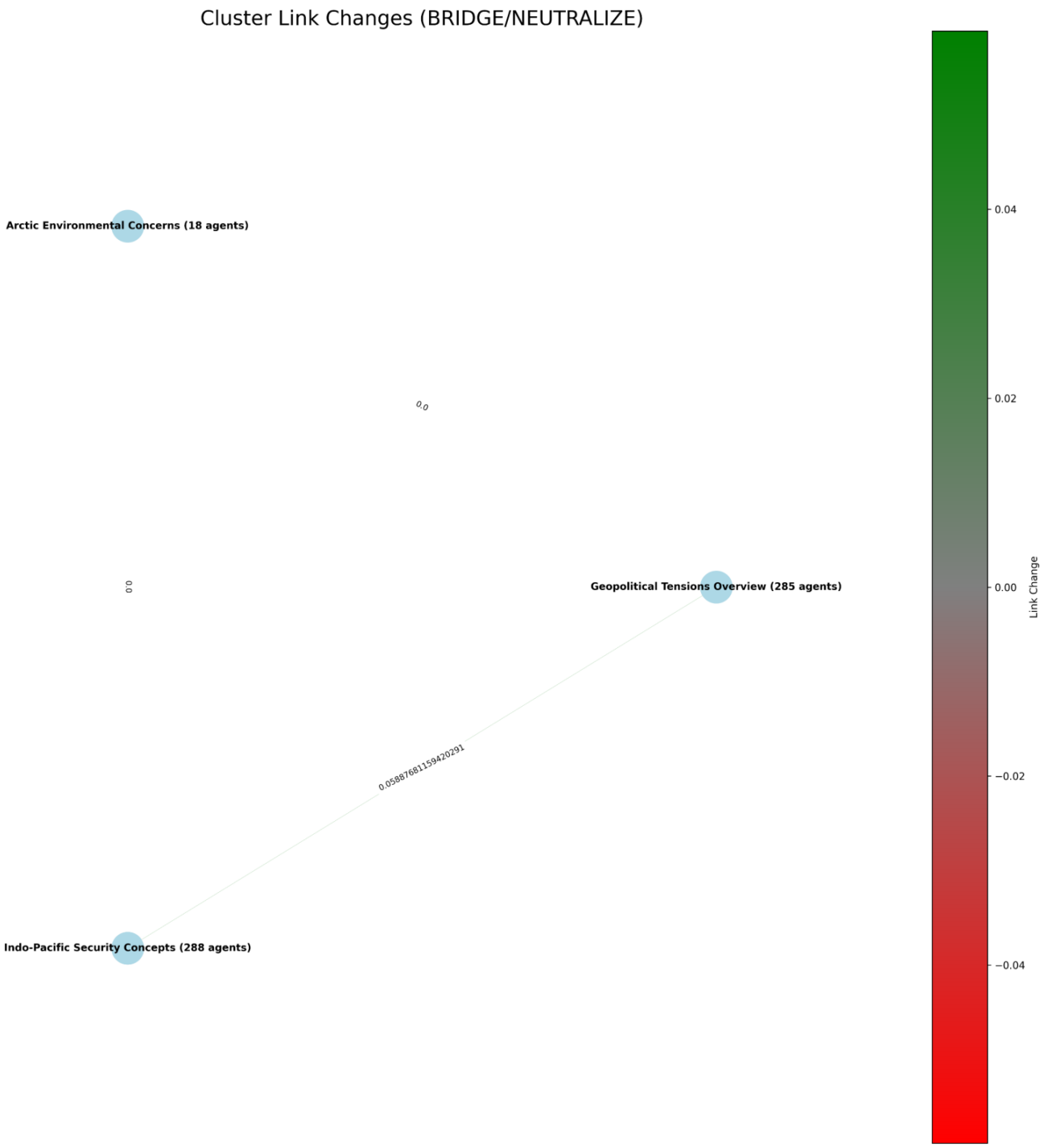

BOOST/NEGLECT Effects Through Time
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Maneuver Ratio (proportion of total)
Maneuver Count (absolute)
Time Period
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Peace and News Concepts (13 agents)
Boost Fraction
Neglect Fraction
Boost Count
Neglect Count


BUILD/NARROW Effects Over Time
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Current Global Issues (68 agents)
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Clusters
Day

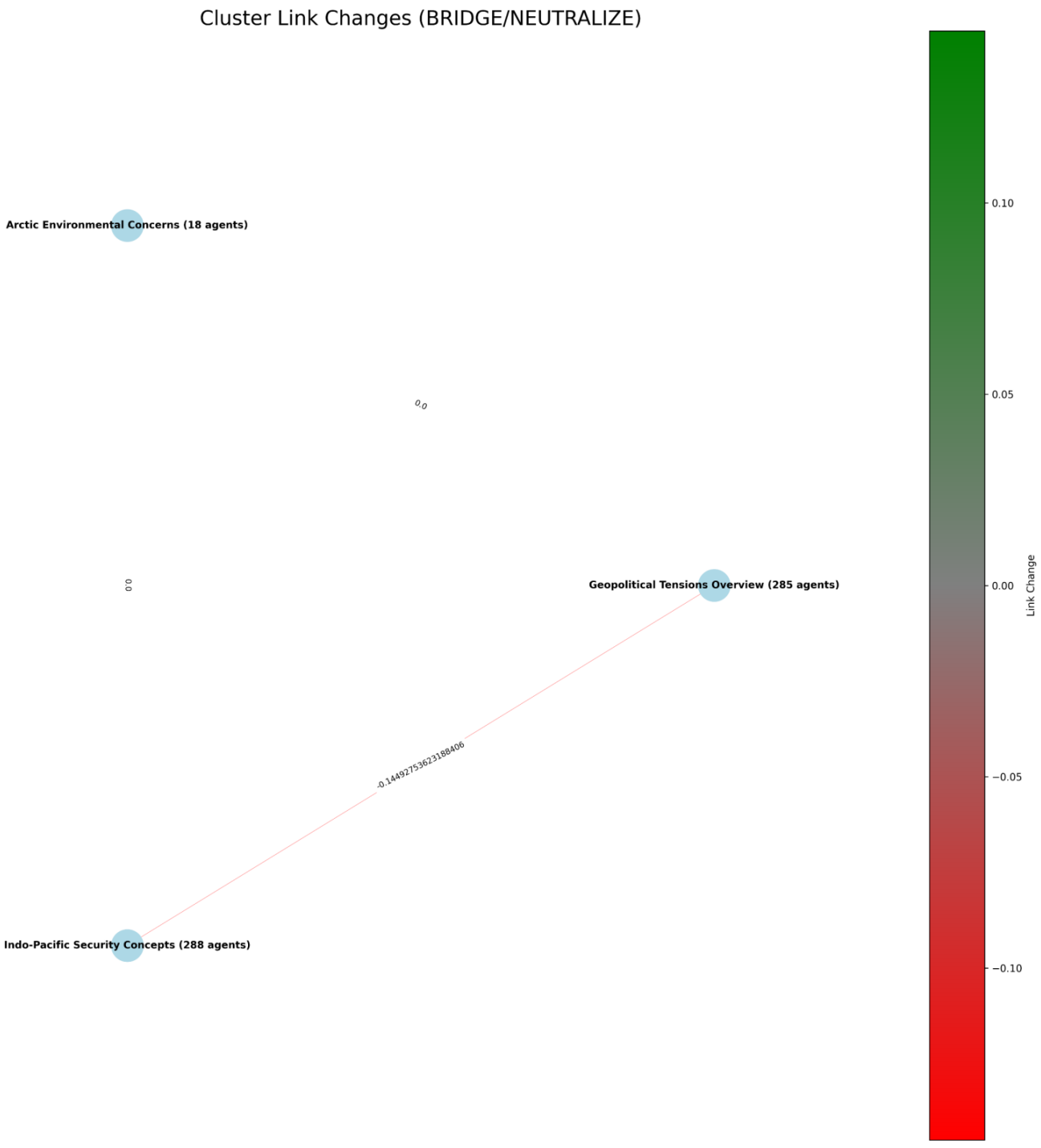
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Link Change

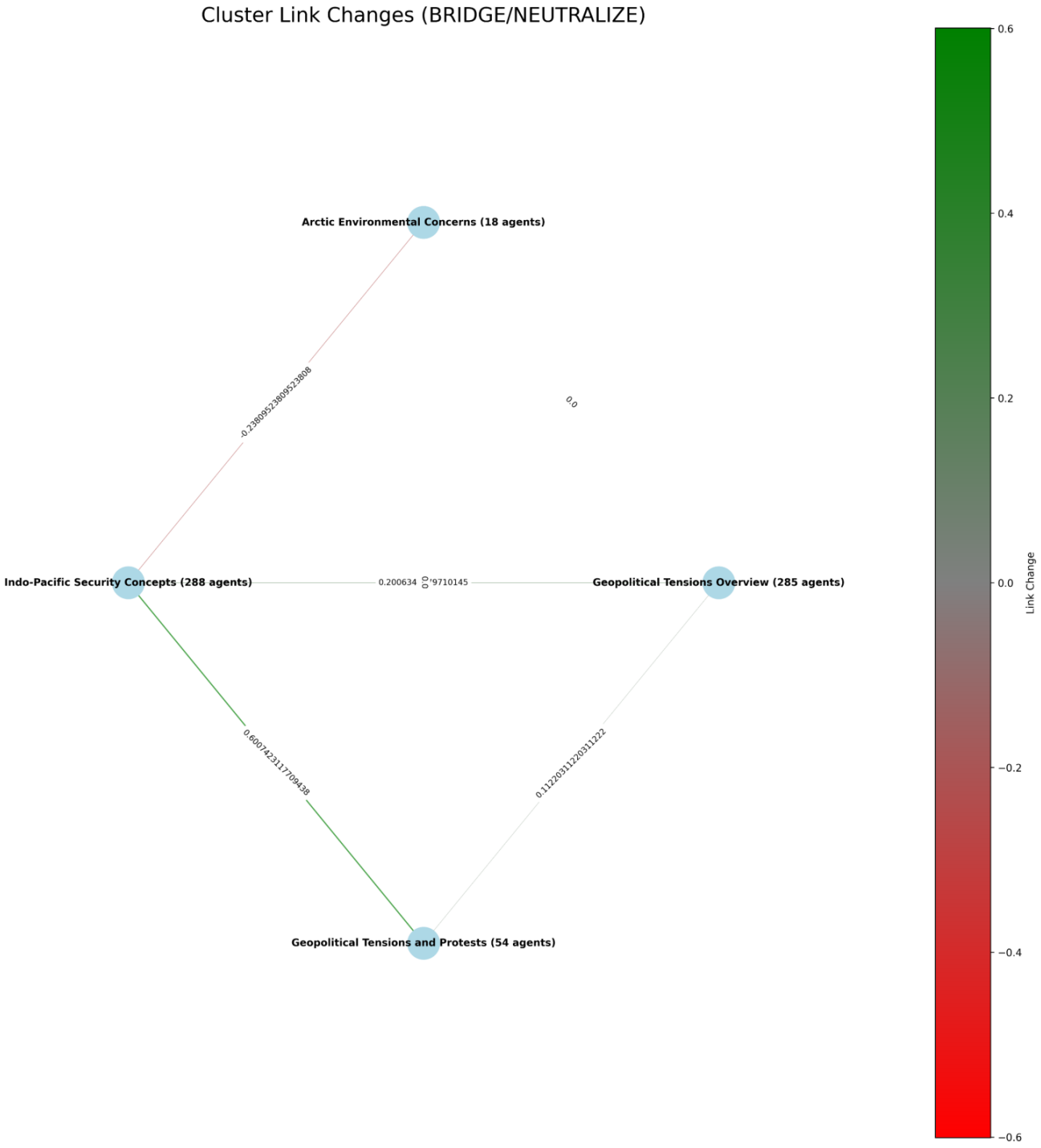
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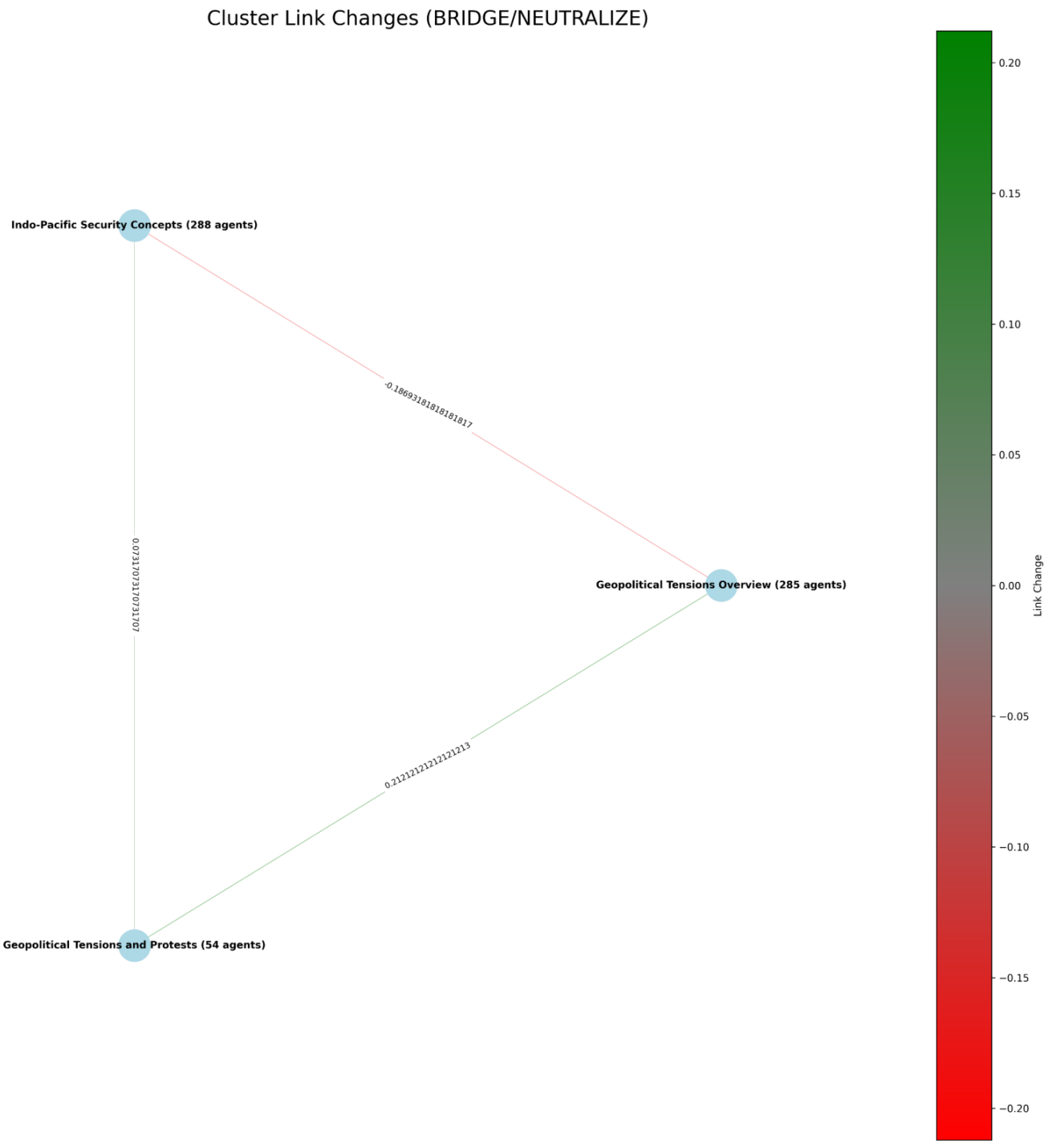
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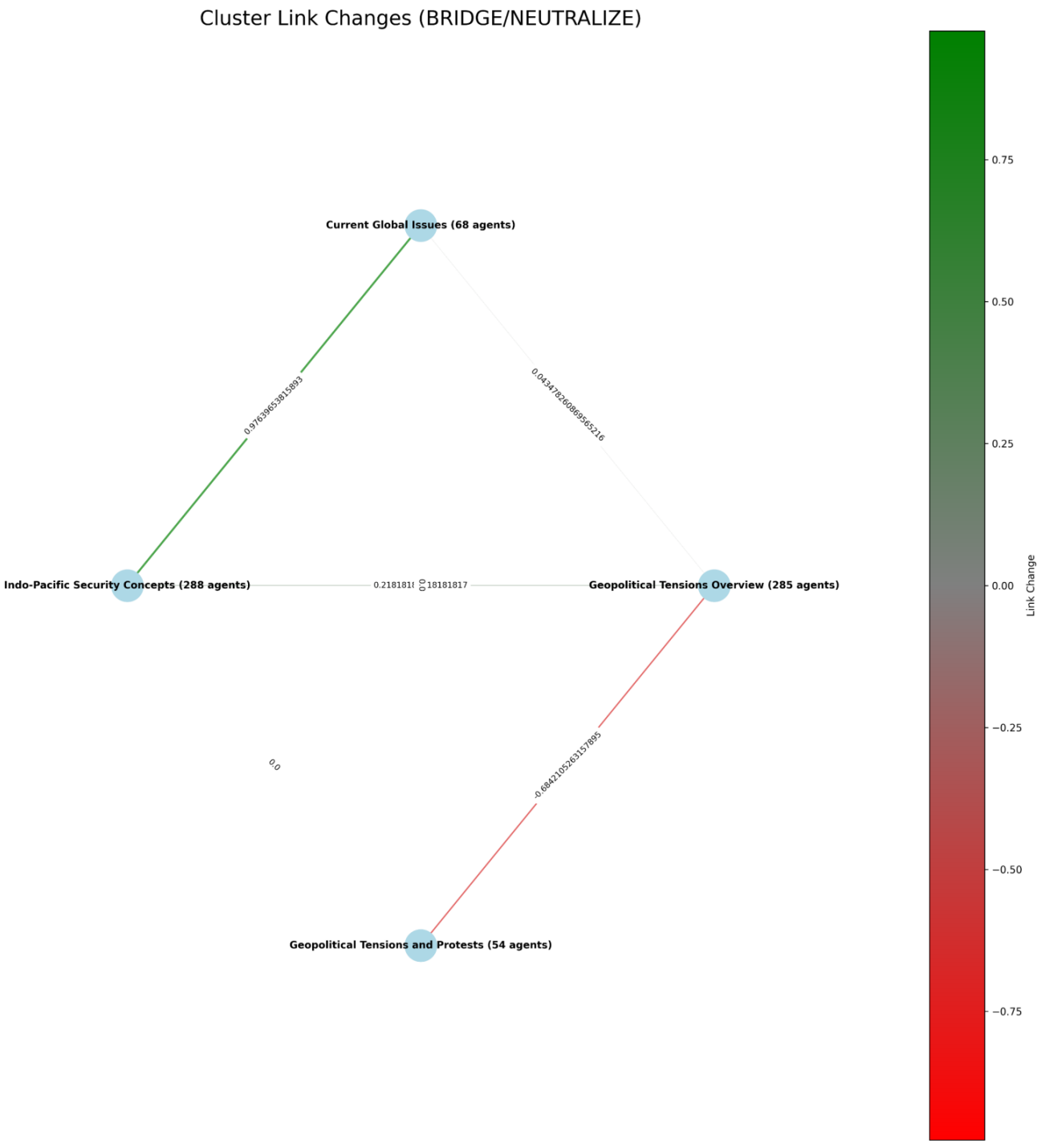
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Arctic Environmental Concerns (18 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions Overview (285 agents)
Geopolitical Tensions and Protests (54 agents)
-0.2380952380952308
0.0
0.200634 0.0 '9710145
0.6007423117709439
0.11220311220311222
Link Change
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6

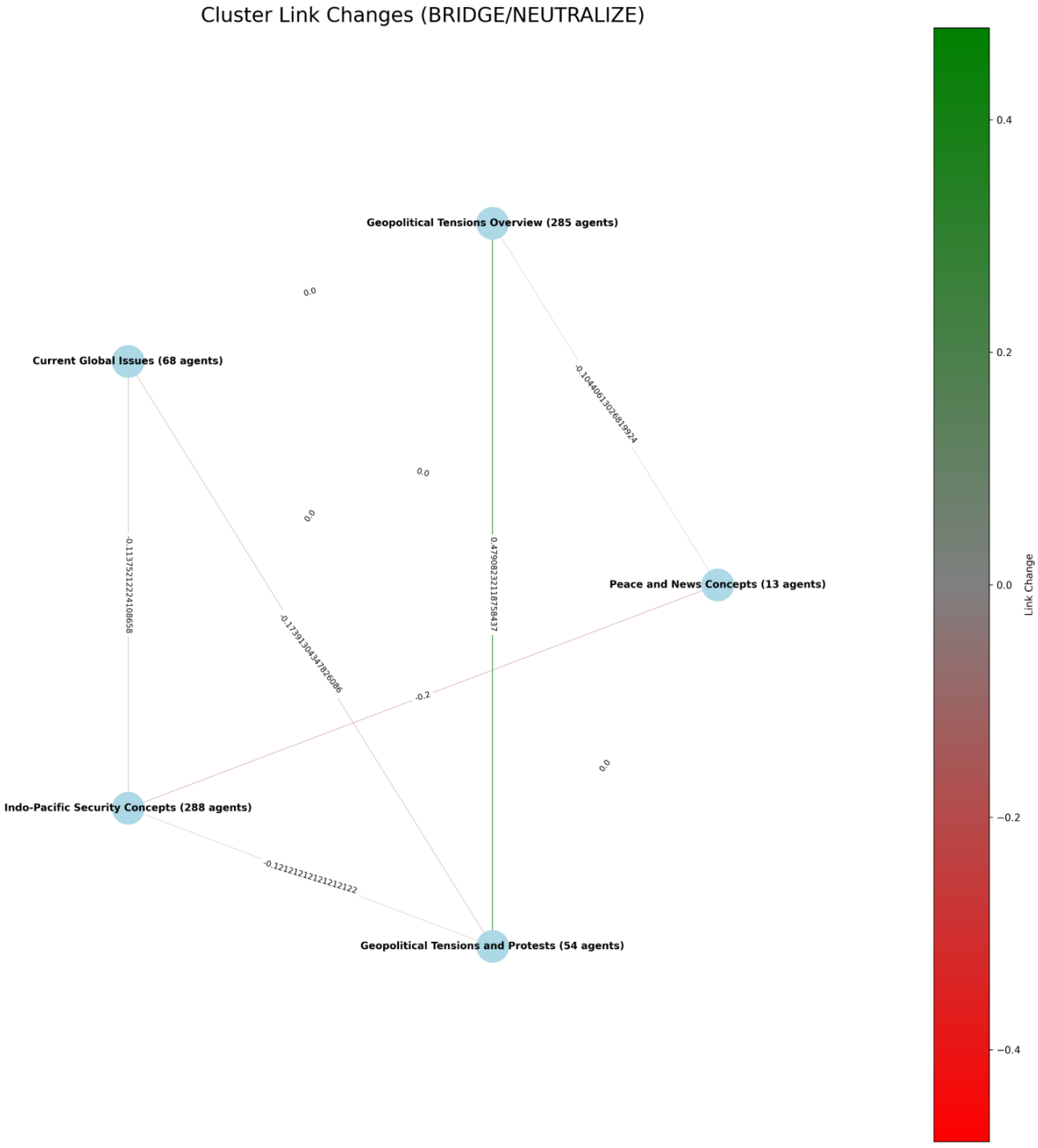
2034-05-06


Cluster Link Changes (BRIDGE/NEUTRALIZE)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions Overview (285 agents)
Geopolitical Tensions and Protests (54 agents)
-0.18693181818181817
0.07317073170731707
0.21212121212121213
Link Change
0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20

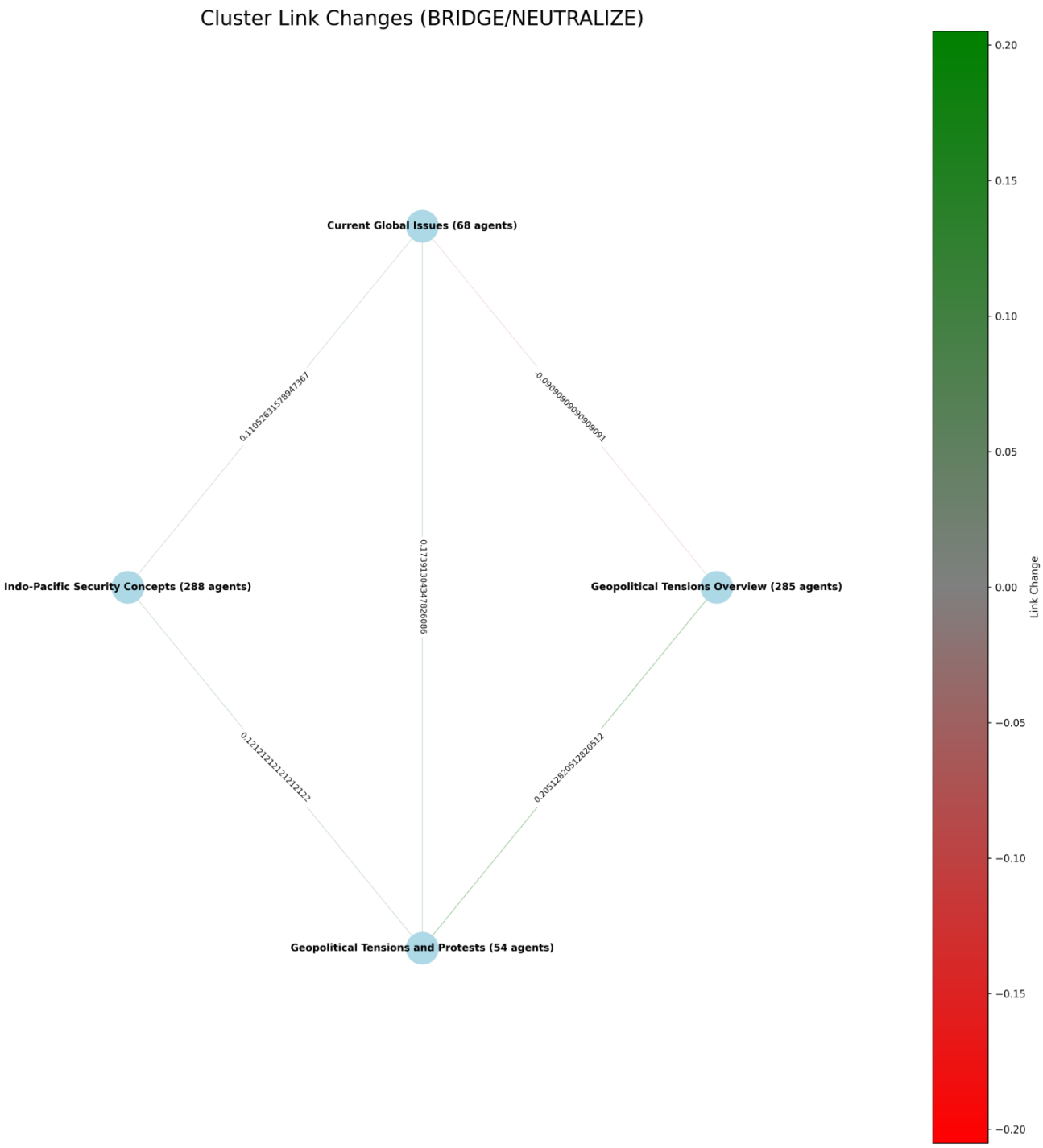
2034-05-07


Cluster Link Changes (BRIDGE/NEUTRALIZE)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions Overview (285 agents)
Geopolitical Tensions and Protests (54 agents)
0.9763965381589 3
0.043478260869565216
0.0
-0.6842105263157895
Link Change
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75

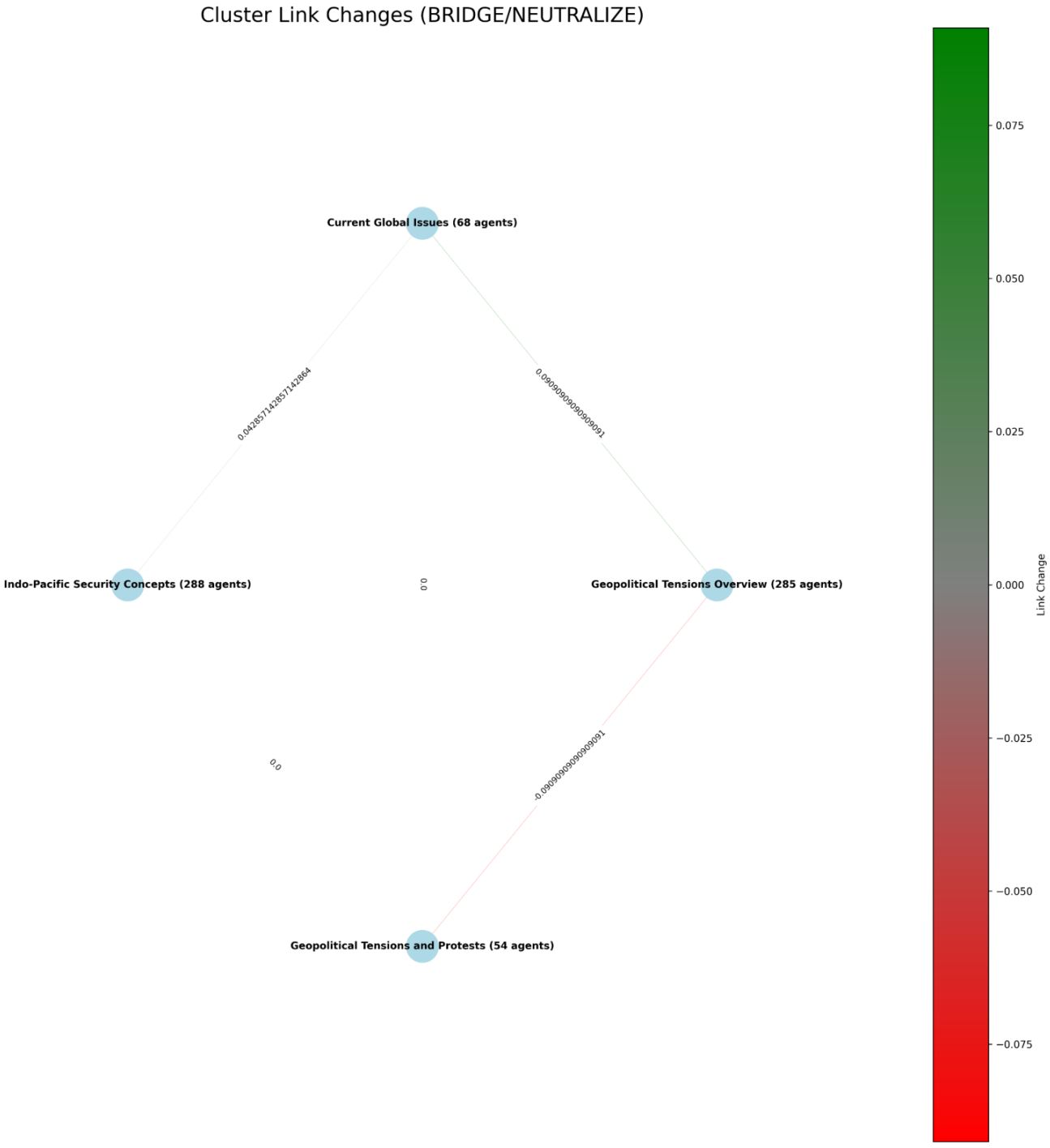
2034-05-08

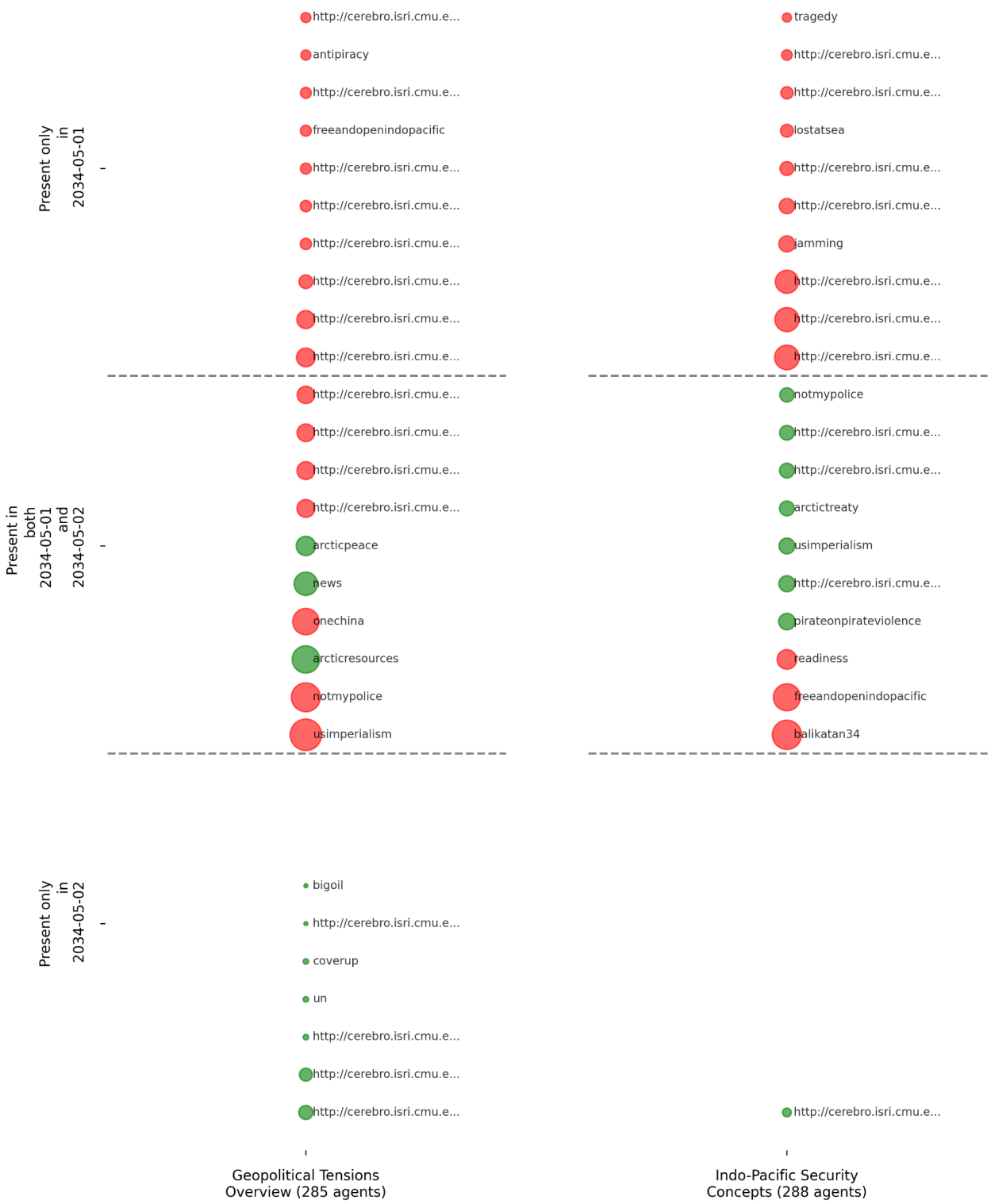

Cluster Link Changes (BRIDGE/NEUTRALIZE)
Geopolitical Tensions Overview (285 agents)
Current Global Issues (68 agents)
Peace and News Concepts (13 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions and Protests (54 agents)
0.0
0.0
-0.10440613026819924
0.0
0.0
-0.11375212224108658
0.47908232118758437
-0.17391304347826086
-0.2
0.0
-0.12121212121212122
Link Change
0.4
0.2
0.0
−0.2
−0.4

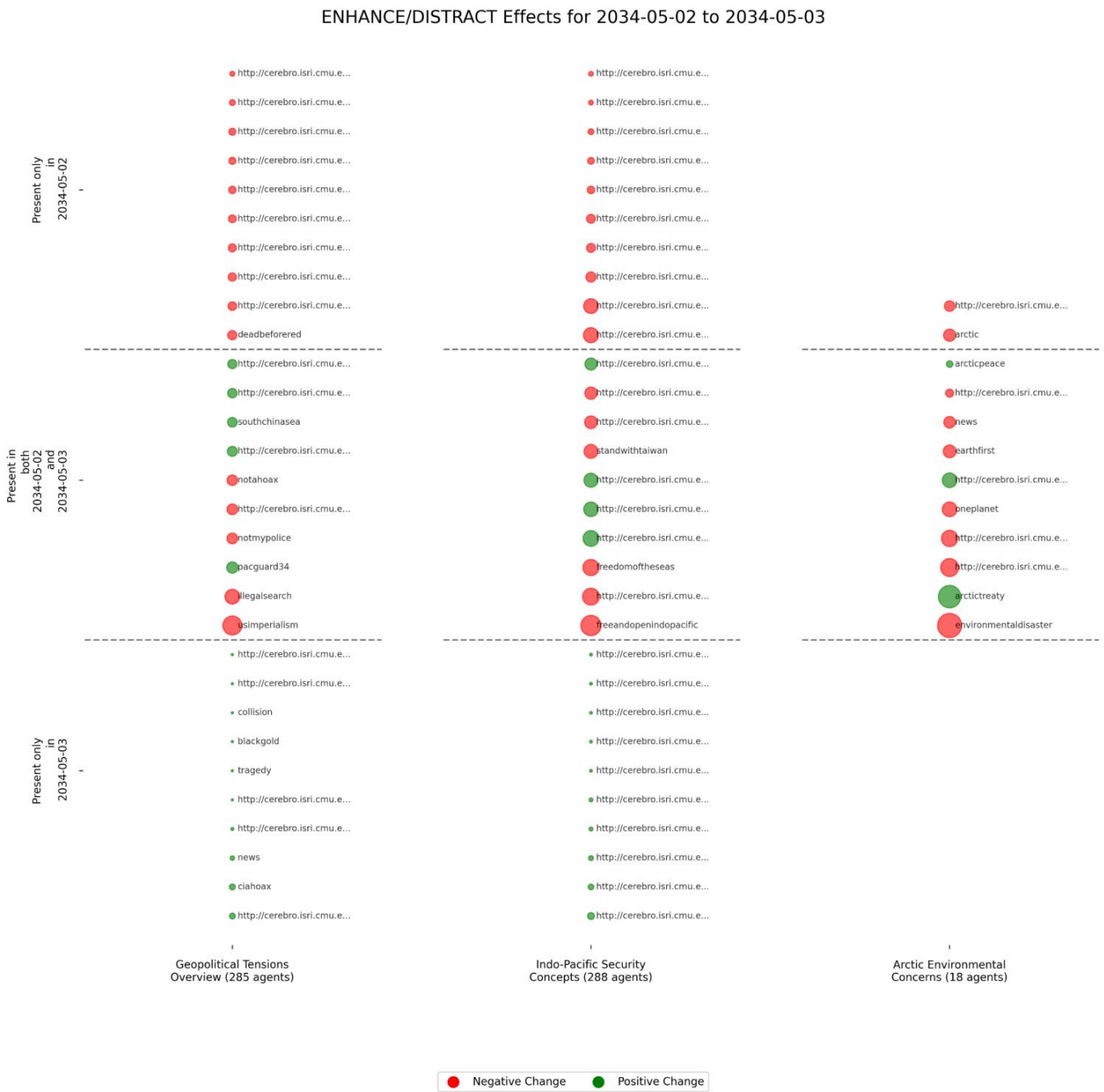
2034-05-09

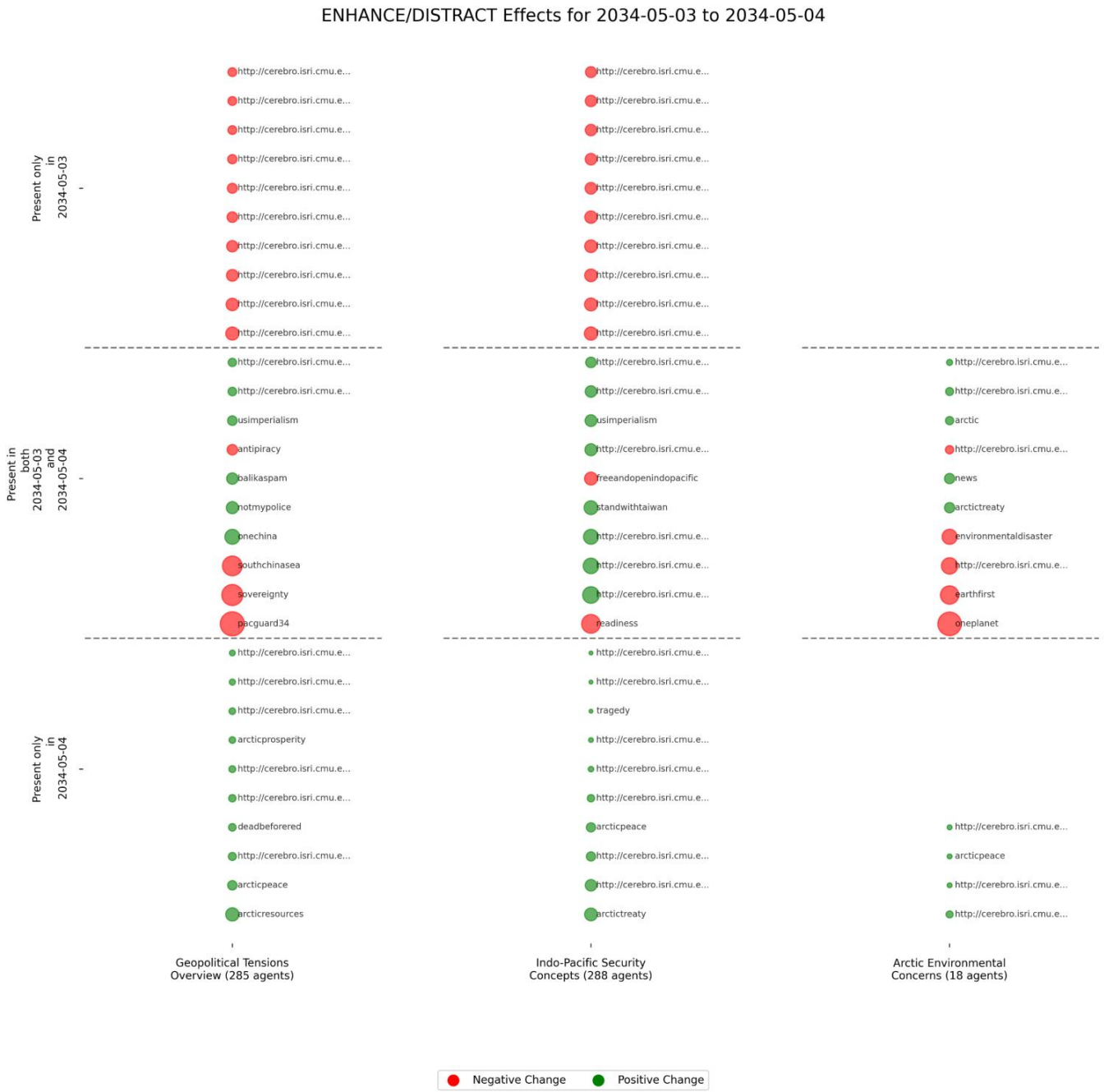

Cluster Link Changes (BRIDGE/NEUTRALIZE)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions Overview (285 agents)
Geopolitical Tensions and Protests (54 agents)
0.11052631578947367
-0.09090909090909091
0.17391304347826086
0.12121212121212122
0.20512820512820512
Link Change
0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20

2034-05-10

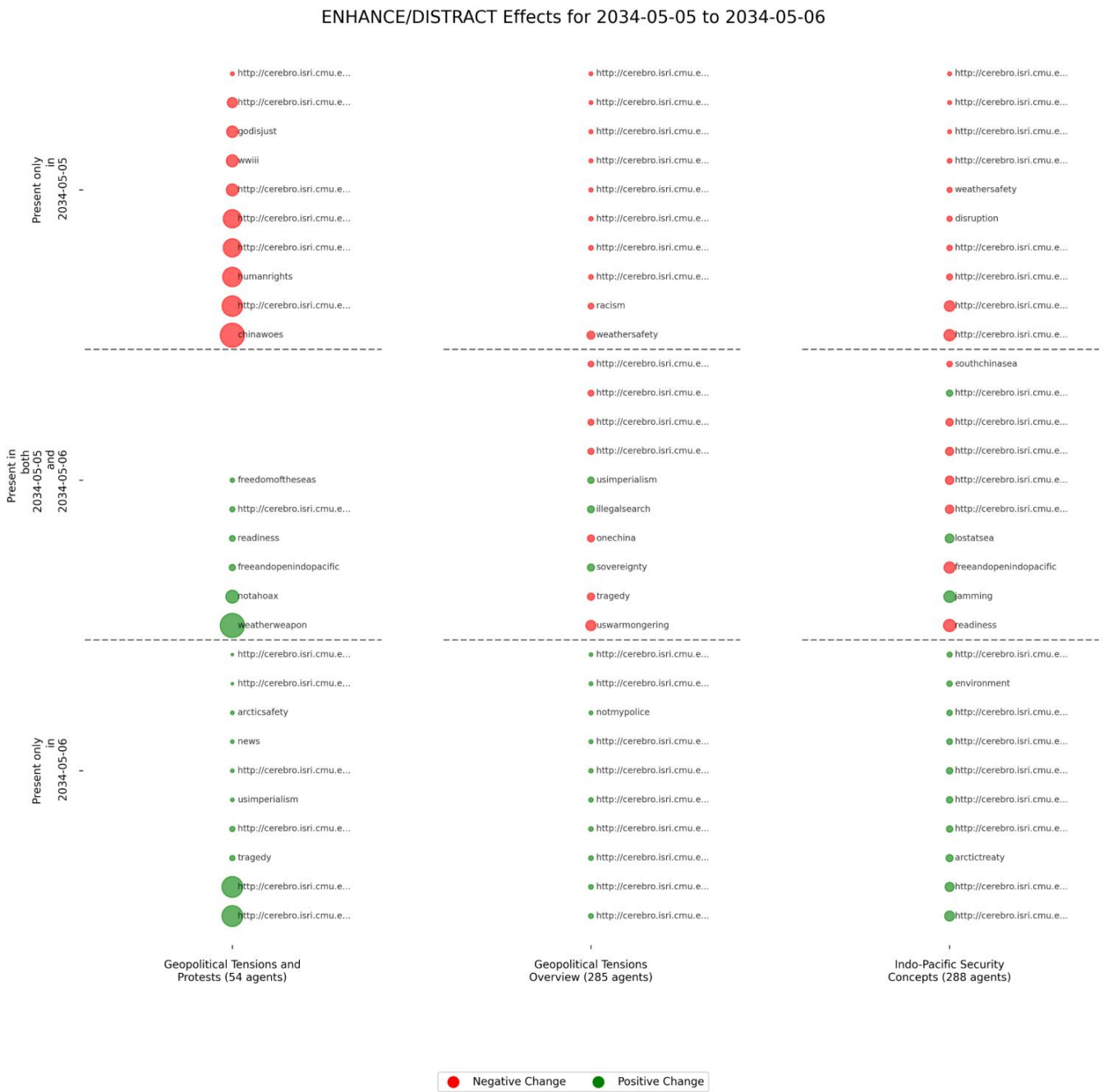

Cluster Link Changes (BRIDGE/NEUTRALIZE)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions Overview (285 agents)
Geopolitical Tensions and Protests (54 agents)
0.04285714285714864
0.09090909090909091
0.0
0.0
-0.09090909090909091
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
Link Change


ENHANCE/DISTRACT Effects for 2034-05-01 to 2034-05-02
Present only in 2034-05-01
Present in both 2034-05-01 and 2034-05-02
Present only in 2034-05-02
http://cerebro.isri.cmu.e...
antipiracy
freeandopenindopacific
tragedy
lostatsea
jamming
notmypolice
arcticpeace
news
onechina
arcticresources
usimperialism
arctictreaty
pirateonpirateviolence
readiness
balikatan34
bigoil
coverup
un
Geopolitical Tensions Overview (285 agents)
Indo-Pacific Security Concepts (288 agents)
Negative Change
Positive Change


ENHANCE/DISTRACT Effects for 2034-05-02 to 2034-05-03
Present only in 2034-05-02
Present in both 2034-05-02 and 2034-05-03
Present only in 2034-05-03
http://cerebro.isri.cmu.e...
deadbeforered
southchinasea
notahoax
notmypolice
pacguard34
illegalsearch
usimperialism
collision
blackgold
tragedy
news
ciahoax
standwithtaiwan
freedomoftheseas
freeandopenindopacific
arctic
arcticpeace
earthfirst
oneplanet
arctictreaty
environmentaldisaster
Geopolitical Tensions Overview (285 agents)
Indo-Pacific Security Concepts (288 agents)
Arctic Environmental Concerns (18 agents)
Negative Change
Positive Change

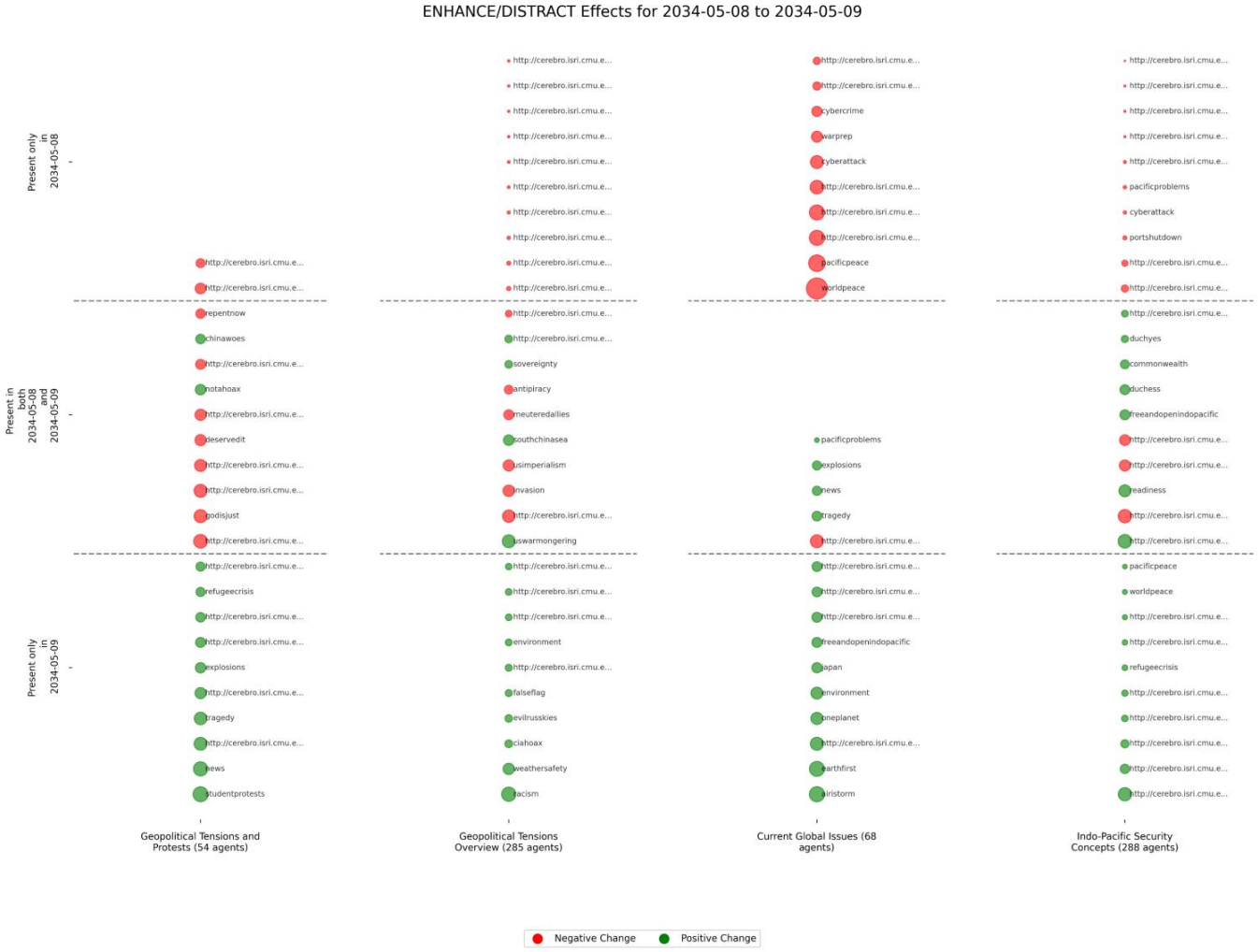

ENHANCE/DISTRACT Effects for 2034-05-03 to 2034-05-04
Present only in 2034-05-03
Present in both 2034-05-03 and 2034-05-04
Present only in 2034-05-04
http://cerebro.isri.cmu.e...
usimperialism
antipiracy
balikaspam
notmypolice
onechina
southchinasea
sovereignty
pacguard34
arcticprosperity
deadbeforered
arcticpeace
arcticresources
tragedy
freeandopenindopacific
standwithtaiwan
readiness
arctictreaty
arctic
news
environmentaldisaster
earthfirst
oneplanet
Geopolitical Tensions Overview (285 agents)
Indo-Pacific Security Concepts (288 agents)
Arctic Environmental Concerns (18 agents)
Negative Change
Positive Change


ENHANCE/DISTRACT Effects for 2034-05-04 to 2034-05-05
Present only in 2034-05-04
Present in both 2034-05-04 and 2034-05-05
Present only in 2034-05-05
http://cerebro.isri.cmu.e...
arcticsafety
tragedy
onechina
southchinasea
sovereignty
notmypolice
pacguard34
usimperialism
freeandopenindopacific
antipiracy
environment
arctictreaty
lostatsea
readiness
slamming
balikatan34
chinacontrolsun
freedomoftheseas
news
notahoax
weatherweapon
deadbeforered
chinawoes
arcticpeace
nonewdrilling
arctic
arctictreaty
environmentaldisaster
oneplanet
earthfirst
Geopolitical Tensions Overview (285 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions and Protests (54 agents)
Arctic Environmental Concerns (18 agents)
Negative Change
Positive Change

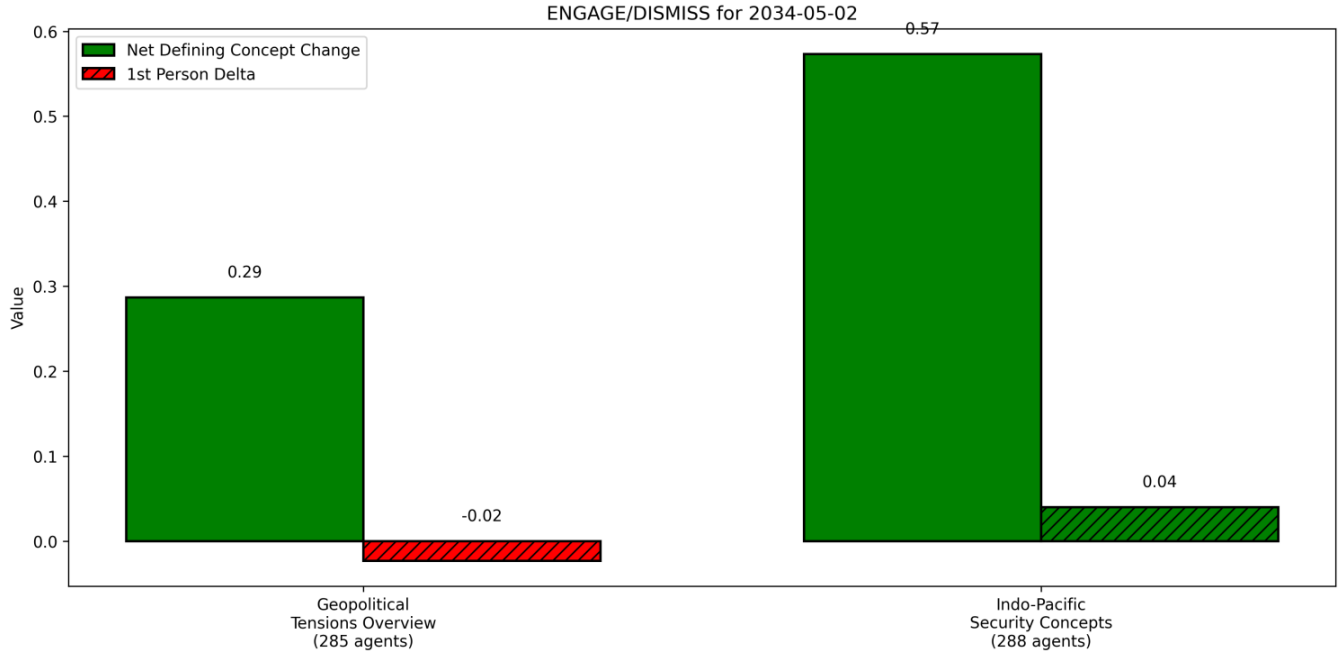

ENHANCE/DISTRACT Effects for 2034-05-05 to 2034-05-06
Present only in 2034-05-05
Present in both 2034-05-05 and 2034-05-06
Present only in 2034-05-06
http://cerebro.isri.cmu.e...
godisjust
wwiii
humanrights
chinawoes
racism
weathersafety
weathersafety
disruption
southchinasea
freedomoftheseas
readiness
freeandopenindopacific
notahoax
weatherweapon
usimperialism
illegalsearch
onechina
sovereignty
tragedy
uswarmongering
lostatsea
jamming
arcticsafety
news
environment
notmypolice
arctictreaty
Geopolitical Tensions and Protests (54 agents)
Geopolitical Tensions Overview (285 agents)
Indo-Pacific Security Concepts (288 agents)
Negative Change
Positive Change

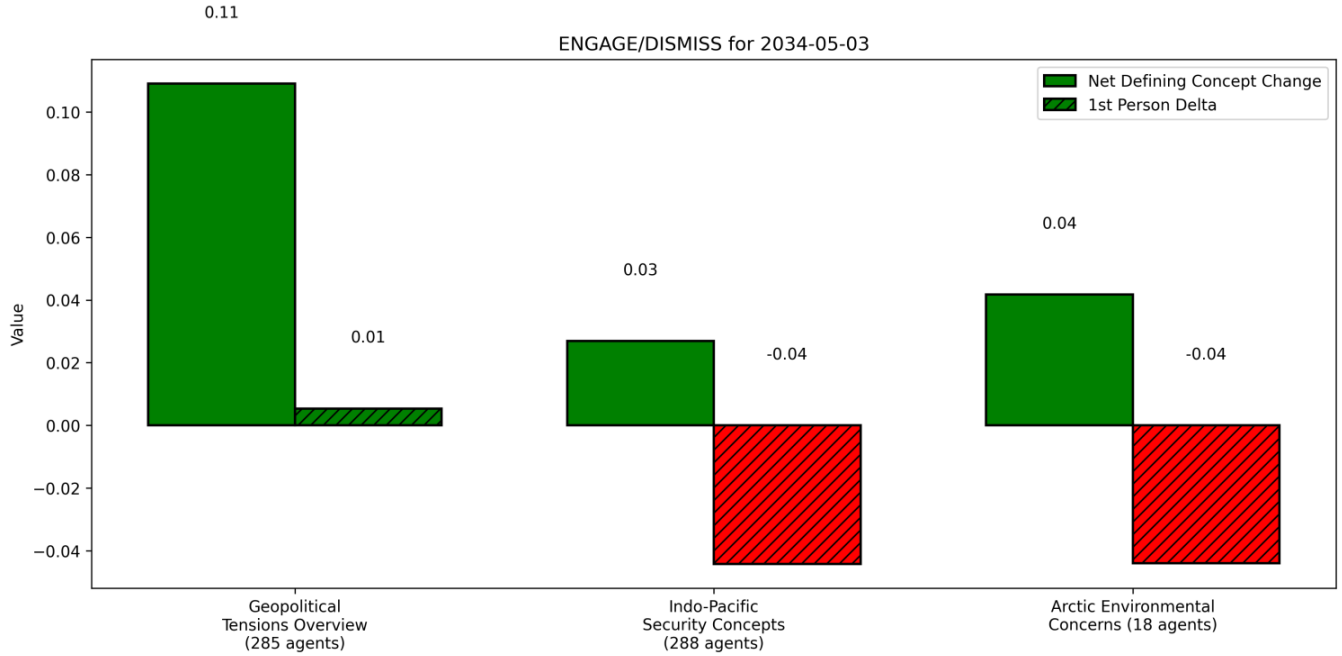

ENHANCE/DISTRACT Effects for 2034-05-06 to 2034-05-07
Present only in 2034-05-06
Present in both 2034-05-06 and 2034-05-07
Present only in 2034-05-07
http://cerebro.isri.cmu.e...
bioweapon
aristono
antipiracy
counterprotests
diplomats
duchess
studentprotests
duchyes
commonwealth
bioweapon
aristono
uswarmongering
studentprotests
racism
notahoax
news
taiwanexists
standwithtaiwan
balloon
onechina
freeandopenindopacific
sovereignty
lostatsea
jamming
news
pacguard34
weathersafety
freedomoftheseas
readiness
humanrights
weatherweapon
chinawoes
pacificproblems
environmentaldisaster
cyberattack
oneplanet
readiness
airistorm
earthfirst
arcticsafety
tragedy
freeandopenindopacific
coverup
godisjust
Geopolitical Tensions Overview (285 agents)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions and Protests (54 agents)
Negative Change
Positive Change

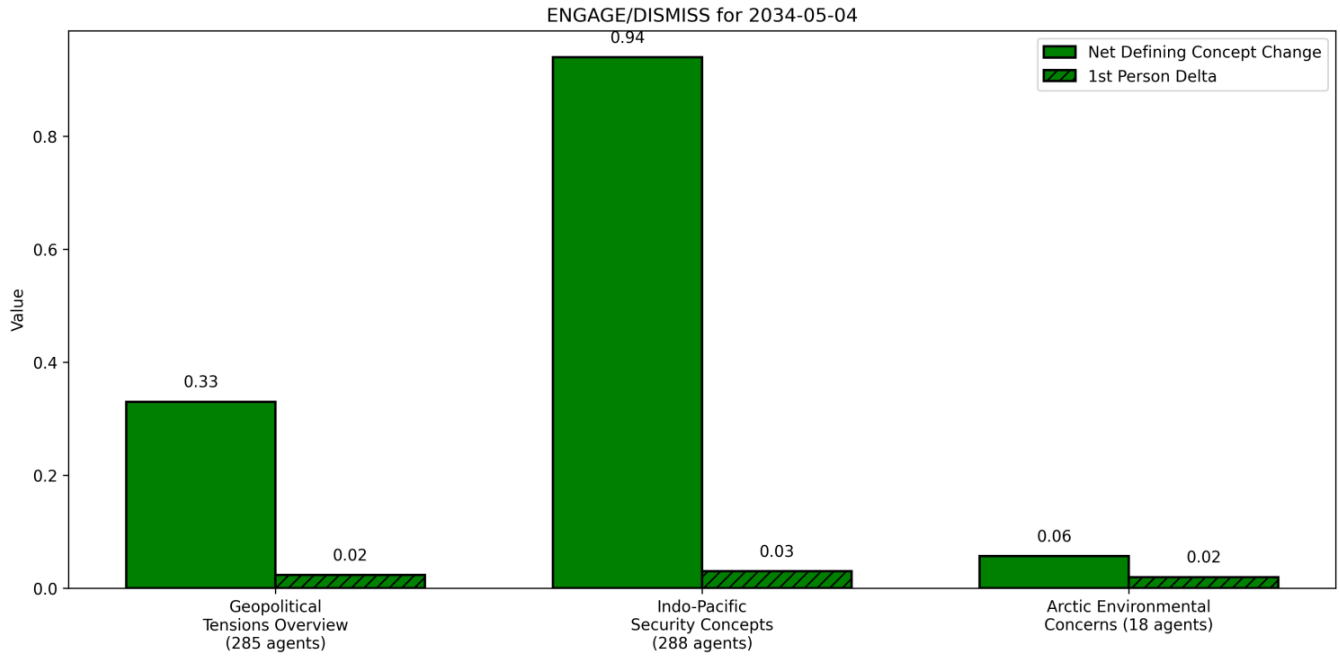

ENHANCE/DISTRACT Effects for 2034-05-07 to 2034-05-08
Present only in 2034-05-07
Present in both 2034-05-07 and 2034-05-08
Present only in 2034-05-08
invasion
terrorism
http://cerebro.isri.cmu.e...
environment
falseflag
evilrusskies
ciahoax
onechina
usimperialism
southchinasea
weathersafety
racism
warmongering
taiwanexists
crash
diplomats
bioweapon
disruption
standwithtaiwan
japan
tragedy
pneplanet
earthfirst
aristorm
pacificproblems
counterprotests
freeandopenindopacific
duchess
news
studentprotests
commonwealth
freedomoftheseas
explosion
explosions
refugeecrisis
weatherweapon
covidhoax
chinawoes
usimperialism
sovereignty
aristono
racism
freedomoftheseas
readiness
pacificpeace
worldpeace
news
Geopolitical Tensions Overview (285 agents)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions and Protests (54 agents)
Peace and News Concepts (13 agents)
Negative Change
Positive Change

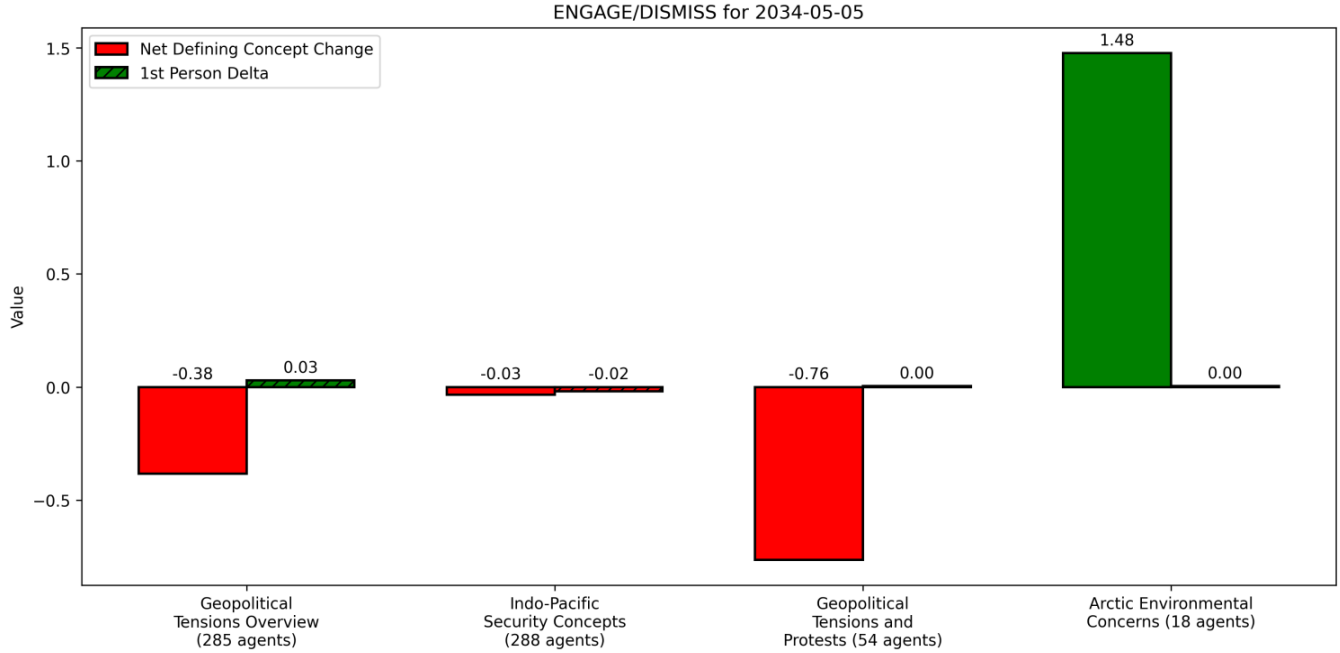

ENHANCE/DISTRACT Effects for 2034-05-08 to 2034-05-09
Present only in 2034-05-08
Present in both 2034-05-08 and 2034-05-09
Present only in 2034-05-09
Geopolitical Tensions and Protests (54 agents)
Geopolitical Tensions Overview (285 agents)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)
Negative Change
Positive Change

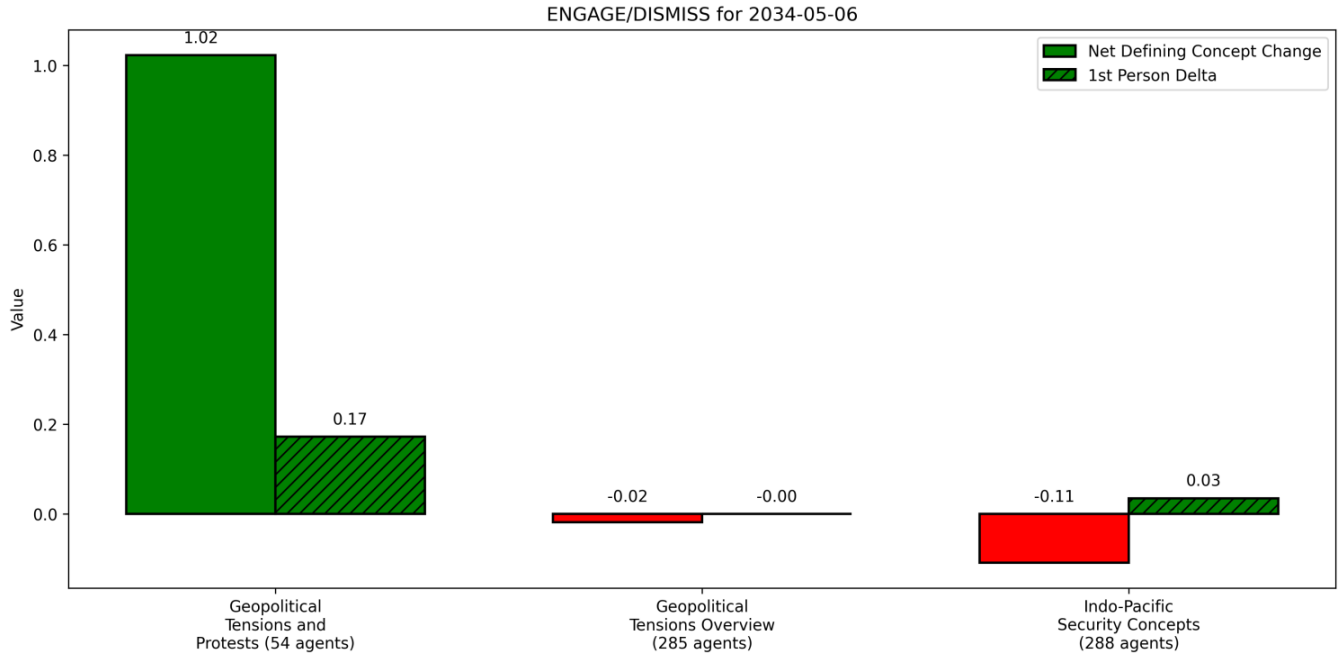

ENHANCE/DISTRACT Effects for 2034-05-09 to 2034-05-10
Present only in 2034-05-09
Present in both 2034-05-09 and 2034-05-10
Present only in 2034-05-10
http://cerebro.isri.cmu.e...
racism
arcticprosperity
portshutdown
cyberattack
arcticpeace
arcticresources
studentprotests
meuteredallies
onechina
antipiracy
invasion
sovereignty
usimperialism
terrorism
Geopolitical Tensions Overview (285 agents)
airistorm
refugeecrisis
standwithtaiwan
environment
russiandrilling
tragedy
cybercrime
warprep
pacificpeace
worldpeace
Current Global Issues (68 agents)
humanrights
readytodefend
ufo
airistorm
commonwealth
pacificproblems
duchyes
duchess
Indo-Pacific Security Concepts (288 agents)
studentprotests
swarmongering
crisis
repentnow
notahoax
humanrights
deservedit
podisjust
chinawoes
wwiii
falseflag
Geopolitical Tensions and Protests (54 agents)
freeandopenindopacific
portshutdown
readiness
Negative Change
Positive Change

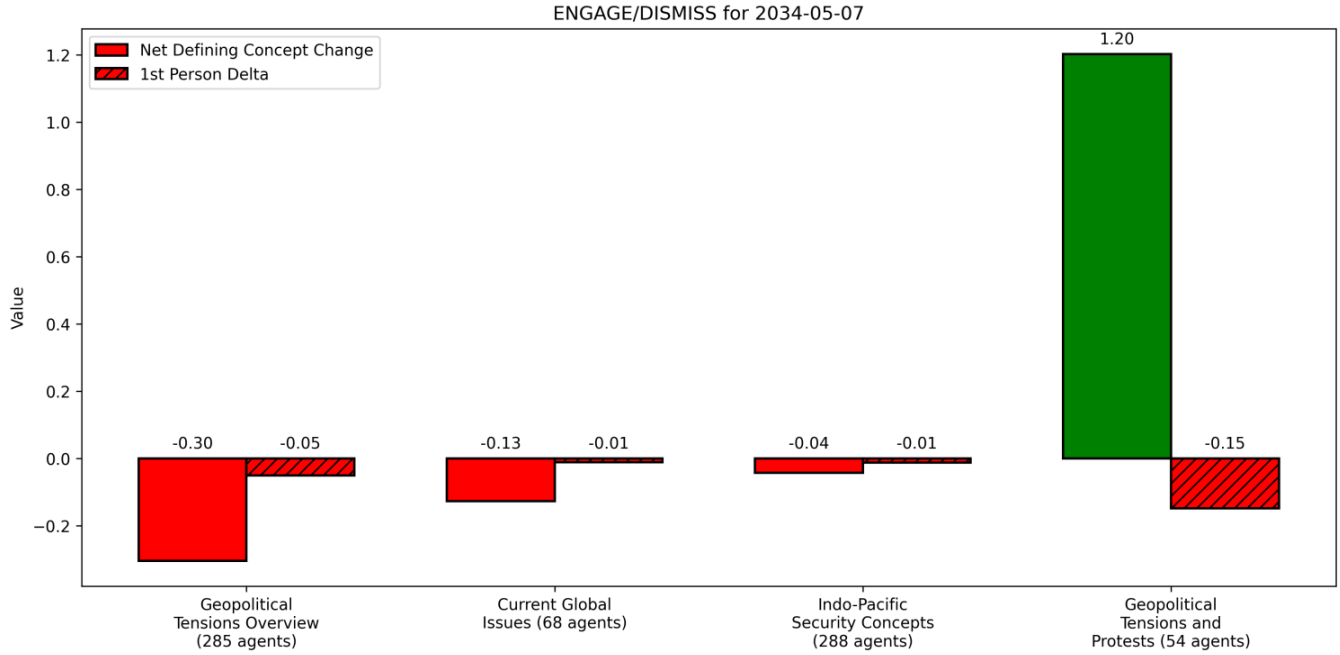

ENGAGE/DISMISS for 2034-05-02
Net Defining Concept Change
1st Person Delta
Value
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.29
-0.02
0.57
0.04
Geopolitical
Tensions Overview
(285 agents)
Indo-Pacific
Security Concepts
(288 agents)

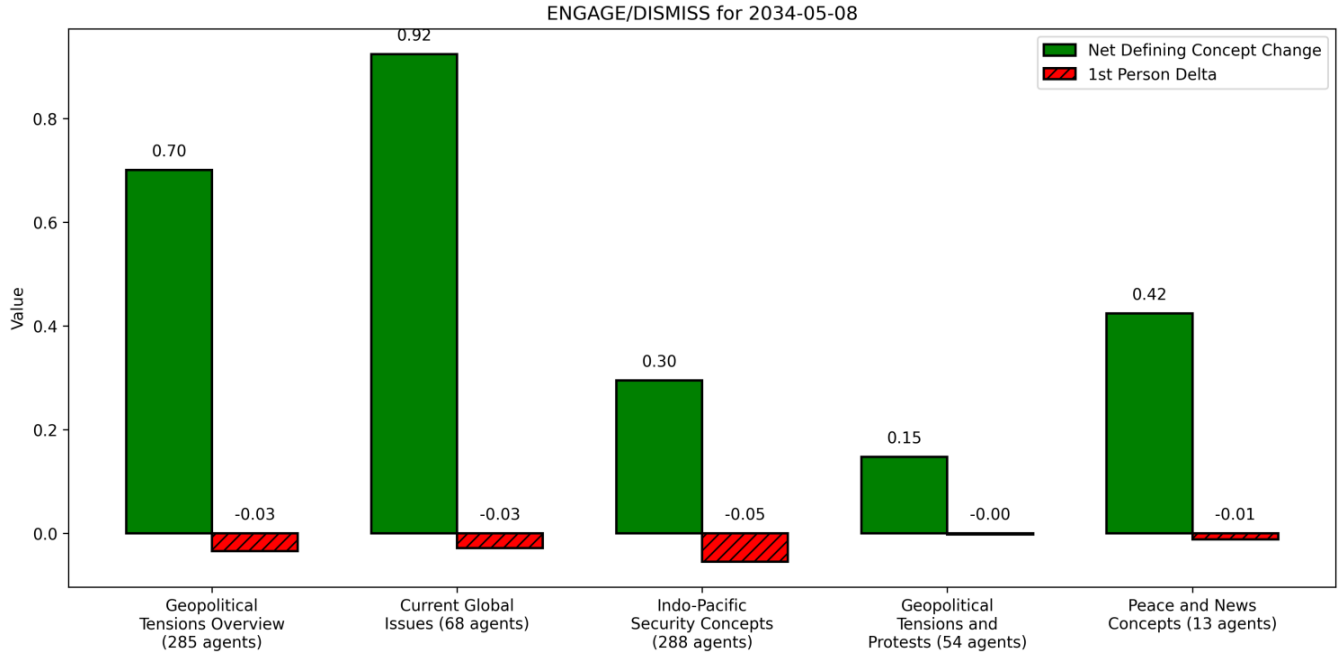

ENGAGE/DISMISS for 2034-05-03
Net Defining Concept Change
1st Person Delta
Value
0.10
0.08
0.06
0.04
0.02
0.00
−0.02
−0.04
0.11
0.01
0.03
-0.04
0.04
-0.04
Geopolitical
Tensions Overview
(285 agents)
Indo-Pacific
Security Concepts
(288 agents)
Arctic Environmental
Concerns (18 agents)

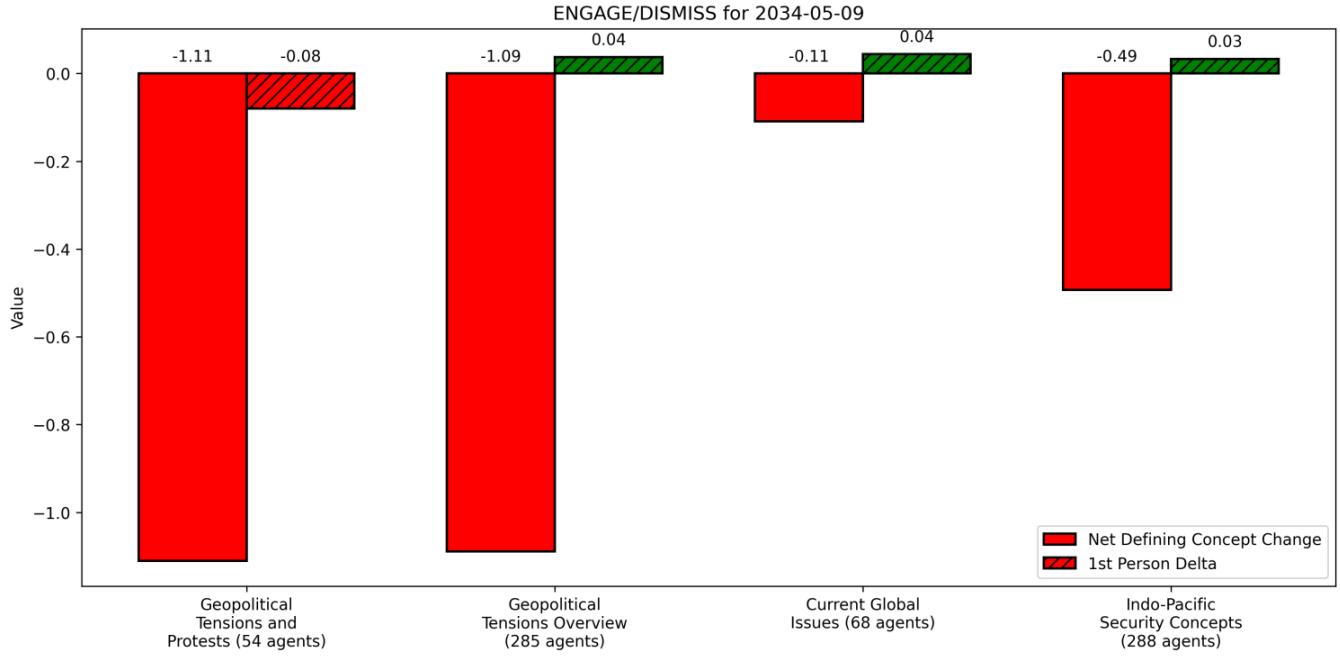

ENGAGE/DISMISS for 2034-05-04
Net Defining Concept Change
1st Person Delta
Value
0.0
0.2
0.4
0.6
0.8
0.33
0.02
0.94
0.03
0.06
0.02
Geopolitical Tensions Overview (285 agents)
Indo-Pacific Security Concepts (288 agents)
Arctic Environmental Concerns (18 agents)

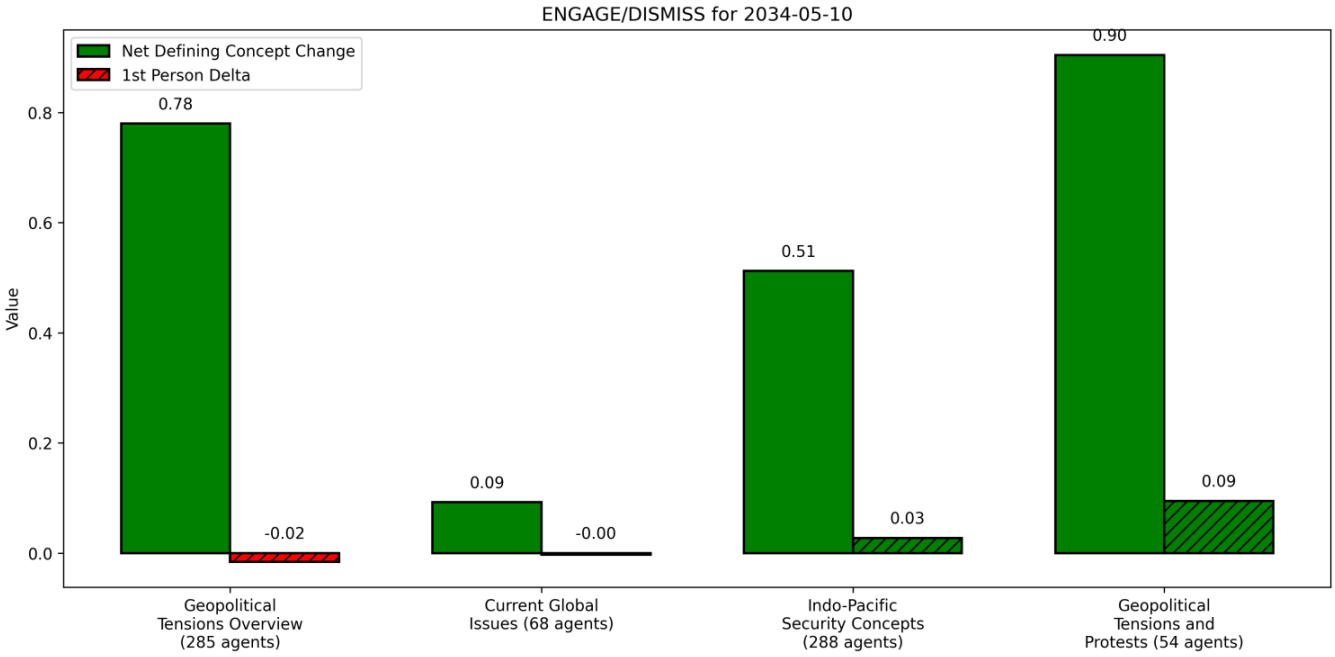

ENGAGE/DISMISS for 2034-05-05
Net Defining Concept Change
1st Person Delta
Value
−0.5
0.0
0.5
1.0
1.5
-0.38
0.03
-0.03
-0.02
-0.76
0.00
1.48
0.00
Geopolitical Tensions Overview (285 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions and Protests (54 agents)
Arctic Environmental Concerns (18 agents)

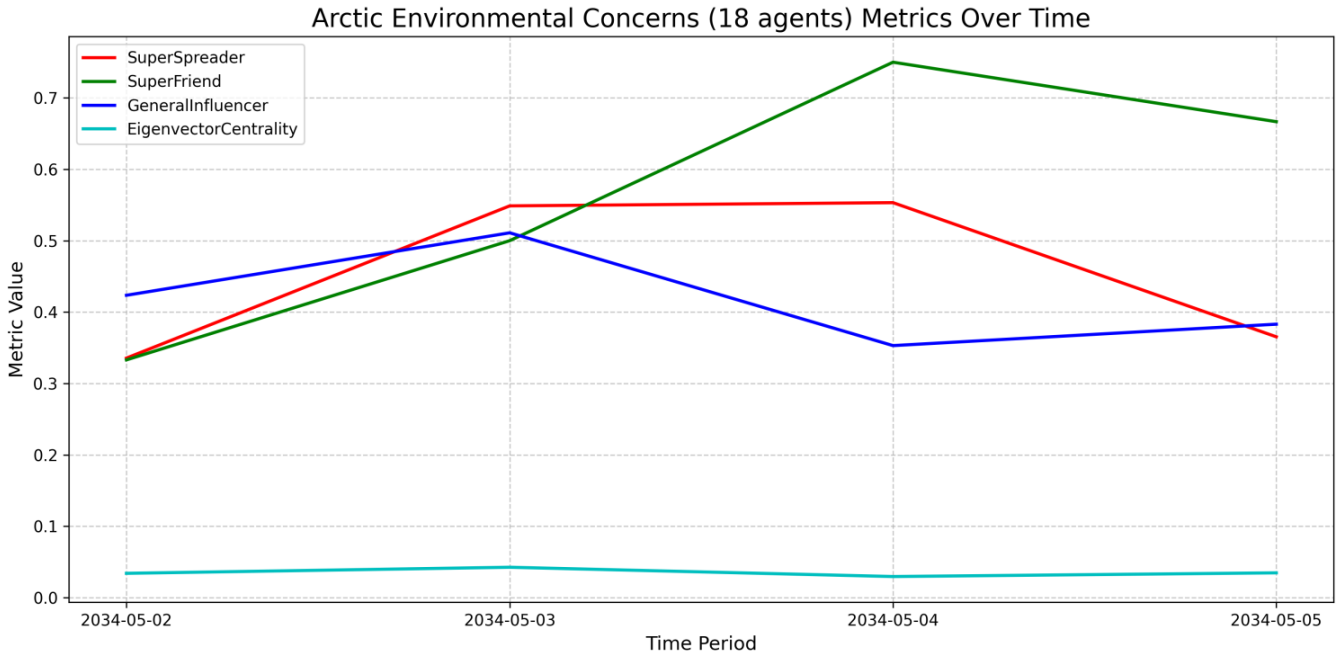

ENGAGE/DISMISS for 2034-05-06
Net Defining Concept Change
1st Person Delta
Value
1.02
0.17
-0.02
-0.00
-0.11
0.03
Geopolitical Tensions and Protests (54 agents)
Geopolitical Tensions Overview (285 agents)
Indo-Pacific Security Concepts (288 agents)

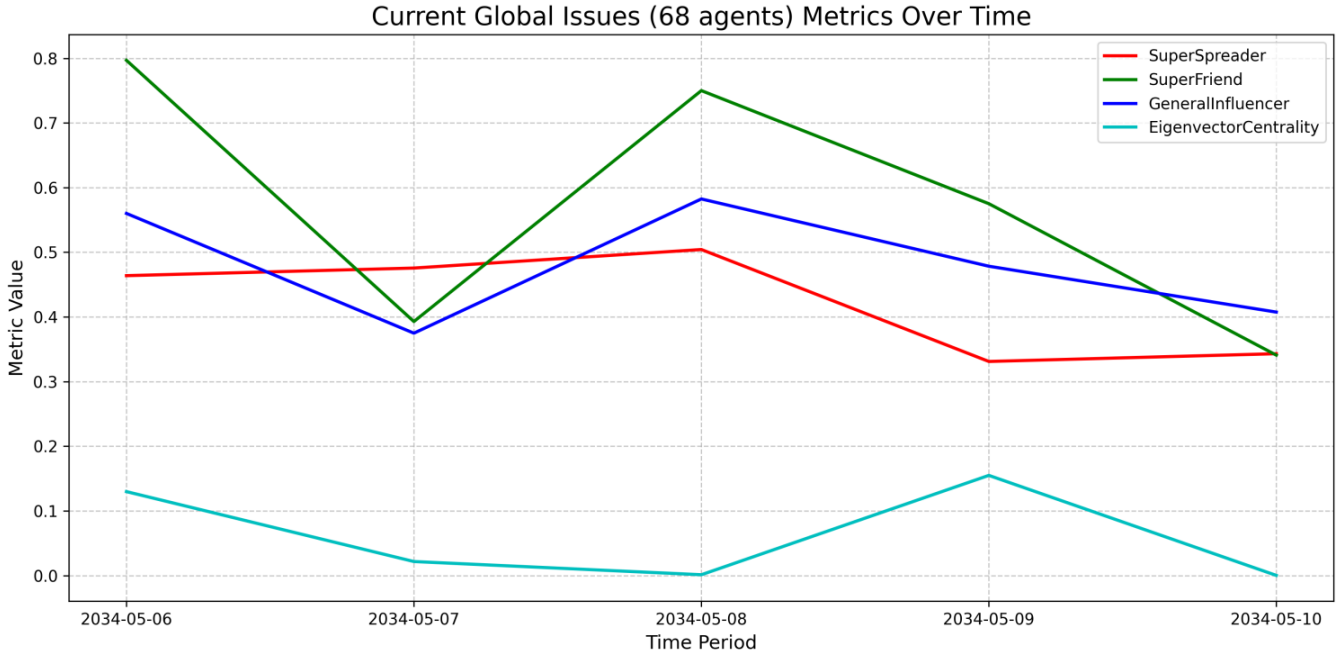

ENGAGE/DISMISS for 2034-05-07
Net Defining Concept Change
1st Person Delta
Value
-0.30
-0.05
-0.13
-0.01
-0.04
-0.01
1.20
-0.15
Geopolitical Tensions Overview (285 agents)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions and Protests (54 agents)

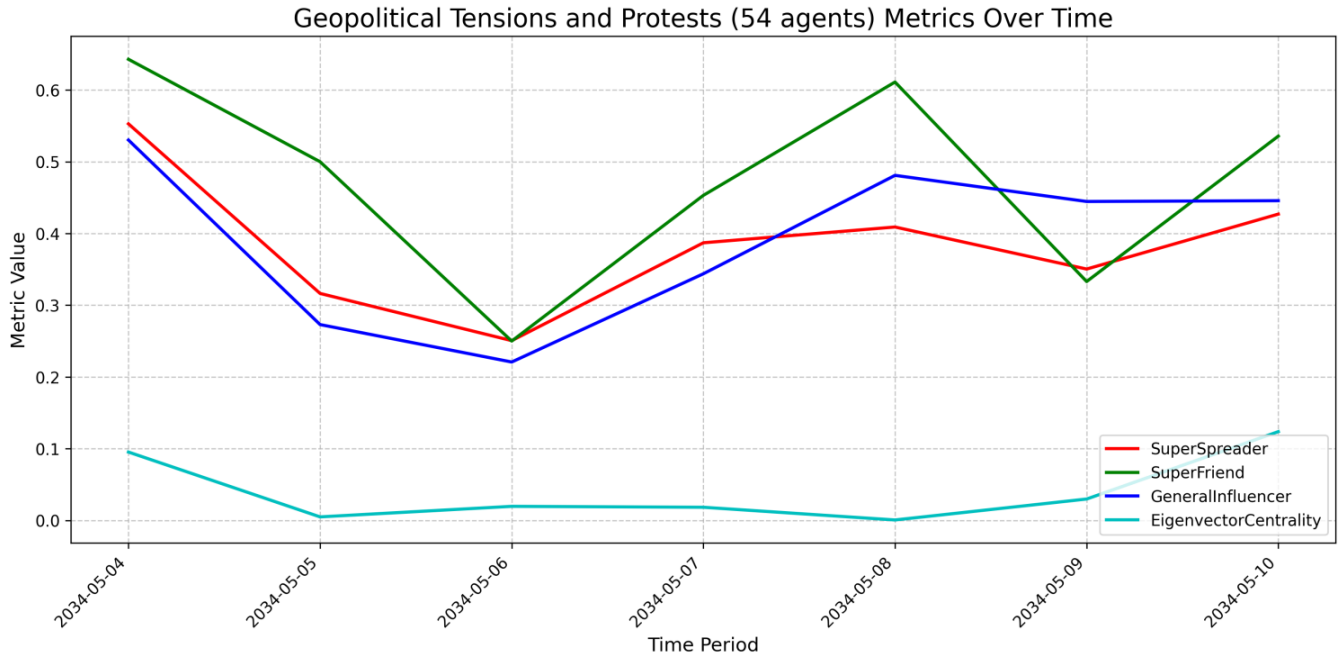

ENGAGE/DISMISS for 2034-05-08
Net Defining Concept Change
1st Person Delta
Value
0.8
0.6
0.4
0.2
0.0
0.70
-0.03
0.92
-0.03
0.30
-0.05
0.15
-0.00
0.42
-0.01
Geopolitical Tensions Overview (285 agents)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions and Protests (54 agents)
Peace and News Concepts (13 agents)

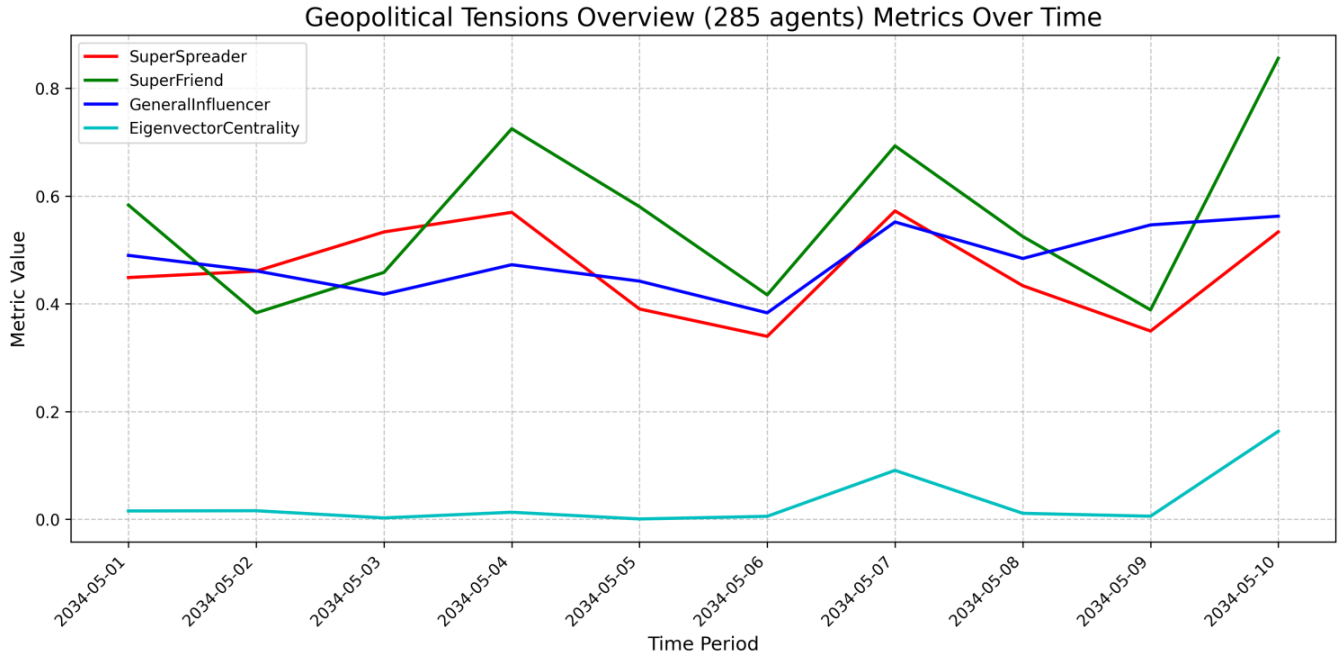

ENGAGE/DISMISS for 2034-05-09
Net Defining Concept Change
1st Person Delta
Value
0.0
−0.2
−0.4
−0.6
−0.8
−1.0
-1.11
-0.08
-1.09
0.04
-0.11
0.04
-0.49
0.03
Geopolitical Tensions and Protests (54 agents)
Geopolitical Tensions Overview (285 agents)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)

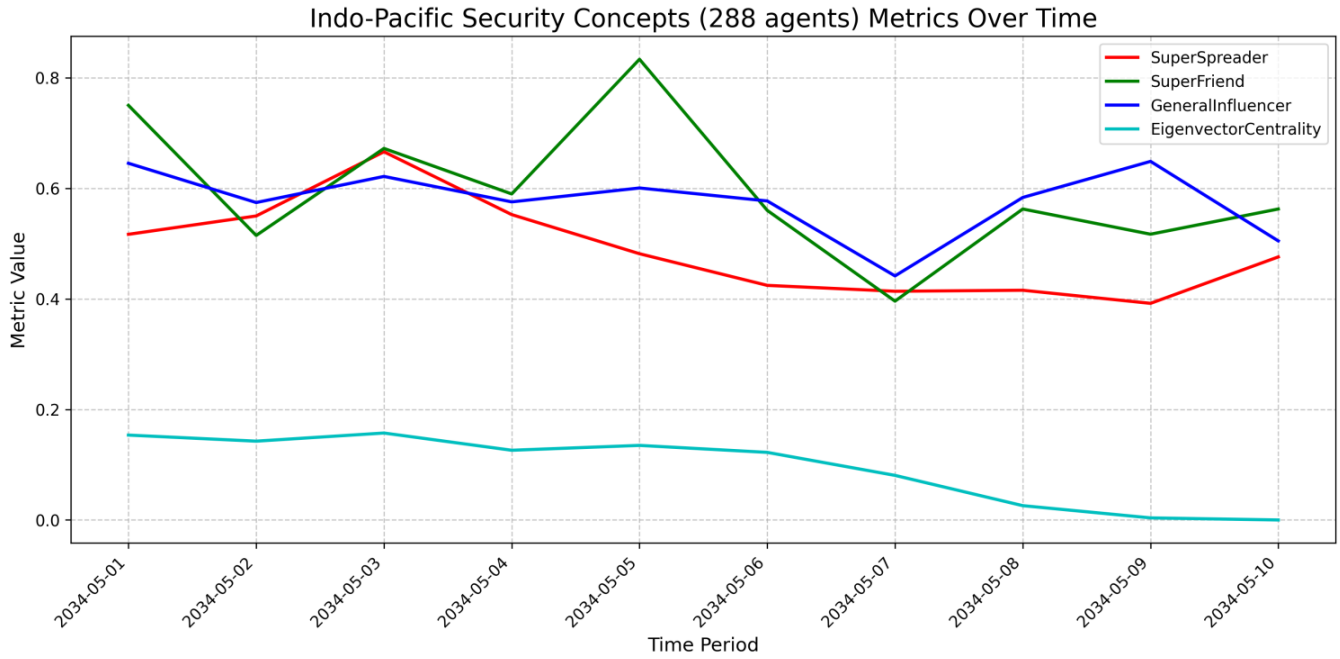

ENGAGE/DISMISS for 2034-05-10
Net Defining Concept Change
1st Person Delta
Value
0.0
0.2
0.4
0.6
0.8
0.78
-0.02
0.09
-0.00
0.51
0.03
0.90
0.09
Geopolitical Tensions Overview (285 agents)
Current Global Issues (68 agents)
Indo-Pacific Security Concepts (288 agents)
Geopolitical Tensions and Protests (54 agents)

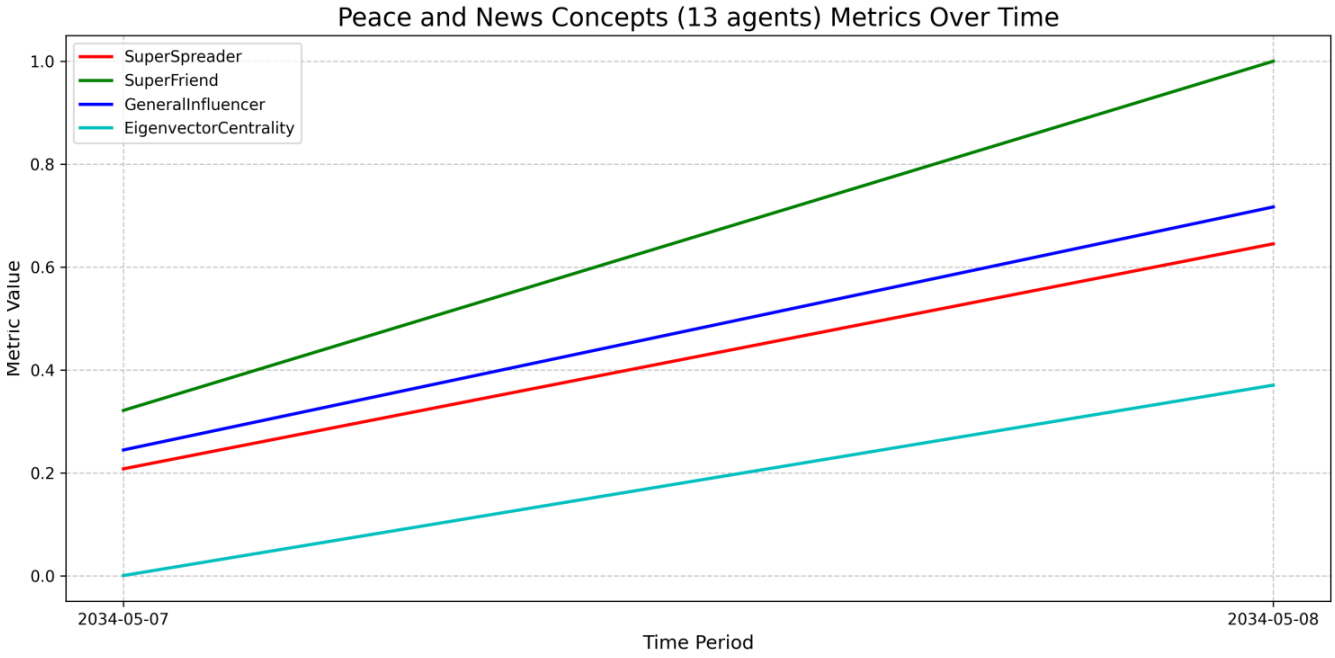

Arctic Environmental Concerns (18 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
2034-05-02
2034-05-03
2034-05-04
2034-05-05
Time Period


Current Global Issues (68 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
2034-05-06
2034-05-07
2034-05-08
2034-05-09
2034-05-10
Time Period

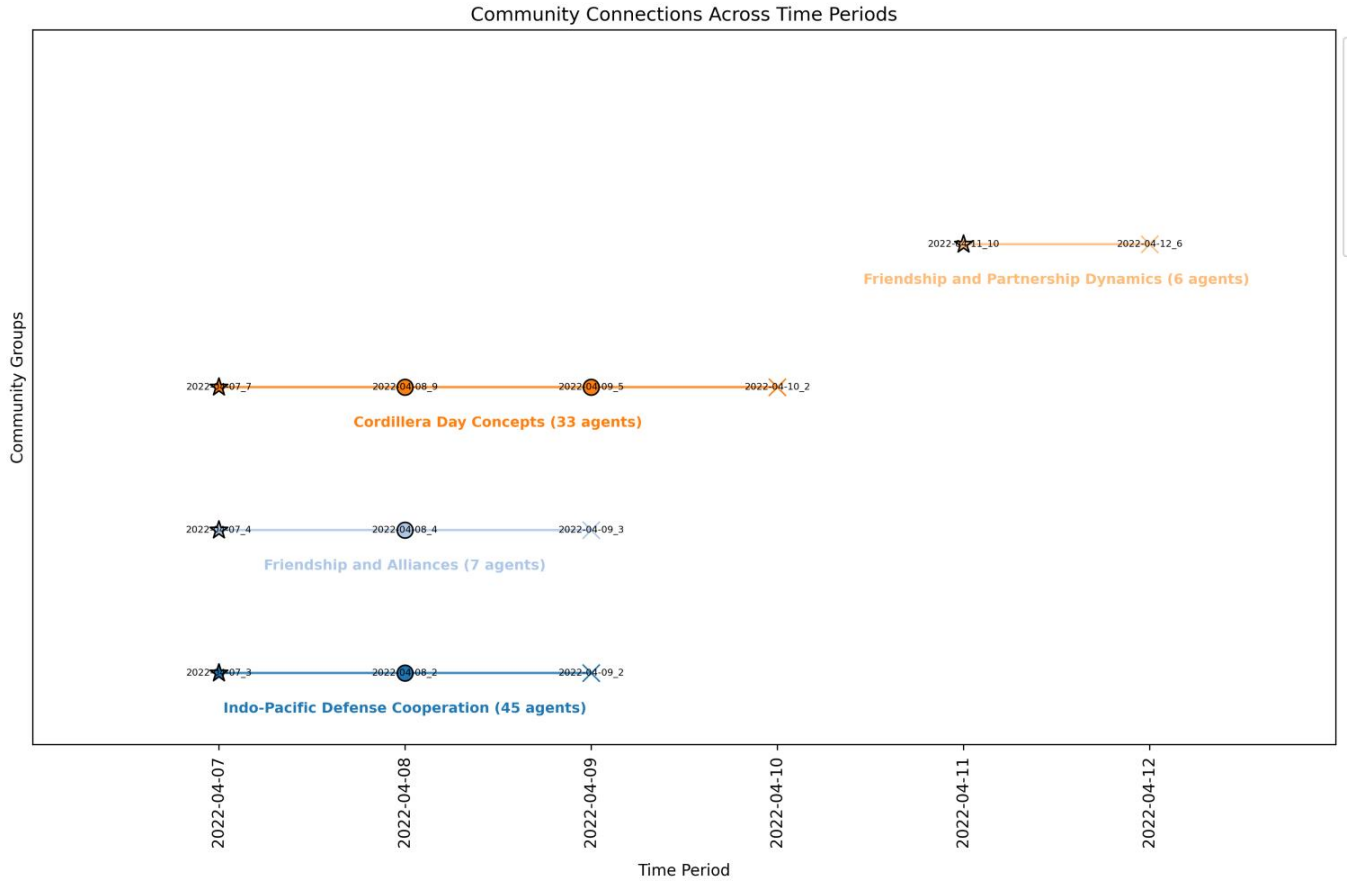

Geopolitical Tensions and Protests (54 agents) Metrics Over Time
Metric Value
Time Period
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
0.0
0.1
0.2
0.3
0.4
0.5
0.6
2034-05-04
2034-05-05
2034-05-06
2034-05-07
2034-05-08
2034-05-09
2034-05-10

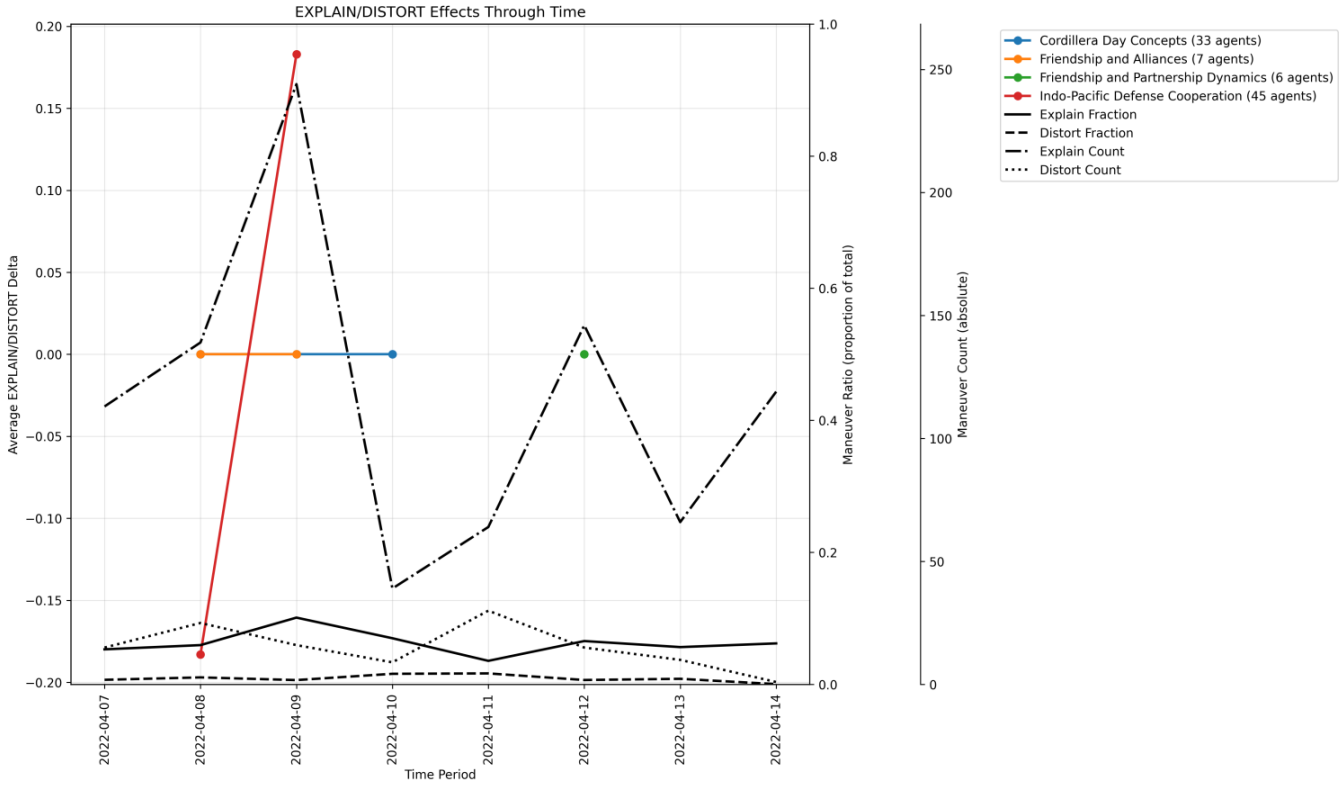

Geopolitical Tensions Overview (285 agents) Metrics Over Time
Metric Value
Time Period
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
0.0
0.2
0.4
0.6
0.8
2034-05-01
2034-05-02
2034-05-03
2034-05-04
2034-05-05
2034-05-06
2034-05-07
2034-05-08
2034-05-09
2034-05-10

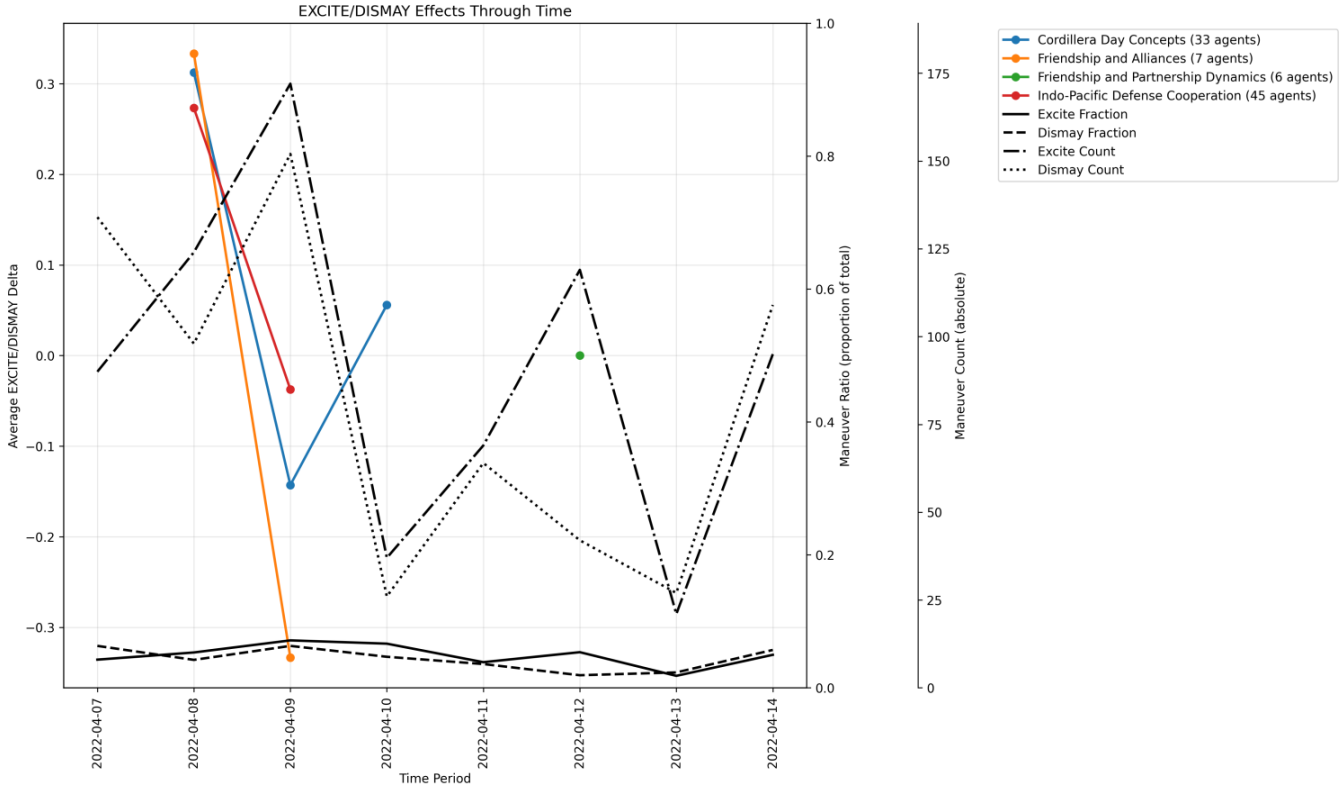

Indo-Pacific Security Concepts (288 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.0
0.2
0.4
0.6
0.8
2034-05-01
2034-05-02
2034-05-03
2034-05-04
2034-05-05
2034-05-06
2034-05-07
2034-05-08
2034-05-09
2034-05-10
Time Period

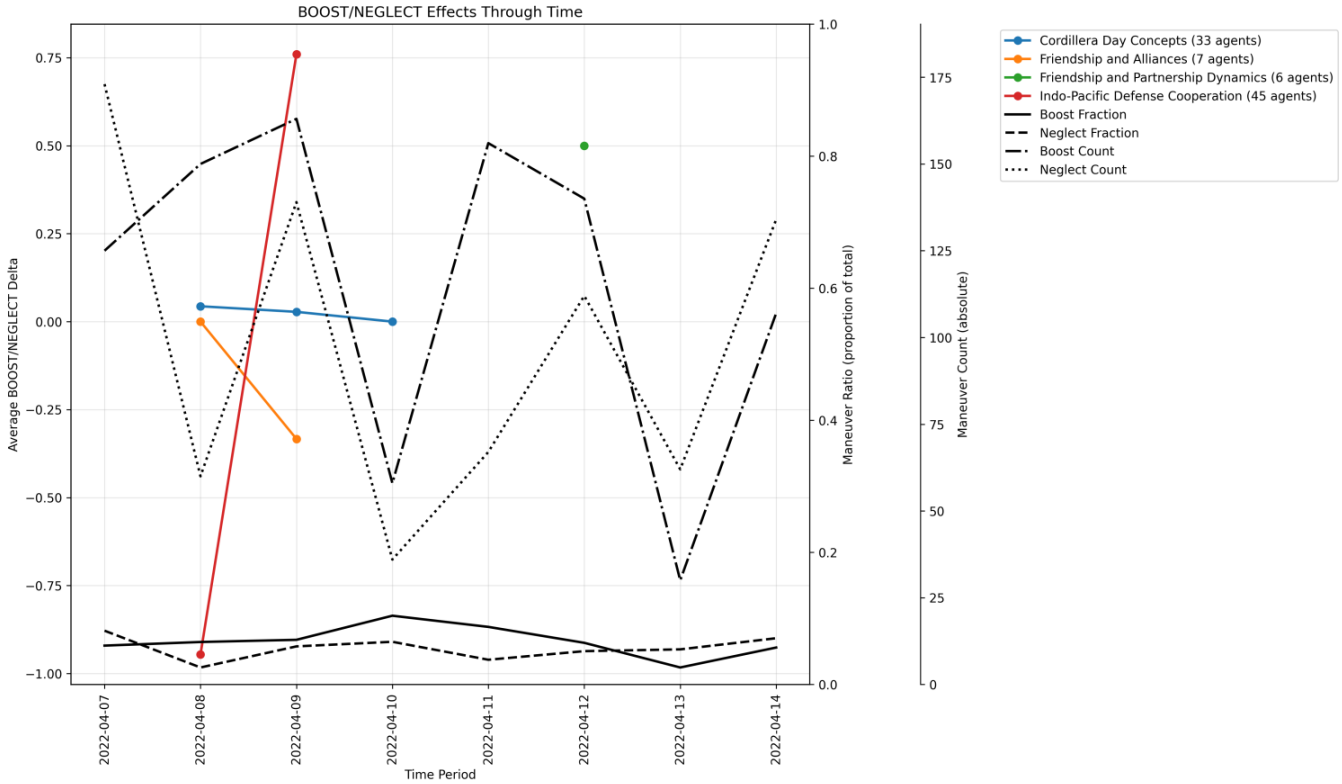

Peace and News Concepts (13 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.0
0.2
0.4
0.6
0.8
1.0
2034-05-07
2034-05-08
Time Period

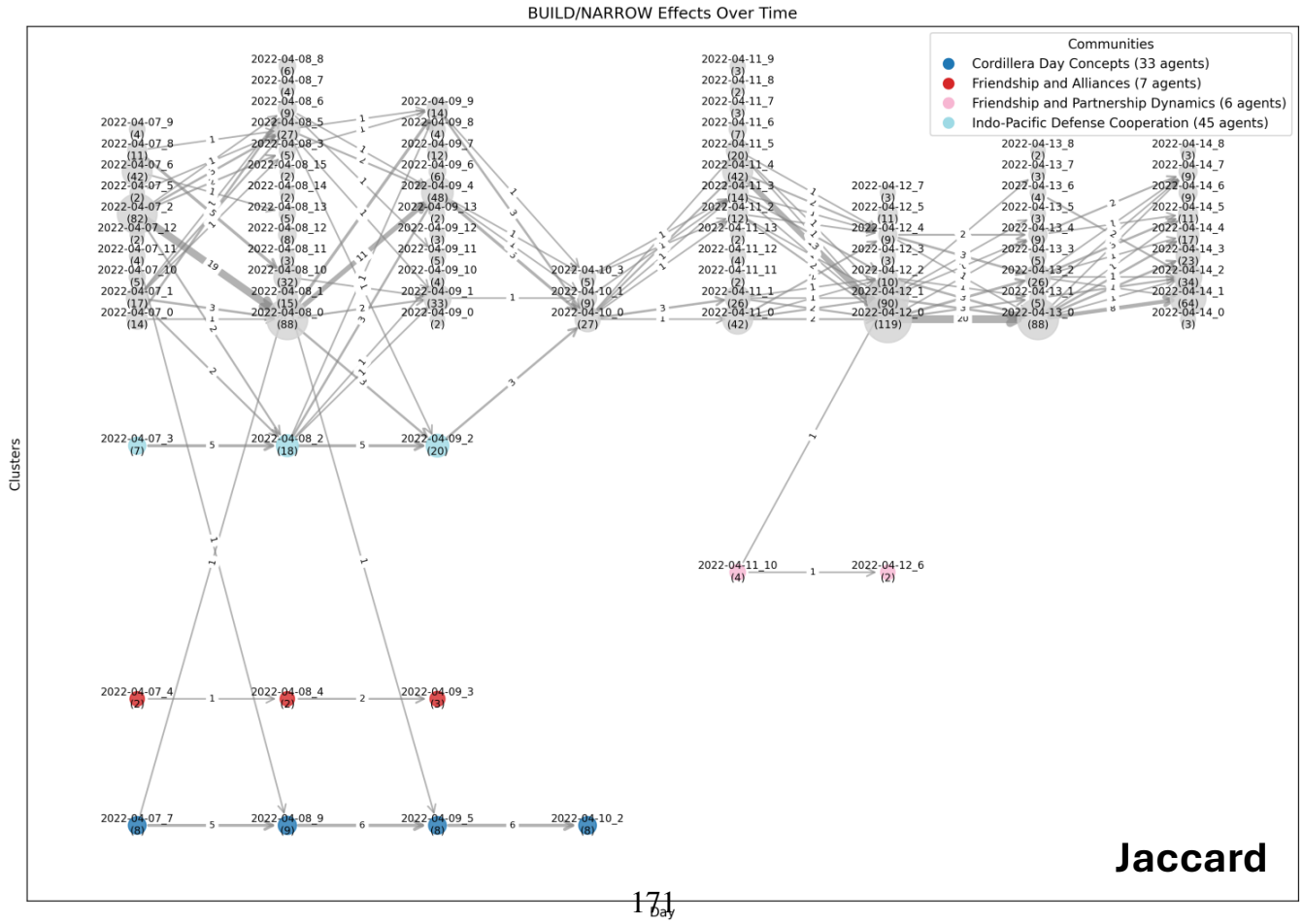
Balikatan 2022 Dataset

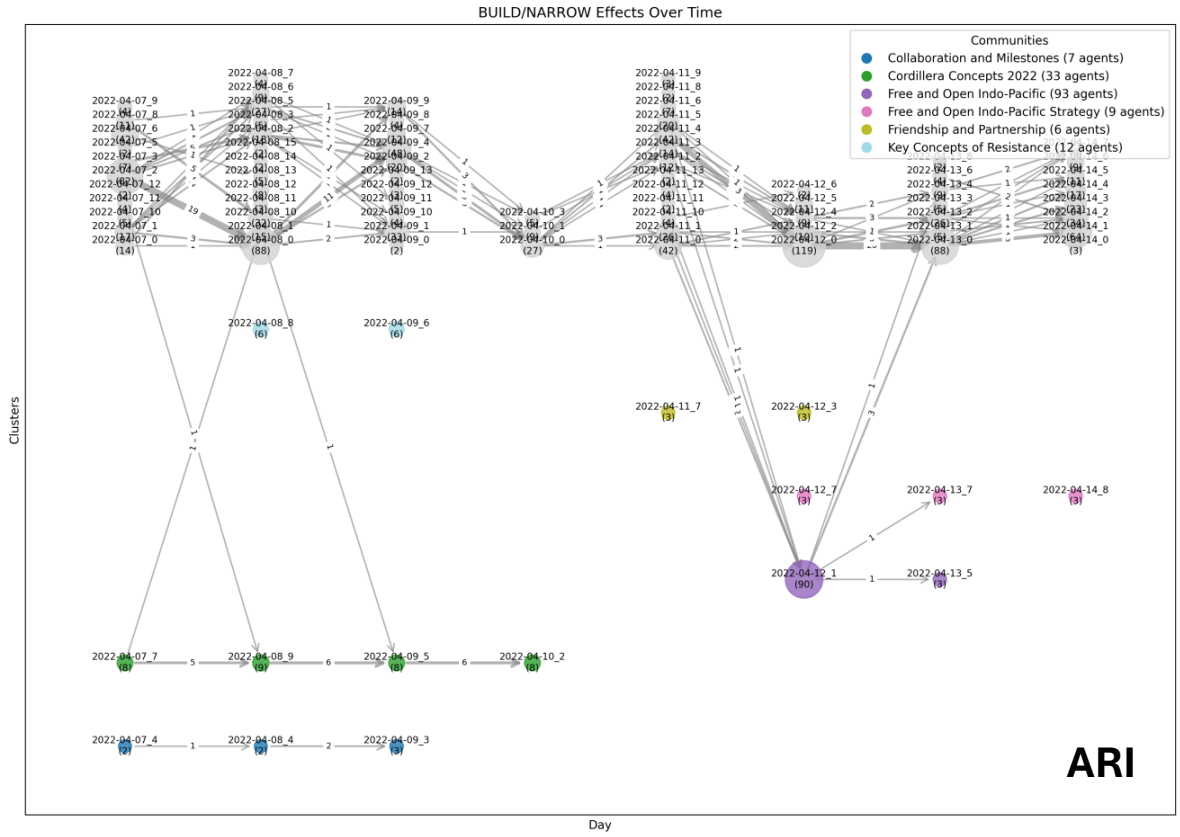


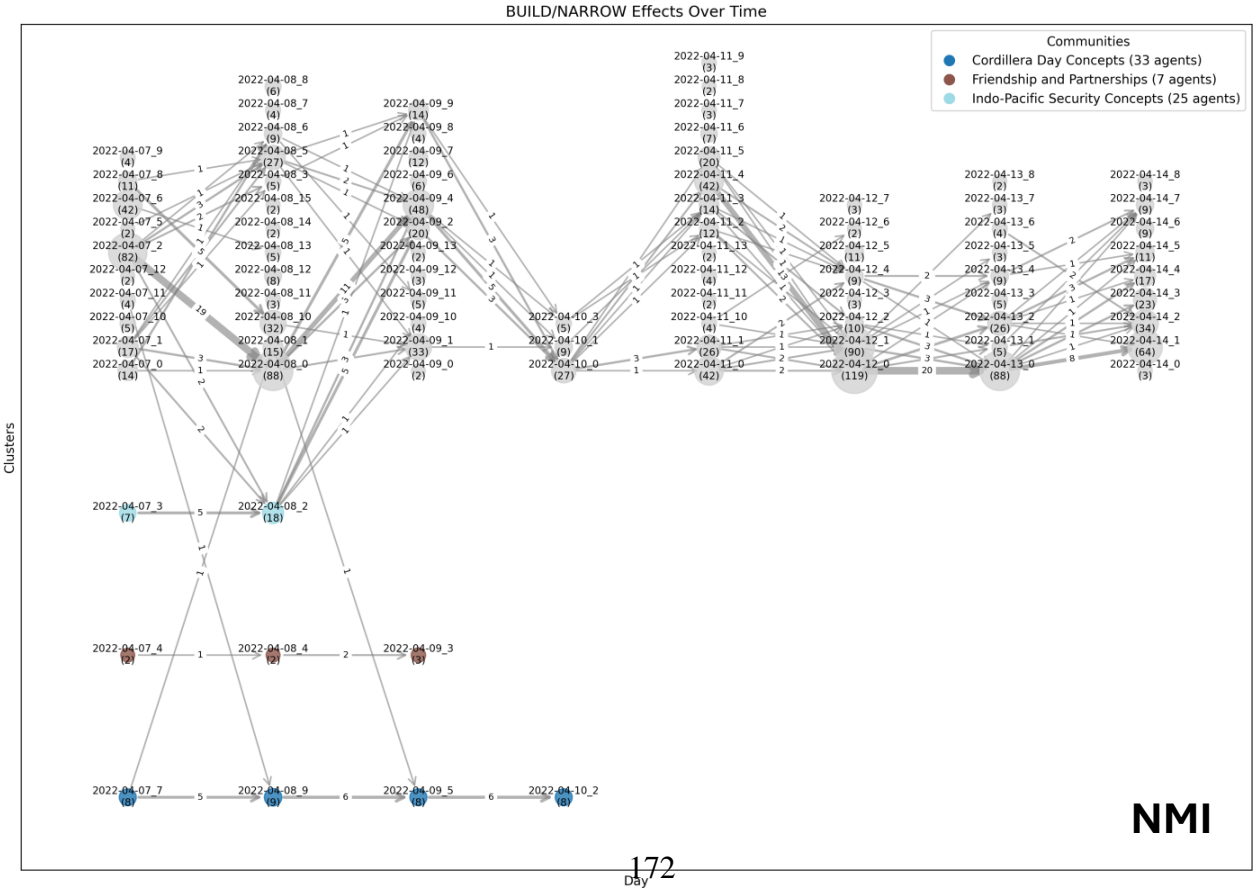

EXPLAIN/DISTORT Effects Through Time
Average EXPLAIN/DISTORT Delta
Maneuver Ratio (proportion of total)
Maneuver Count (absolute)
Time Period
Cordillera Day Concepts (33 agents)
Friendship and Alliances (7 agents)
Friendship and Partnership Dynamics (6 agents)
Indo-Pacific Defense Cooperation (45 agents)
Explain Fraction
Distort Fraction
Explain Count
Distort Count


EXCITE/DISMAY Effects Through Time
Average EXCITE/DISMAY Delta
Maneuver Ratio (proportion of total)
Maneuver Count (absolute)
Time Period
Cordillera Day Concepts (33 agents)
Friendship and Alliances (7 agents)
Friendship and Partnership Dynamics (6 agents)
Indo-Pacific Defense Cooperation (45 agents)
Excite Fraction
Dismay Fraction
Excite Count
Dismay Count

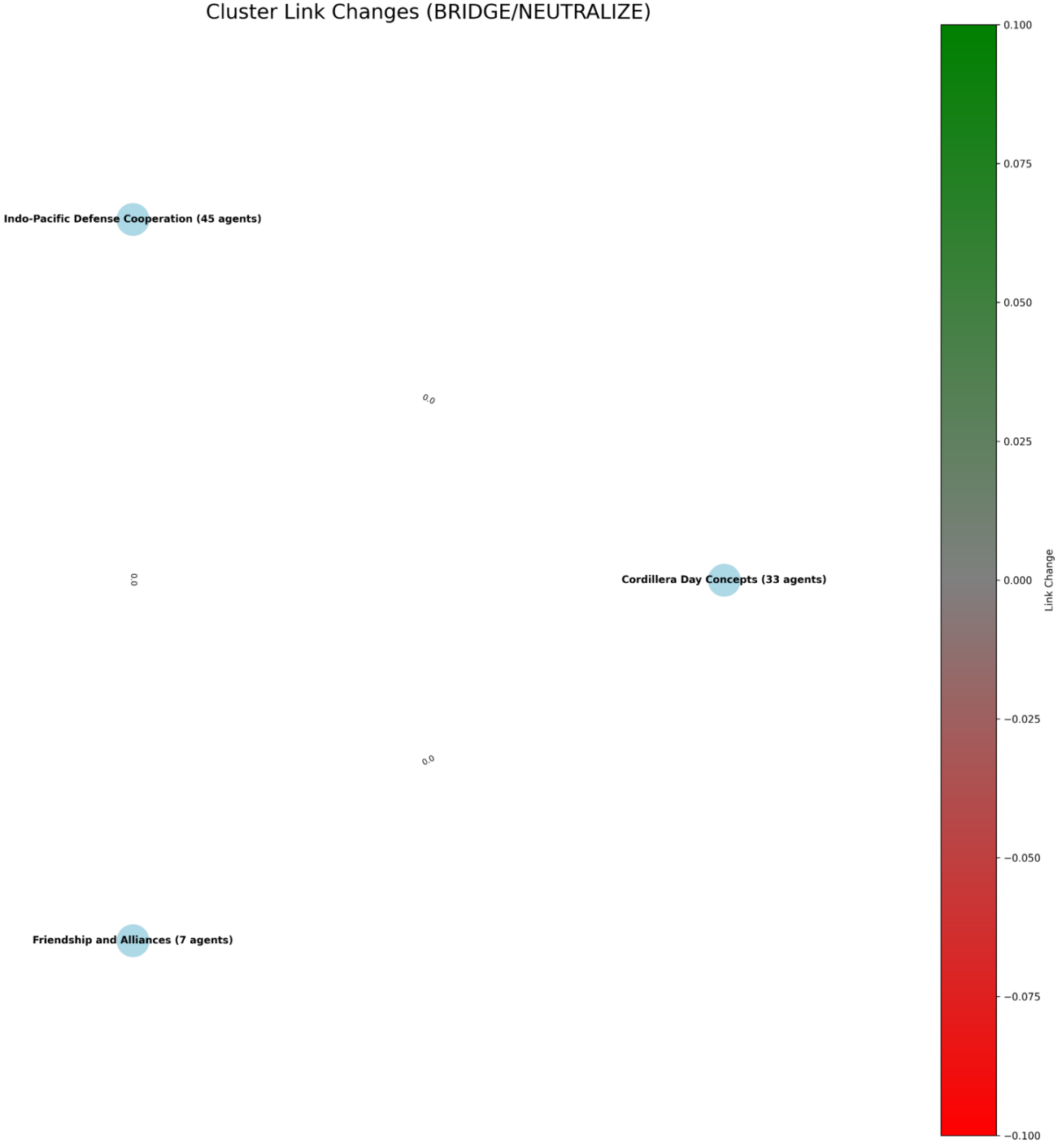

BOOST/NEGLECT Effects Through Time
Average BOOST/NEGLECT Delta
Maneuver Ratio (proportion of total)
Maneuver Count (absolute)
Time Period
2022-04-07
2022-04-08
2022-04-09
2022-04-10
2022-04-11
2022-04-12
2022-04-13
2022-04-14
Cordillera Day Concepts (33 agents)
Friendship and Alliances (7 agents)
Friendship and Partnership Dynamics (6 agents)
Indo-Pacific Defense Cooperation (45 agents)
Boost Fraction
Neglect Fraction
Boost Count
Neglect Count


BUILD/NARROW Effects Over Time
Communities
Cordillera Day Concepts (33 agents)
Friendship and Alliances (7 agents)
Friendship and Partnership Dynamics (6 agents)
Indo-Pacific Defense Cooperation (45 agents)
Clusters
Day
Jaccard

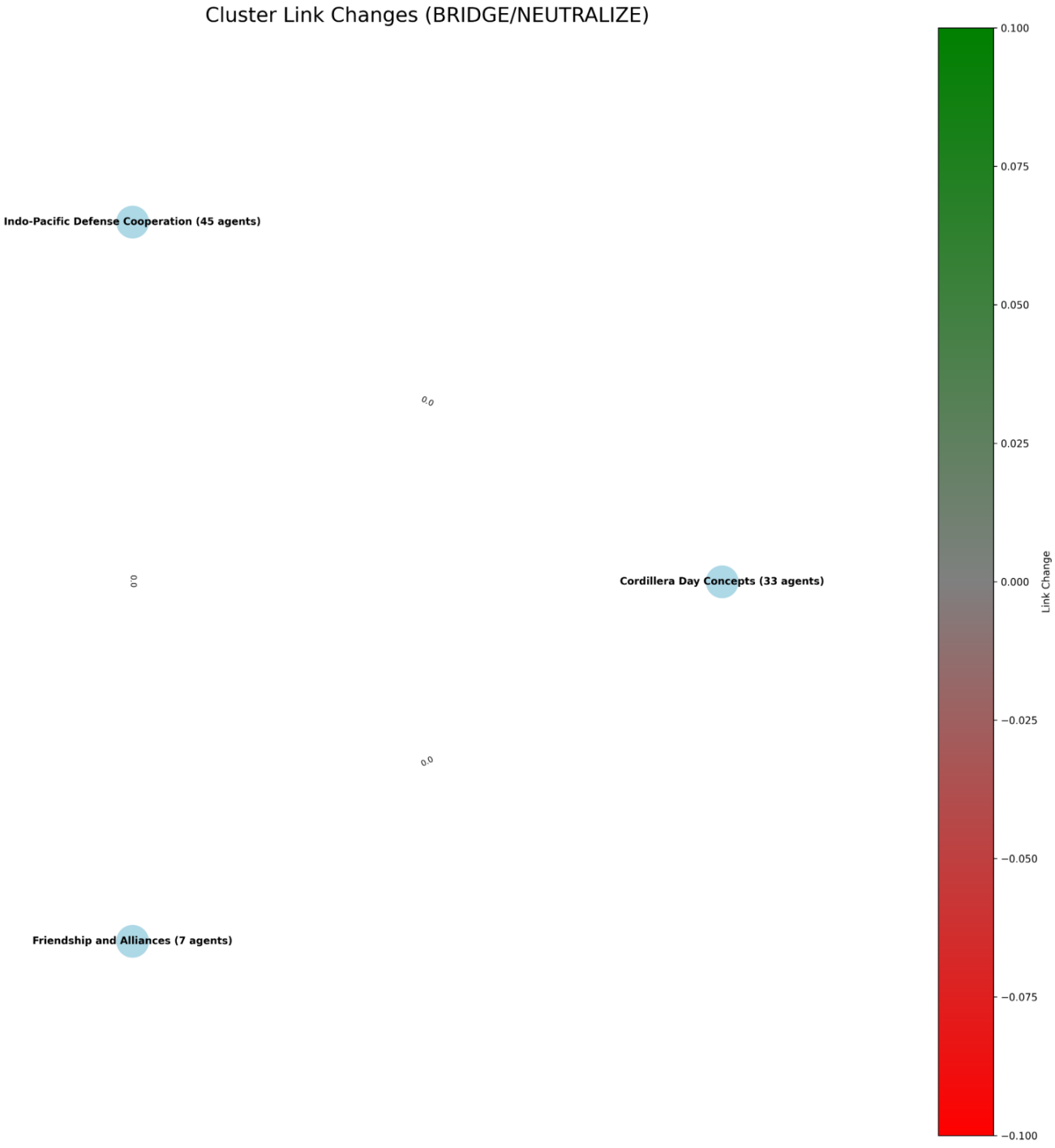

BUILD/NARROW Effects Over Time
Communities
Collaboration and Milestones (7 agents)
Cordillera Concepts 2022 (33 agents)
Free and Open Indo-Pacific (93 agents)
Free and Open Indo-Pacific Strategy (9 agents)
Friendship and Partnership (6 agents)
Key Concepts of Resistance (12 agents)
Clusters
Day
ARI


BUILD/NARROW Effects Over Time
Communities
Cordillera Day Concepts (33 agents)
Friendship and Partnerships (7 agents)
Indo-Pacific Security Concepts (25 agents)
Clusters
Day
NMI

2022-04-08

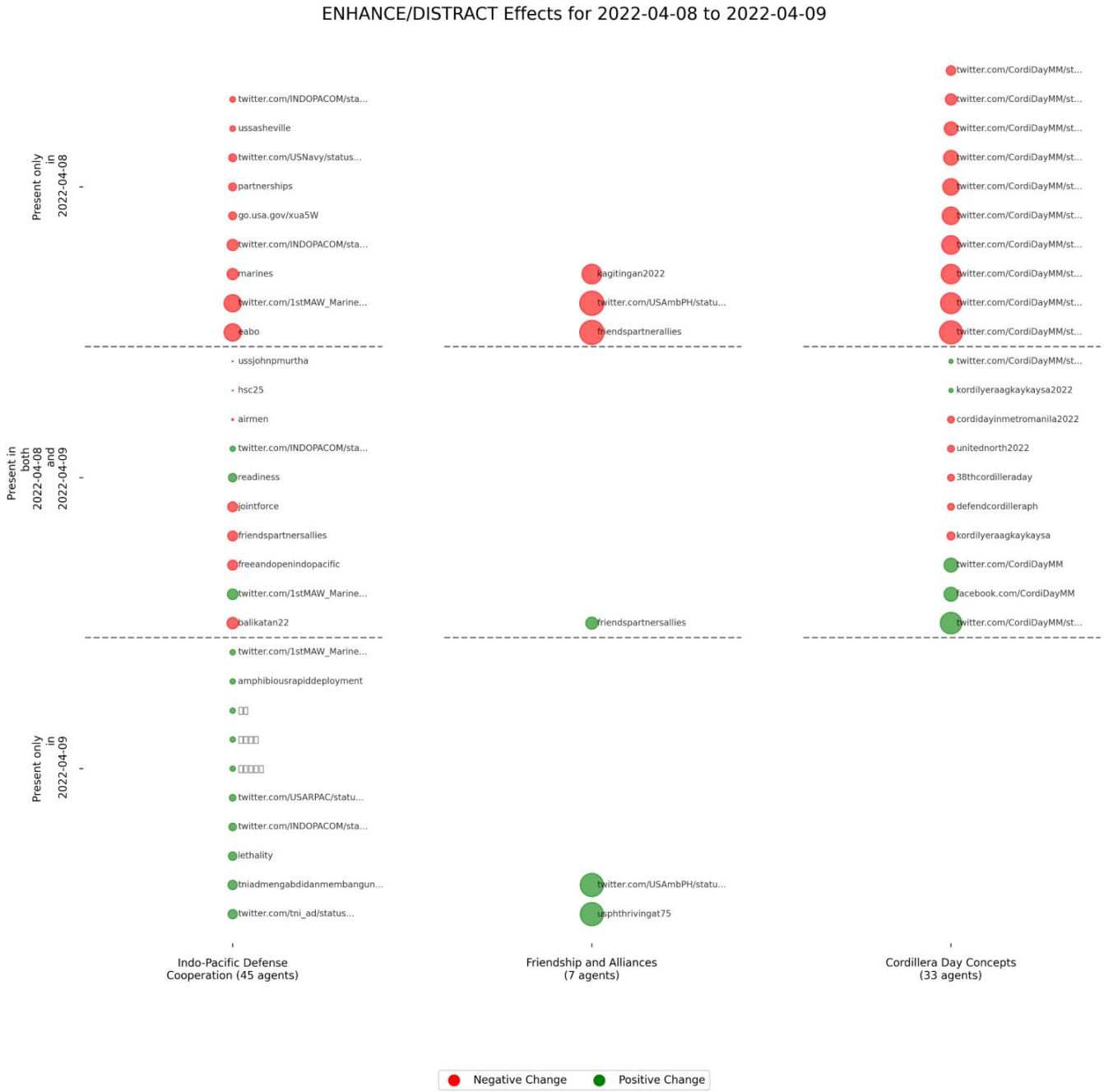

Cluster Link Changes (BRIDGE/NEUTRALIZE)
Indo-Pacific Defense Cooperation (45 agents)
Cordillera Day Concepts (33 agents)
Friendship and Alliances (7 agents)
0.0
0.0
0.0
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100
Link Change

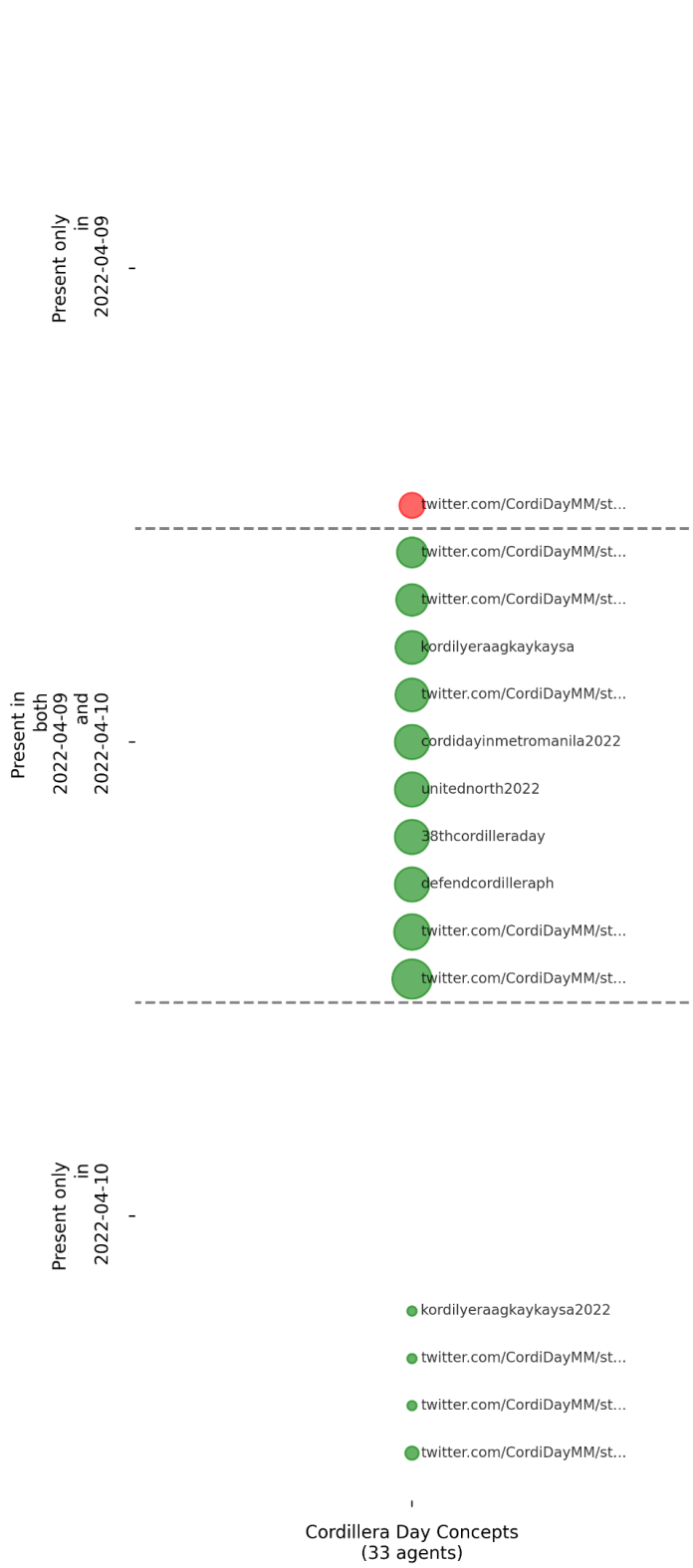
2022-04-09



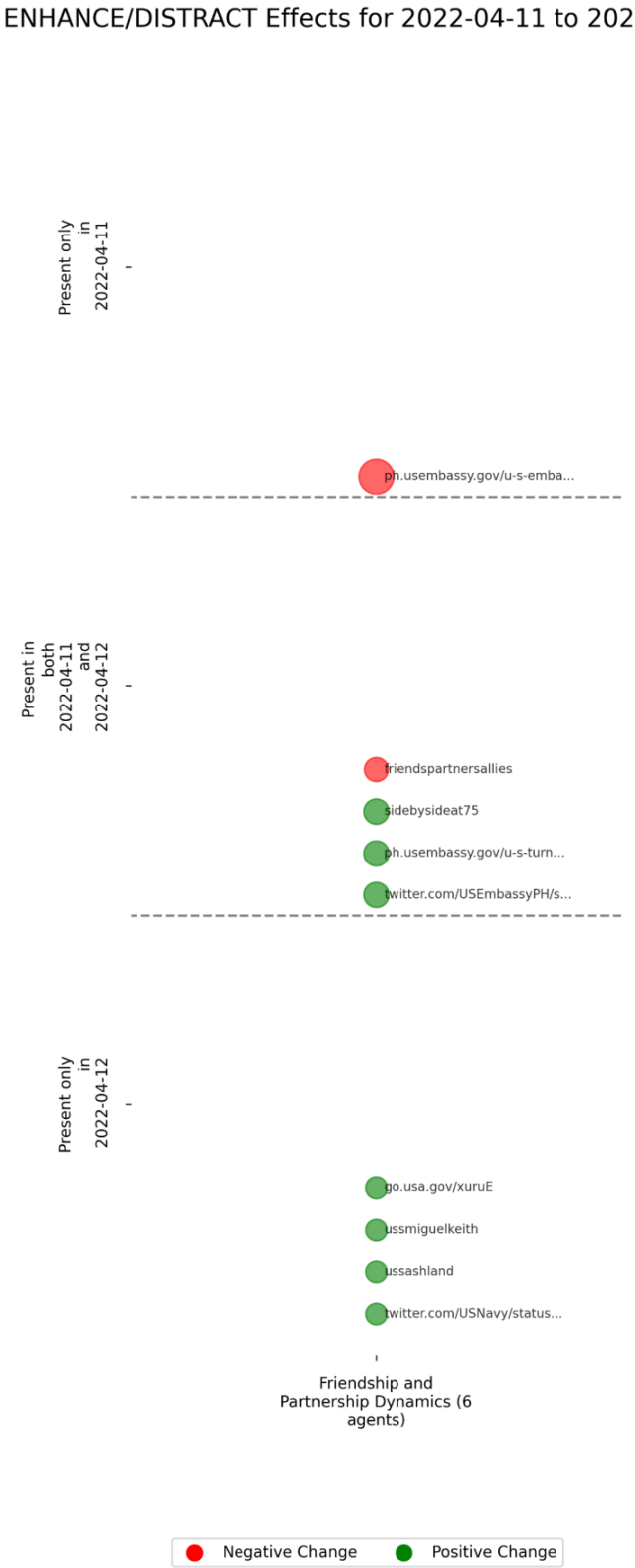
Bridge/Neutralize - 2022-04-10 through 2022-04-14 are blank


ENHANCE/DISTRACT Effects for 2022-04-07 to 2022-04-08
Present only in 2022-04-07
Present in both 2022-04-07 and 2022-04-08
Present only in 2022-04-08
twitter.com/INDOPACOM/sta...
friendspartnersallies
jointforce
airmen
balikatan22
twitter.com/USARPAC/statu...
twitter.com/INDOPACOM/sta...
tniadmengabdidanmembangun...
twitter.com/tni_ad/status...
twitter.com/1stMAW_Marine...
amphibiousrapiddeployment
lethality
usstripoli
twitter.com/INDOPACOM/sta...
freeandopenindopacific
pacificocean
twitter.com/1stMAW_Marine...
balikatan2022
marines
twitter.com/INDOPACOM/sta...
twitter.com/USMC/status/1...
Indo-Pacific Defense Cooperation (45 agents)
twitter.com/USAmbPH/statu...
usphthrivingat75
friendspartnersallies
twitter.com/USEmbassyPH/s...
twitter.com/USEmbassyPH/s...
freeandopenindopacific
newsinfo.inquirer.net/157...
sidebysideat75
Friendship and Alliances (7 agents)
kordilyeraagkaykaysa
twitter.com/CordiDayMM/st...
cordidayinmetromanila2022
38thcordilleraday
defendcordilleraph
twitter.com/CordiDayMM
facebook.com/CordiDayMM
twitter.com/CordiDayMM/st...
unitednorth2022
kordilyeraagkaykaysa2022
twitter.com/cordi_in/stat...
twitter.com/katribuphils/...
twitter.com/katribuphils/...
Cordillera Day Concepts (33 agents)
Negative Change
Positive Change

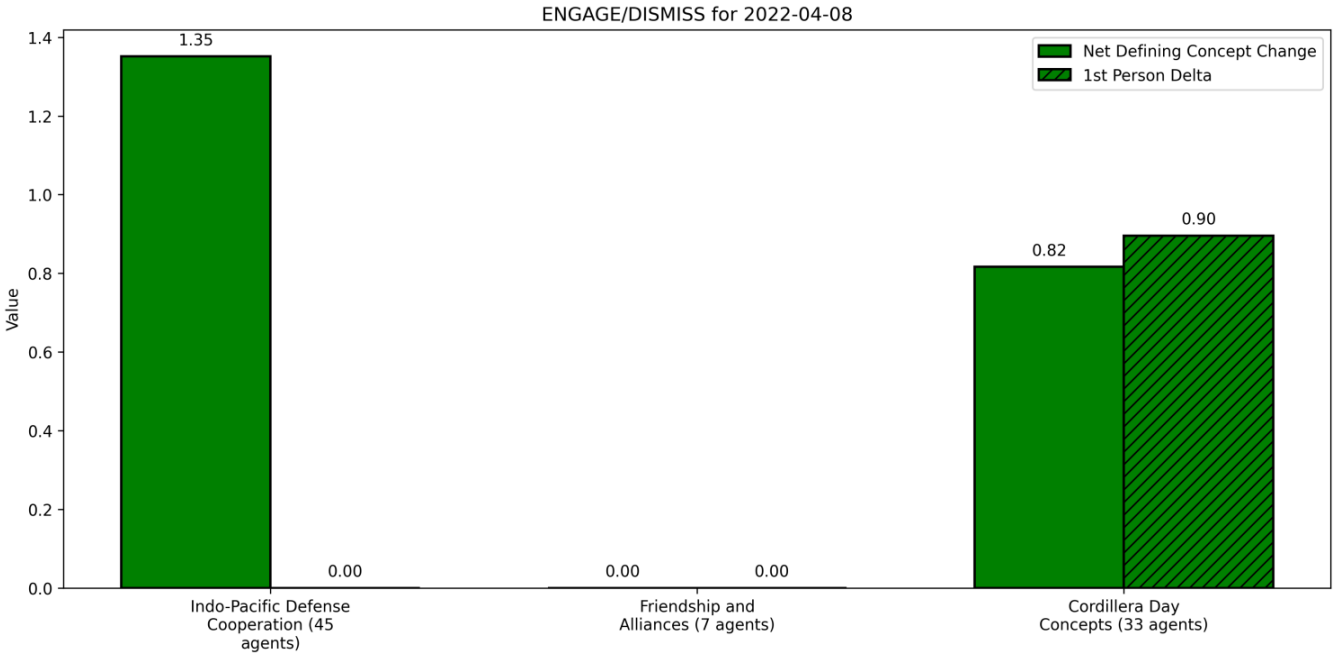

ENHANCE/DISTRACT Effects for 2022-04-08 to 2022-04-09
Present only in 2022-04-08
Present in both 2022-04-08 and 2022-04-09
Present only in 2022-04-09
twitter.com/INDOPACOM/sta...
ussasheville
twitter.com/USNavy/status...
partnerships
go.usa.gov/xua5W
twitter.com/INDOPACOM/sta...
marines
twitter.com/1stMAW_Marine...
eabo
ussjohnpmurtha
hsc25
airmen
twitter.com/INDOPACOM/sta...
readiness
jointforce
friendspartnersallies
freeandopenindopacific
twitter.com/1stMAW_Marine...
balikatan22
twitter.com/1stMAW_Marine...
amphibiousrapiddeployment
twitter.com/USARPAC/statu...
twitter.com/INDOPACOM/sta...
lethality
tniadmengabdidanmembangun...
twitter.com/tni_ad/status...
kagitingan2022
twitter.com/USAmbPH/statu...
friendspartnerallies
friendspartnersallies
twitter.com/USAmbPH/statu...
usphthrivingat75
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
kordilyeraagkaykaysa2022
cordidayinmetromanila2022
unitednorth2022
38thcordilleraday
defendcordilleraph
kordilyeraagkaykaysa
twitter.com/CordiDayMM
facebook.com/CordiDayMM
twitter.com/CordiDayMM/st...
Indo-Pacific Defense Cooperation (45 agents)
Friendship and Alliances (7 agents)
Cordillera Day Concepts (33 agents)
Negative Change
Positive Change

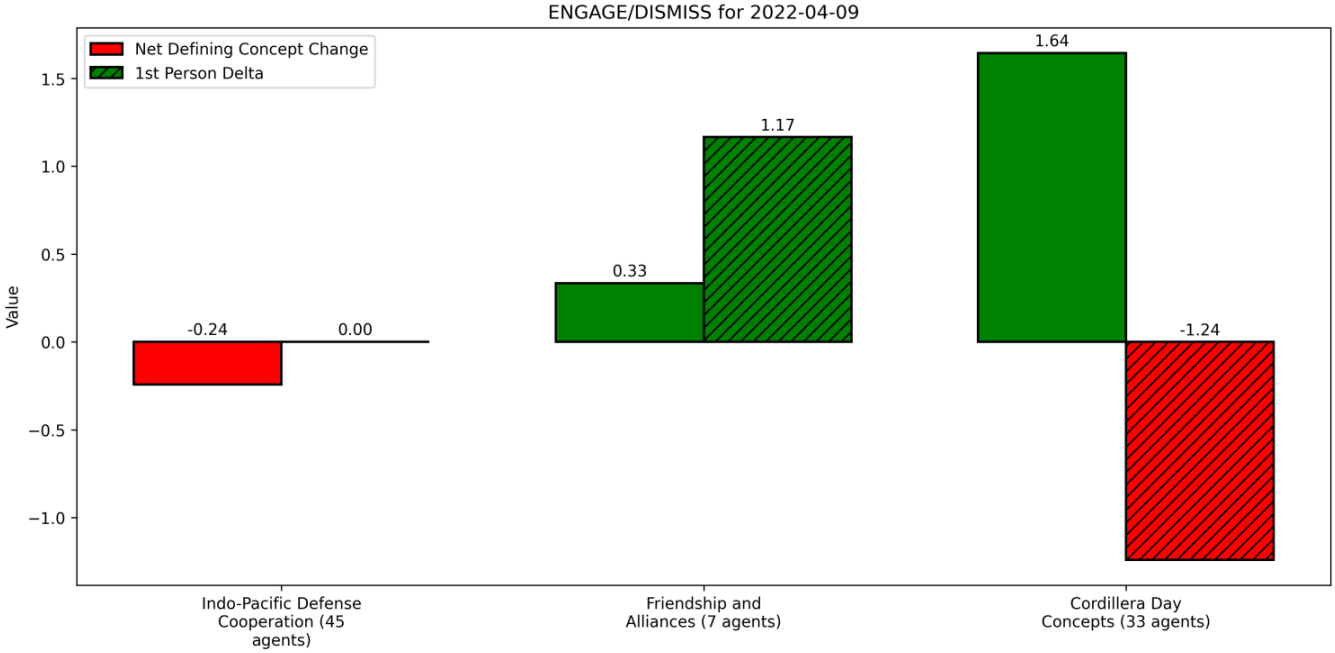

ENHANCE/DISTRACT Effects for 2022-04-09 to 2022-04-10
Present only in 2022-04-09
Present in both 2022-04-09 and 2022-04-10
Present only in 2022-04-10
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
kordilyeraagkaykaysa
twitter.com/CordiDayMM/st...
cordidayinmetromanila2022
unitednorth2022
38thcordilleraday
defendcordilleraph
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
kordilyeraagkaykaysa2022
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
twitter.com/CordiDayMM/st...
Cordillera Day Concepts
(33 agents)
Negative Change
Positive Change

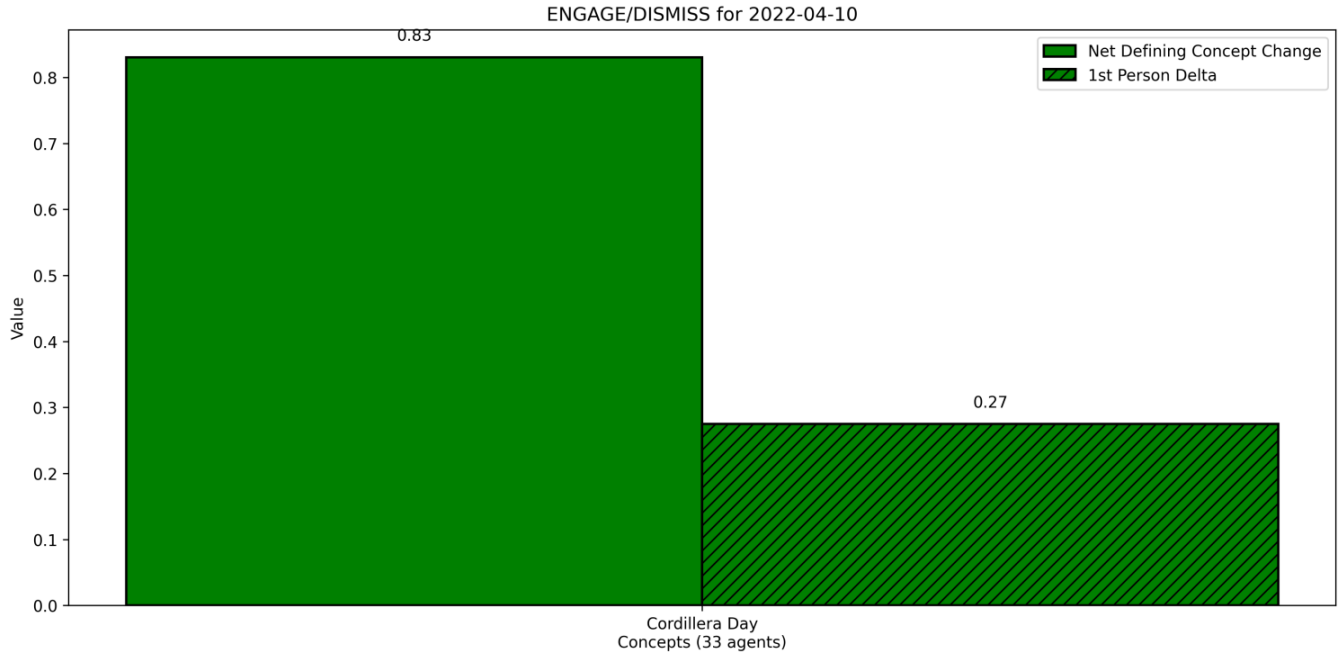
2022-04-11 is blank



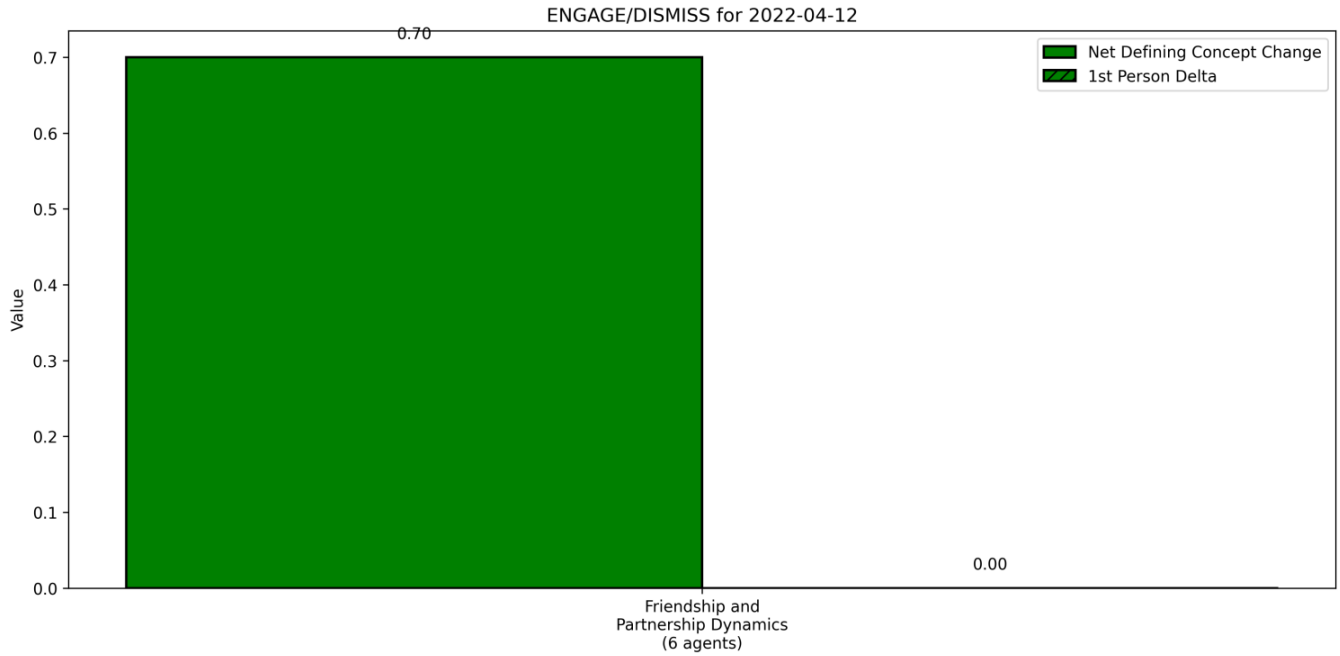
2022-04-13 – 2022-04-14 are blank


ENGAGE/DISMISS for 2022-04-08
Net Defining Concept Change
1st Person Delta
Value
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1.35
0.00
0.00
0.00
0.82
0.90
Indo-Pacific Defense Cooperation (45 agents)
Friendship and Alliances (7 agents)
Cordillera Day Concepts (33 agents)

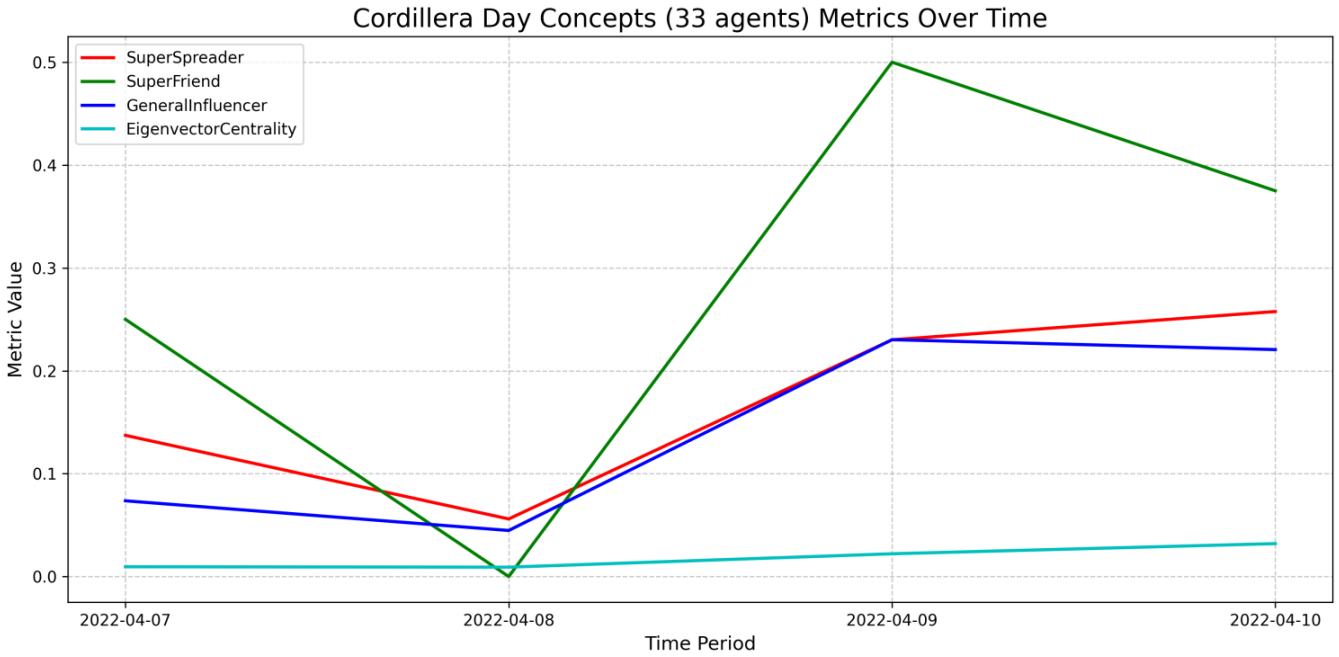

ENGAGE/DISMISS for 2022-04-09
Net Defining Concept Change
1st Person Delta
Value
1.5
1.0
0.5
0.0
−0.5
−1.0
-0.24
0.00
0.33
1.17
1.64
-1.24
Indo-Pacific Defense Cooperation (45 agents)
Friendship and Alliances (7 agents)
Cordillera Day Concepts (33 agents)

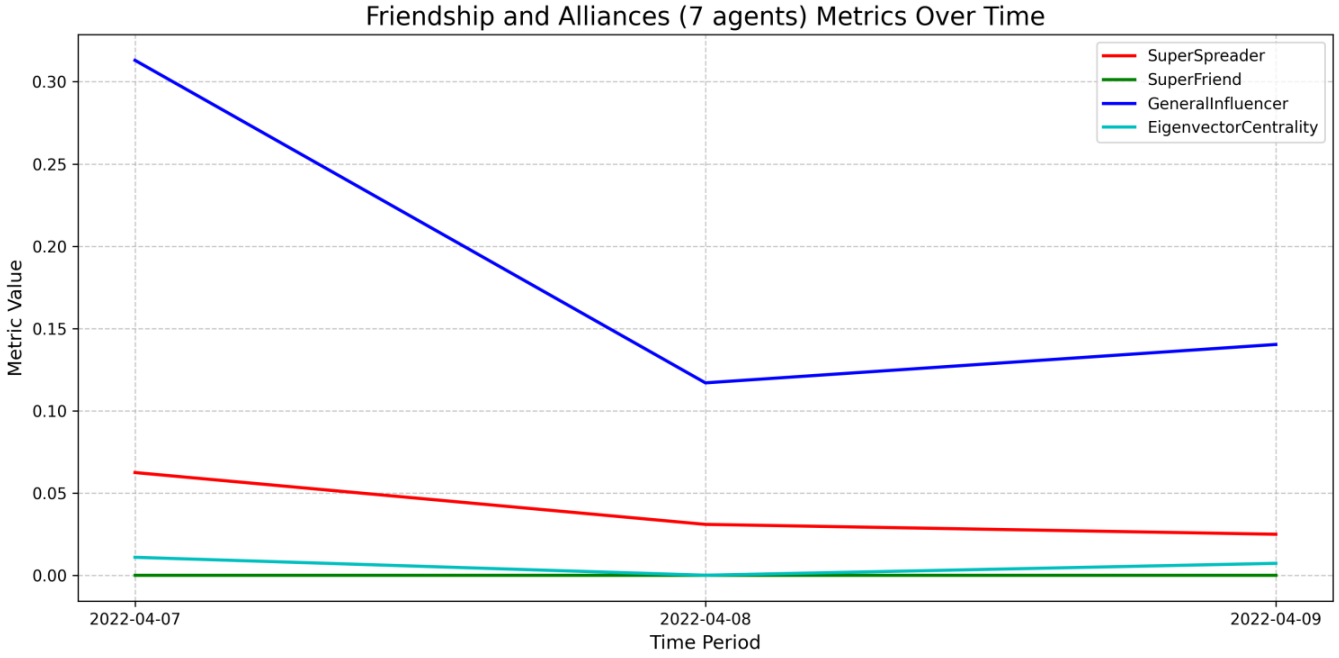


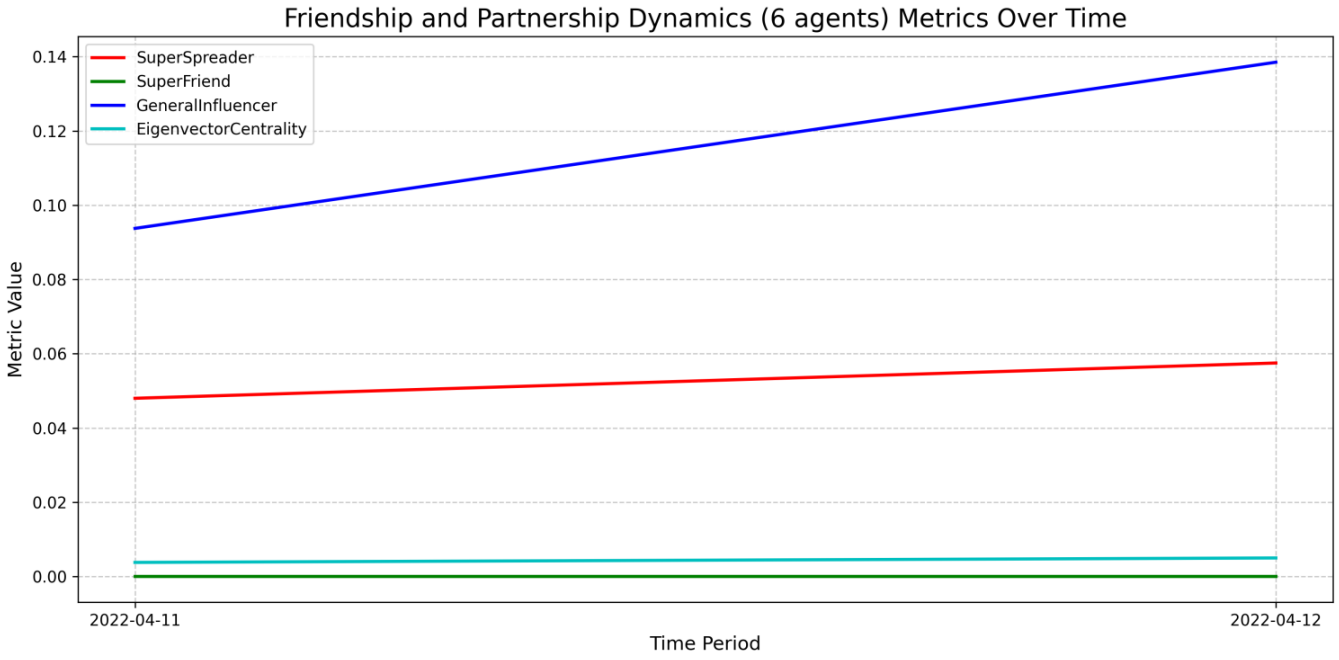
Engage/Dismiss - 2022-04-11 is blank

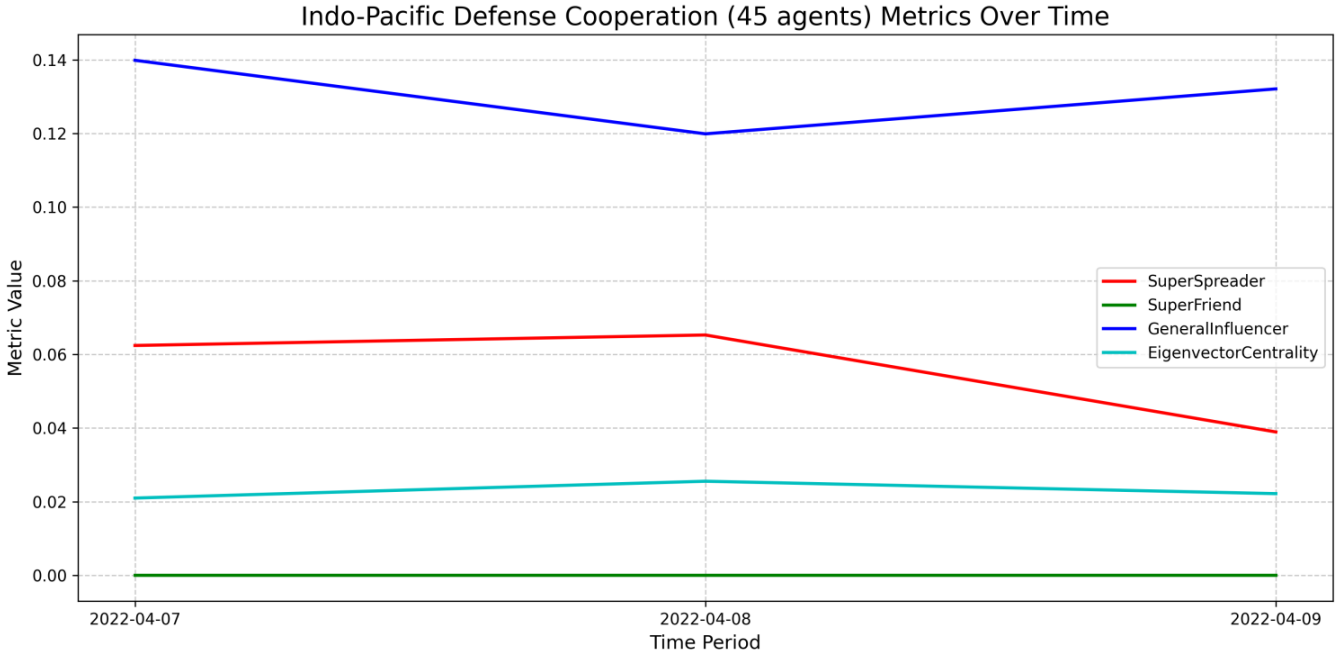


Engage/Dismiss - 2022-04-13 through 2022-04-14 are blank

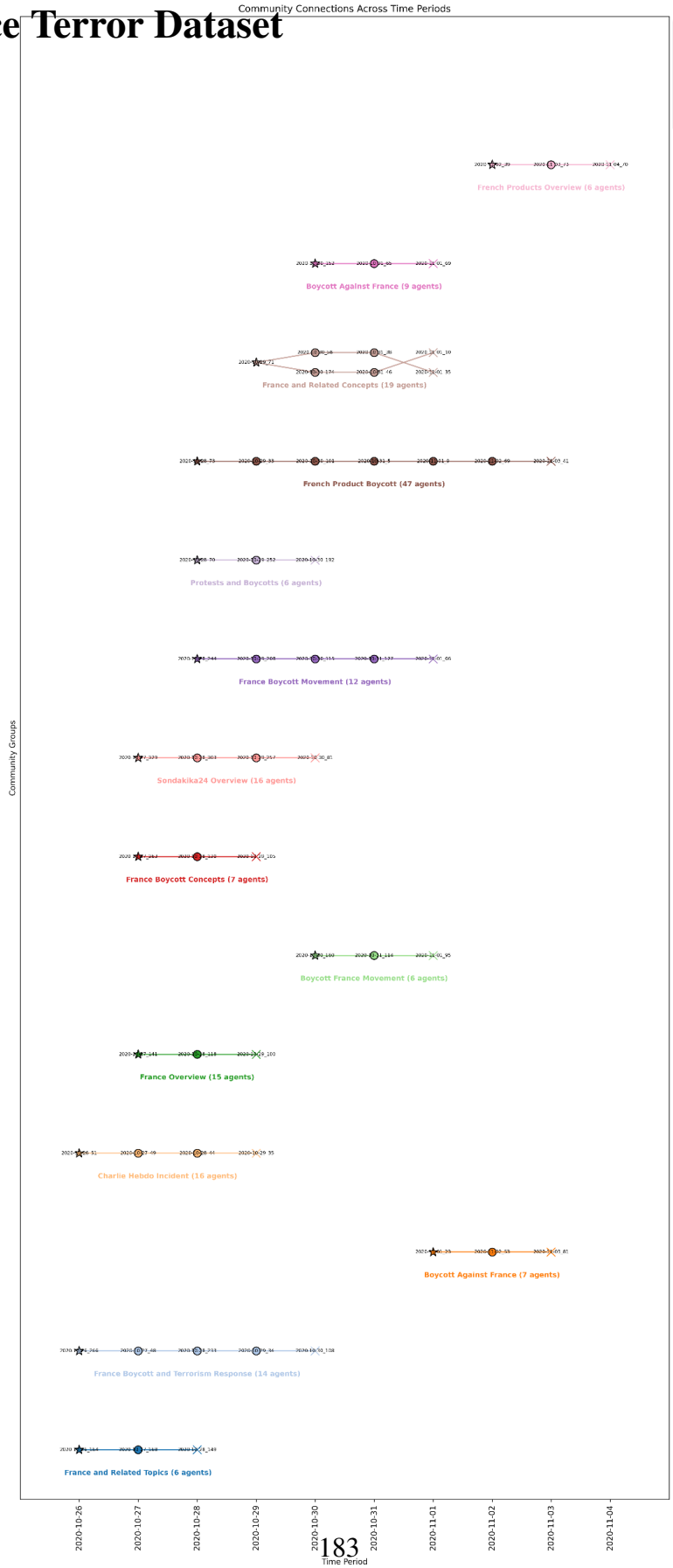

Cordillera Day Concepts (33 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.0
0.1
0.2
0.3
0.4
0.5
2022-04-07
2022-04-08
2022-04-09
2022-04-10
Time Period

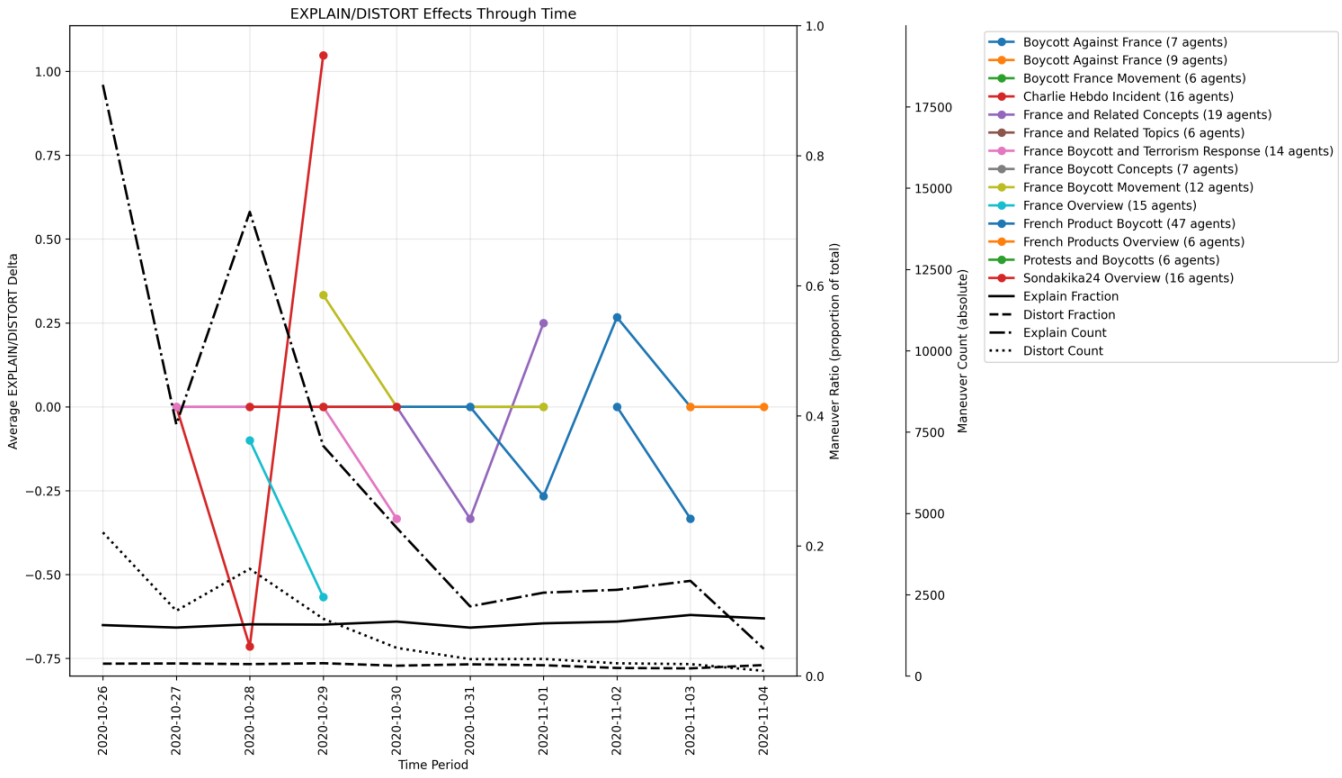

Friendship and Alliances (7 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.00
0.05
0.10
0.15
0.20
0.25
0.30
2022-04-07
2022-04-08
2022-04-09
Time Period

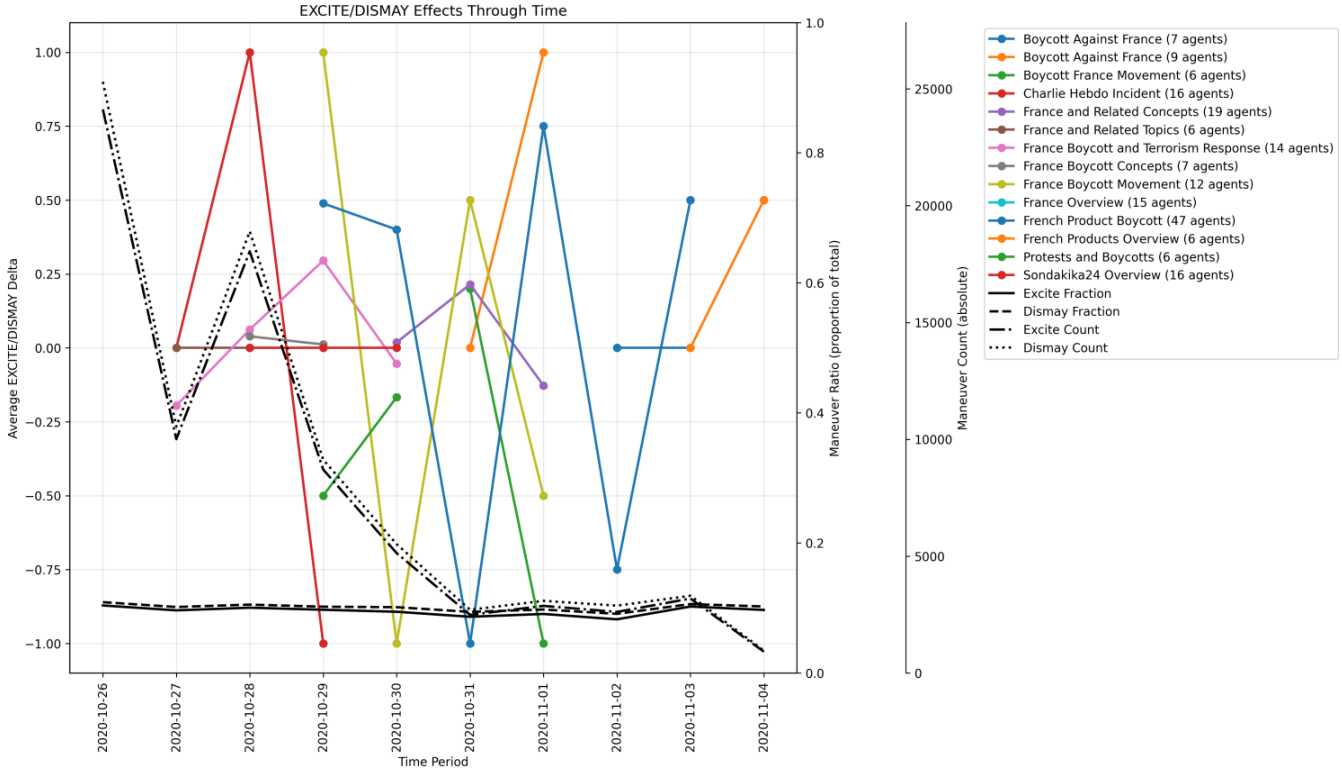

Friendship and Partnership Dynamics (6 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
2022-04-11
2022-04-12
Time Period

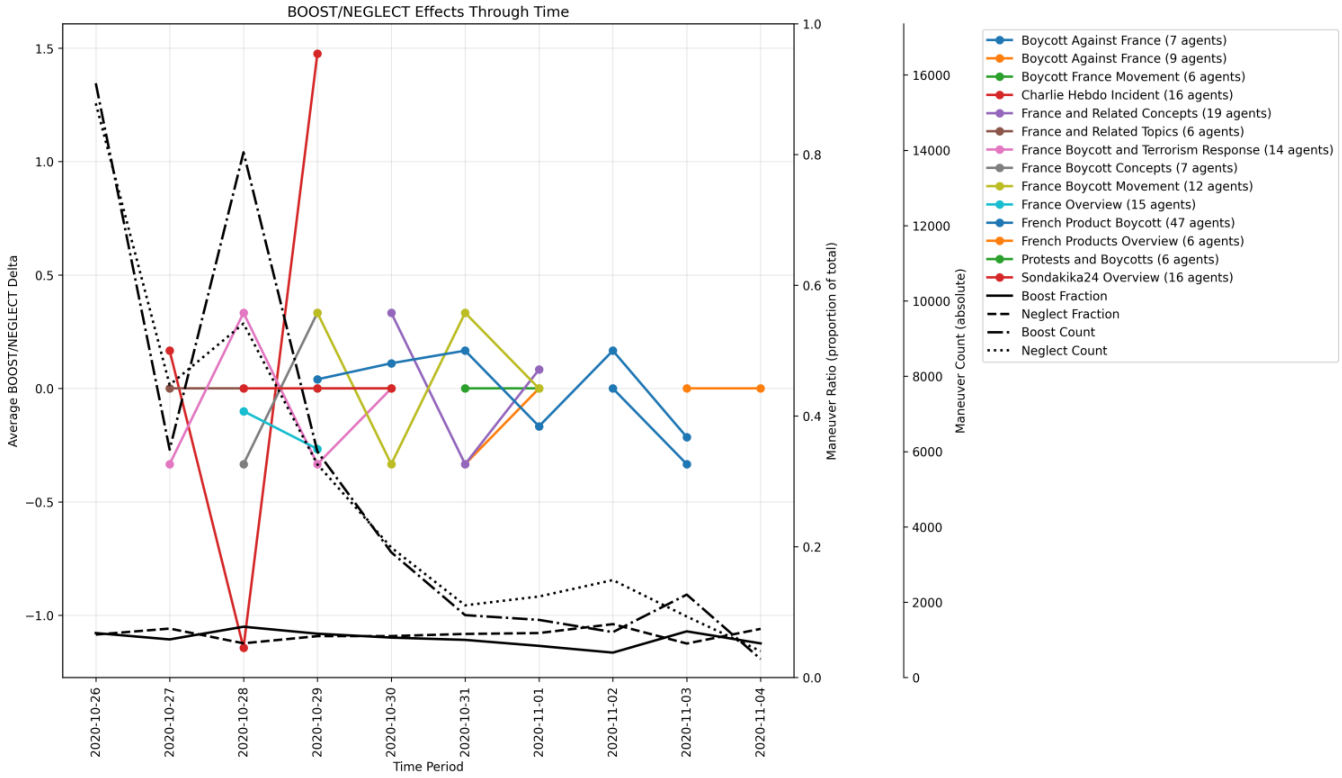

Indo-Pacific Defense Cooperation (45 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
2022-04-07
2022-04-08
2022-04-09
Time Period

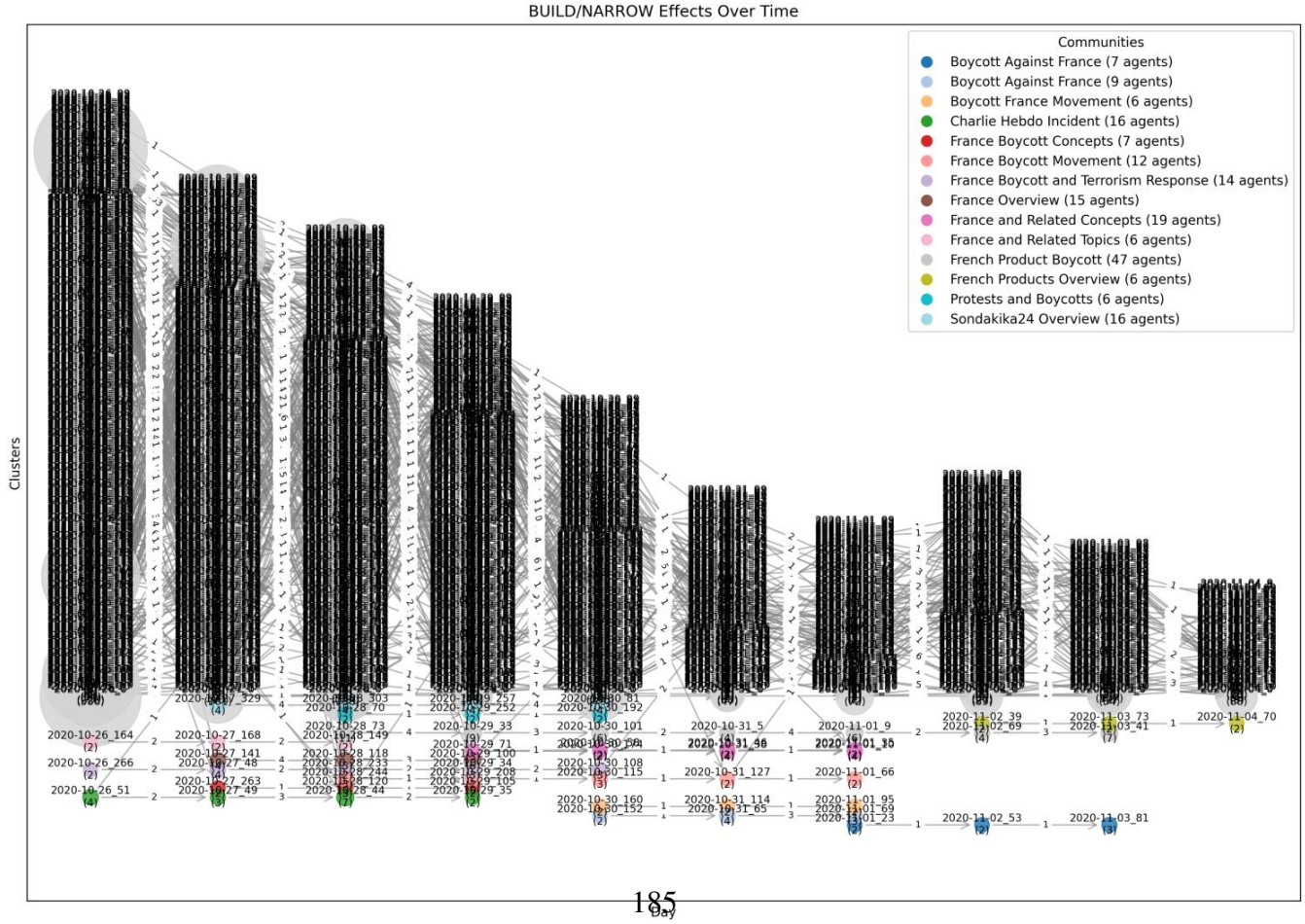
Nice, France Terror Dataset



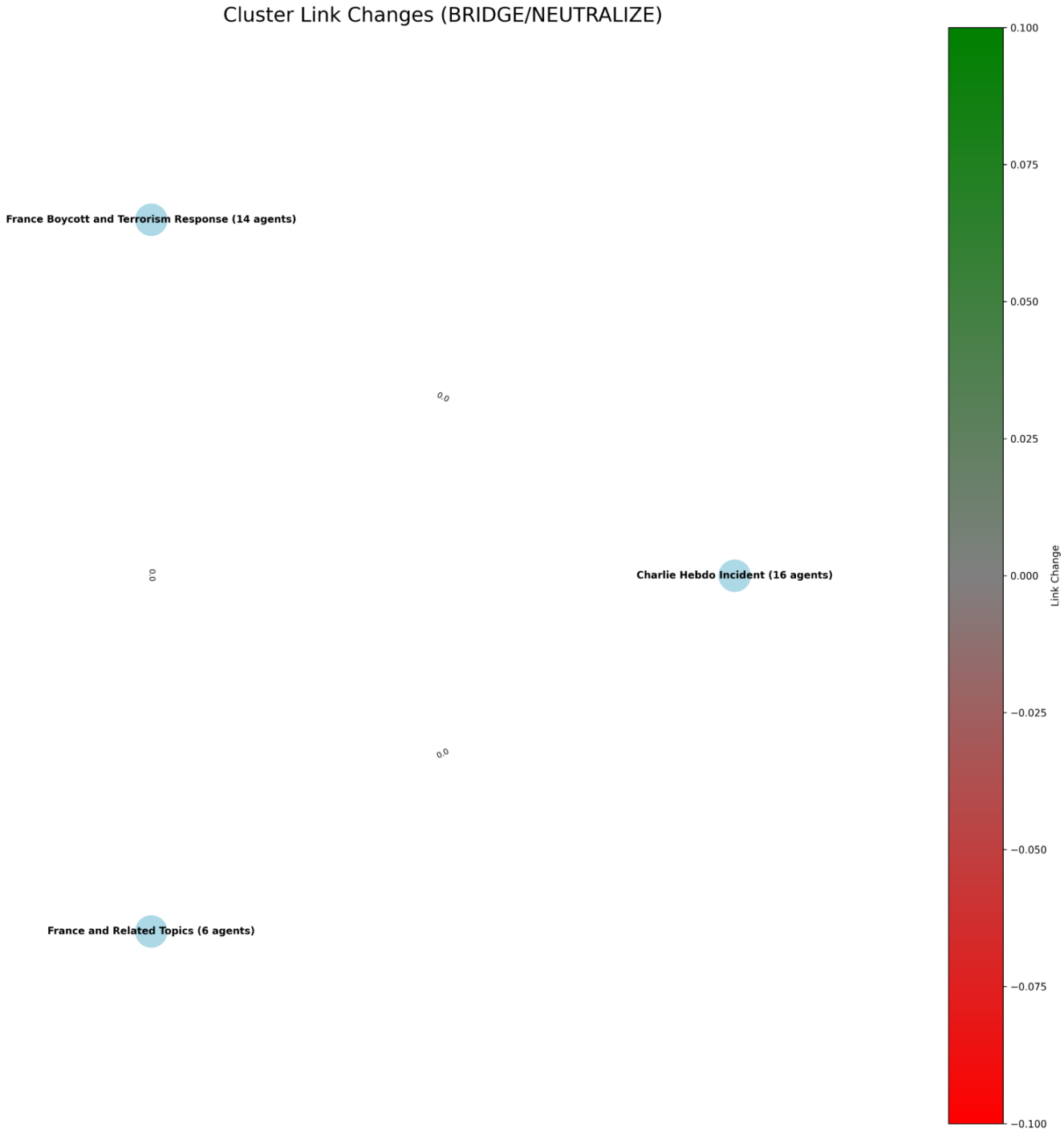

EXPLAIN/DISTORT Effects Through Time
Average EXPLAIN/DISTORT Delta
Maneuver Ratio (proportion of total)
Maneuver Count (absolute)
Time Period
2020-10-26
2020-10-27
2020-10-28
2020-10-29
2020-10-30
2020-10-31
2020-11-01
2020-11-02
2020-11-03
2020-11-04
Boycott Against France (7 agents)
Boycott Against France (9 agents)
Boycott France Movement (6 agents)
Charlie Hebdo Incident (16 agents)
France and Related Concepts (19 agents)
France and Related Topics (6 agents)
France Boycott and Terrorism Response (14 agents)
France Boycott Concepts (7 agents)
France Boycott Movement (12 agents)
France Overview (15 agents)
French Product Boycott (47 agents)
French Products Overview (6 agents)
Protests and Boycotts (6 agents)
Sondakika24 Overview (16 agents)
Explain Fraction
Distort Fraction
Explain Count
Distort Count


EXCITE/DISMAY Effects Through Time
Average EXCITE/DISMAY Delta
Maneuver Ratio (proportion of total)
Maneuver Count (absolute)
Time Period
2020-10-26
2020-10-27
2020-10-28
2020-10-29
2020-10-30
2020-10-31
2020-11-01
2020-11-02
2020-11-03
2020-11-04
Boycott Against France (7 agents)
Boycott Against France (9 agents)
Boycott France Movement (6 agents)
Charlie Hebdo Incident (16 agents)
France and Related Concepts (19 agents)
France and Related Topics (6 agents)
France Boycott and Terrorism Response (14 agents)
France Boycott Concepts (7 agents)
France Boycott Movement (12 agents)
France Overview (15 agents)
French Product Boycott (47 agents)
French Products Overview (6 agents)
Protests and Boycotts (6 agents)
Sondakika24 Overview (16 agents)
Excite Fraction
Dismay Fraction
Excite Count
Dismay Count

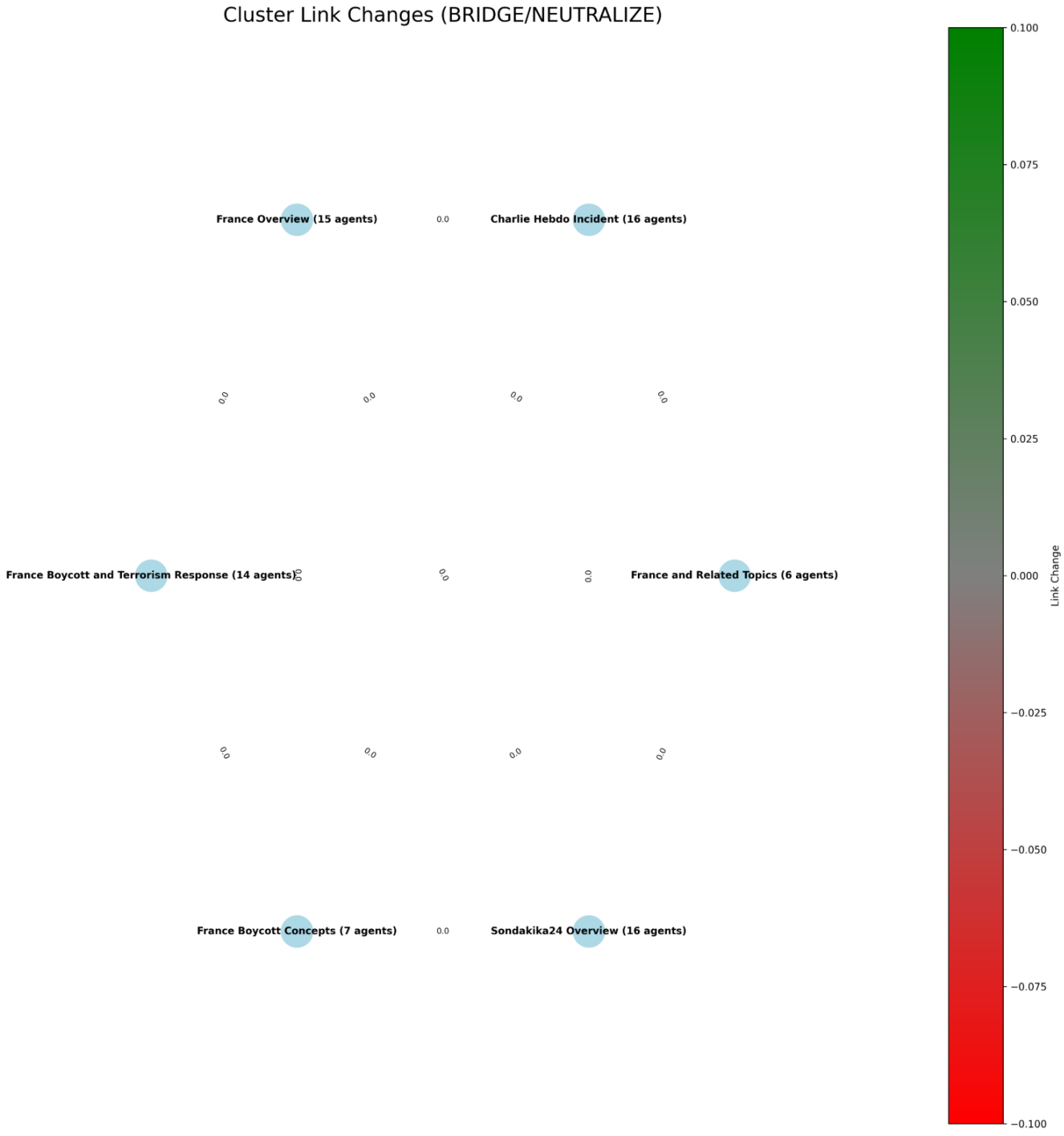

BOOST/NEGLECT Effects Through Time
Average BOOST/NEGLECT Delta
Maneuver Ratio (proportion of total)
Maneuver Count (absolute)
Time Period
2020-10-26
2020-10-27
2020-10-28
2020-10-29
2020-10-30
2020-10-31
2020-11-01
2020-11-02
2020-11-03
2020-11-04
Boycott Against France (7 agents)
Boycott Against France (9 agents)
Boycott France Movement (6 agents)
Charlie Hebdo Incident (16 agents)
France and Related Concepts (19 agents)
France and Related Topics (6 agents)
France Boycott and Terrorism Response (14 agents)
France Boycott Concepts (7 agents)
France Boycott Movement (12 agents)
France Overview (15 agents)
French Product Boycott (47 agents)
French Products Overview (6 agents)
Protests and Boycotts (6 agents)
Sondakika24 Overview (16 agents)
Boost Fraction
Neglect Fraction
Boost Count
Neglect Count


BUILD/NARROW Effects Over Time
Clusters
Communities
Boycott Against France (7 agents)
Boycott Against France (9 agents)
Boycott France Movement (6 agents)
Charlie Hebdo Incident (16 agents)
France Boycott Concepts (7 agents)
France Boycott Movement (12 agents)
France Boycott and Terrorism Response (14 agents)
France Overview (15 agents)
France and Related Concepts (19 agents)
France and Related Topics (6 agents)
French Product Boycott (47 agents)
French Products Overview (6 agents)
Protests and Boycotts (6 agents)
Sondakika24 Overview (16 agents)

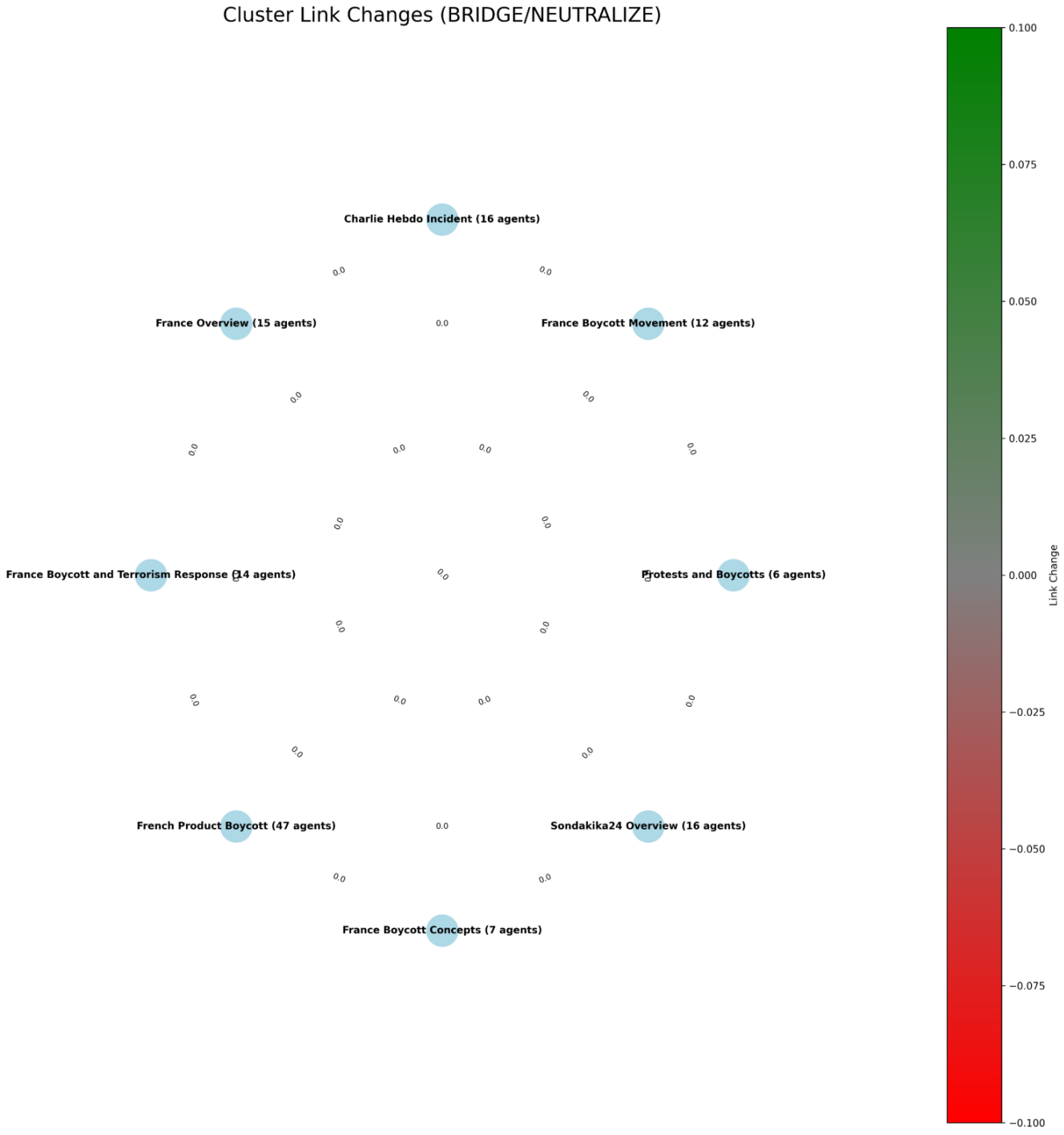
2020-10-27


Cluster Link Changes (BRIDGE/NEUTRALIZE)
France Boycott and Terrorism Response (14 agents)
Charlie Hebdo Incident (16 agents)
France and Related Topics (6 agents)
0.0
0.0
0.0
Link Change
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100

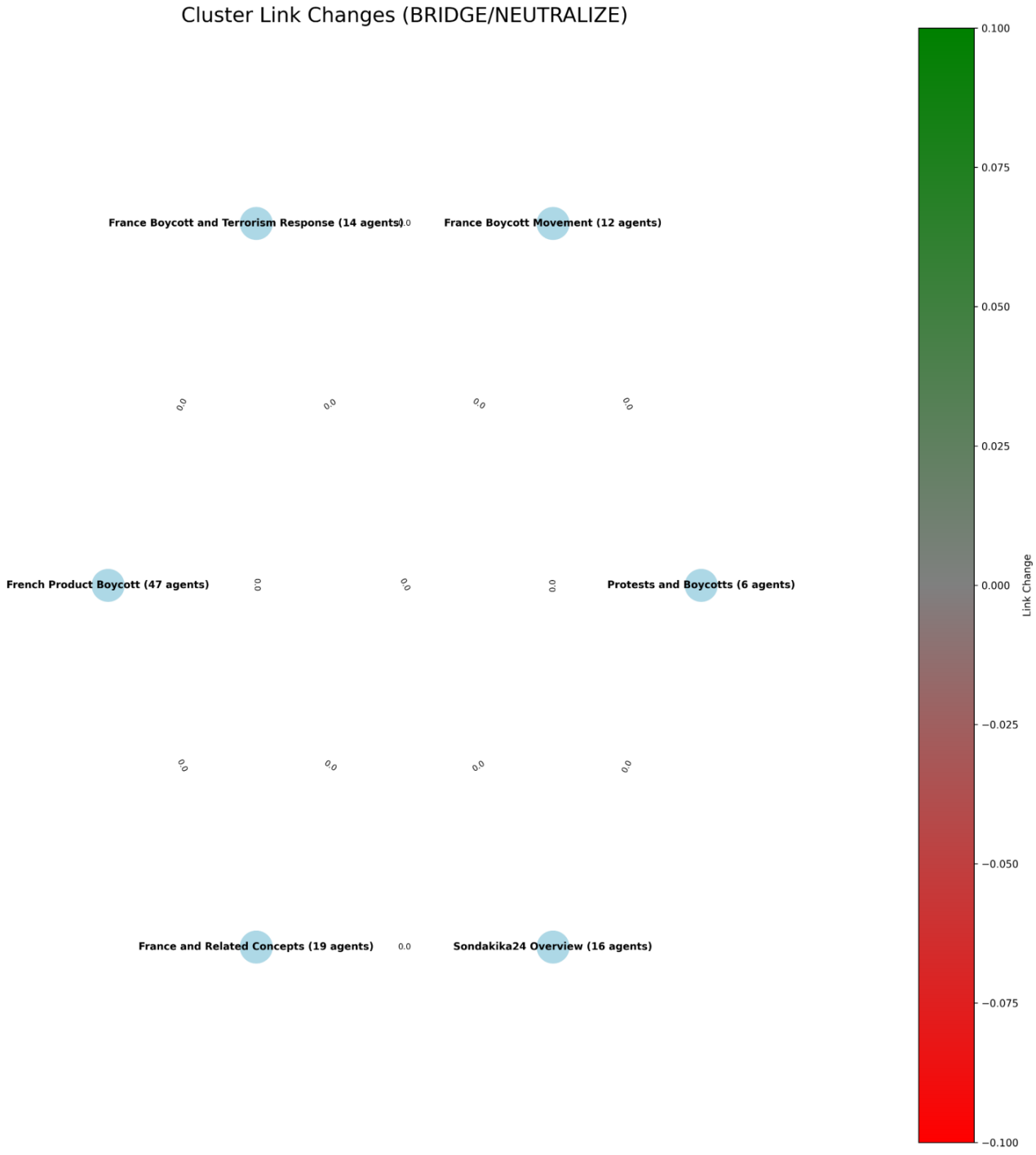
2020-10-28


Cluster Link Changes (BRIDGE/NEUTRALIZE)
France Overview (15 agents)
Charlie Hebdo Incident (16 agents)
France Boycott and Terrorism Response (14 agents)
France and Related Topics (6 agents)
France Boycott Concepts (7 agents)
Sondakika24 Overview (16 agents)
0.0
Link Change
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100

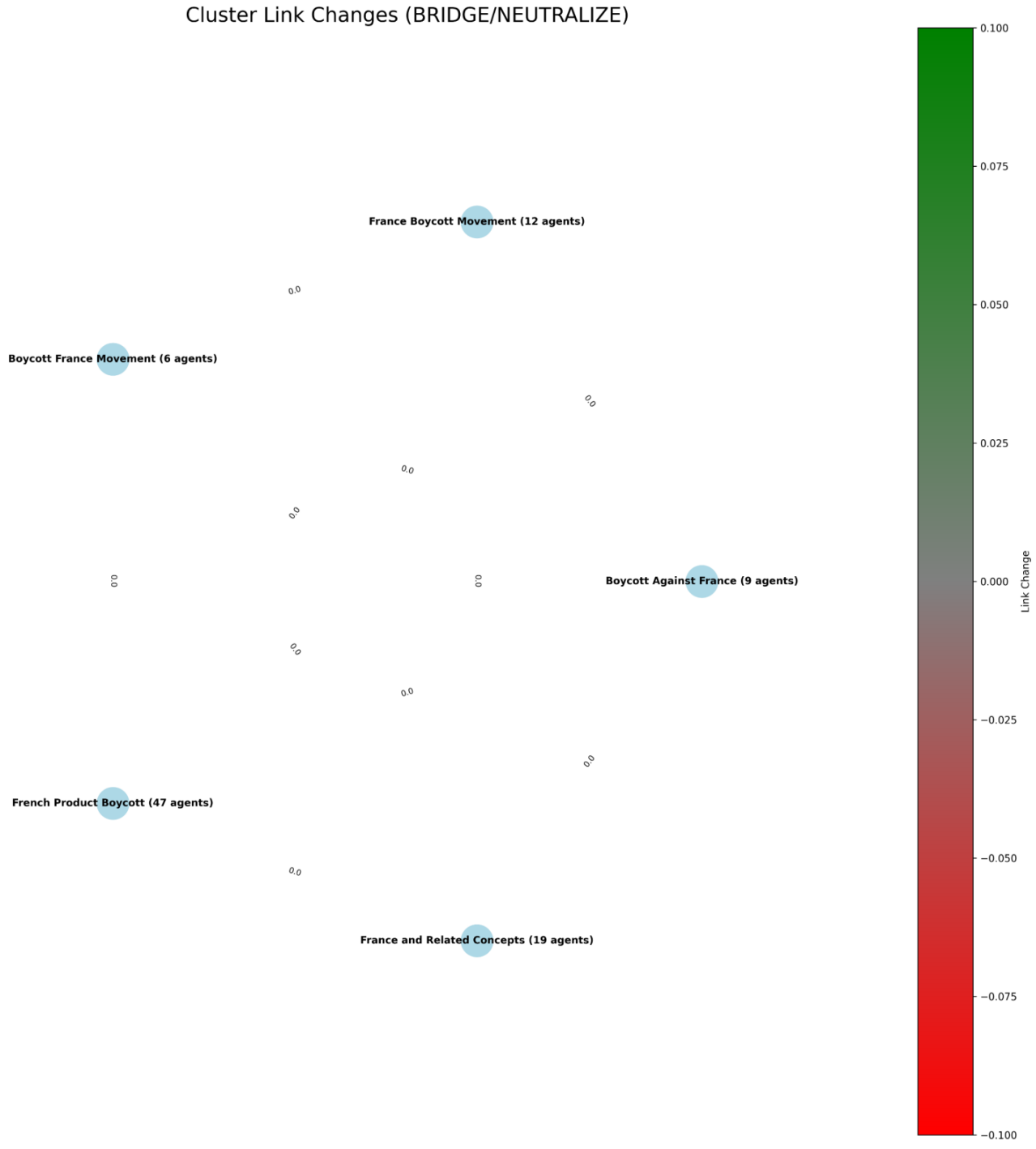
2020-10-29


Cluster Link Changes (BRIDGE/NEUTRALIZE)
Charlie Hebdo Incident (16 agents)
France Overview (15 agents)
France Boycott Movement (12 agents)
France Boycott and Terrorism Response (14 agents)
Protests and Boycotts (6 agents)
French Product Boycott (47 agents)
Sondakika24 Overview (16 agents)
France Boycott Concepts (7 agents)
Link Change
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100

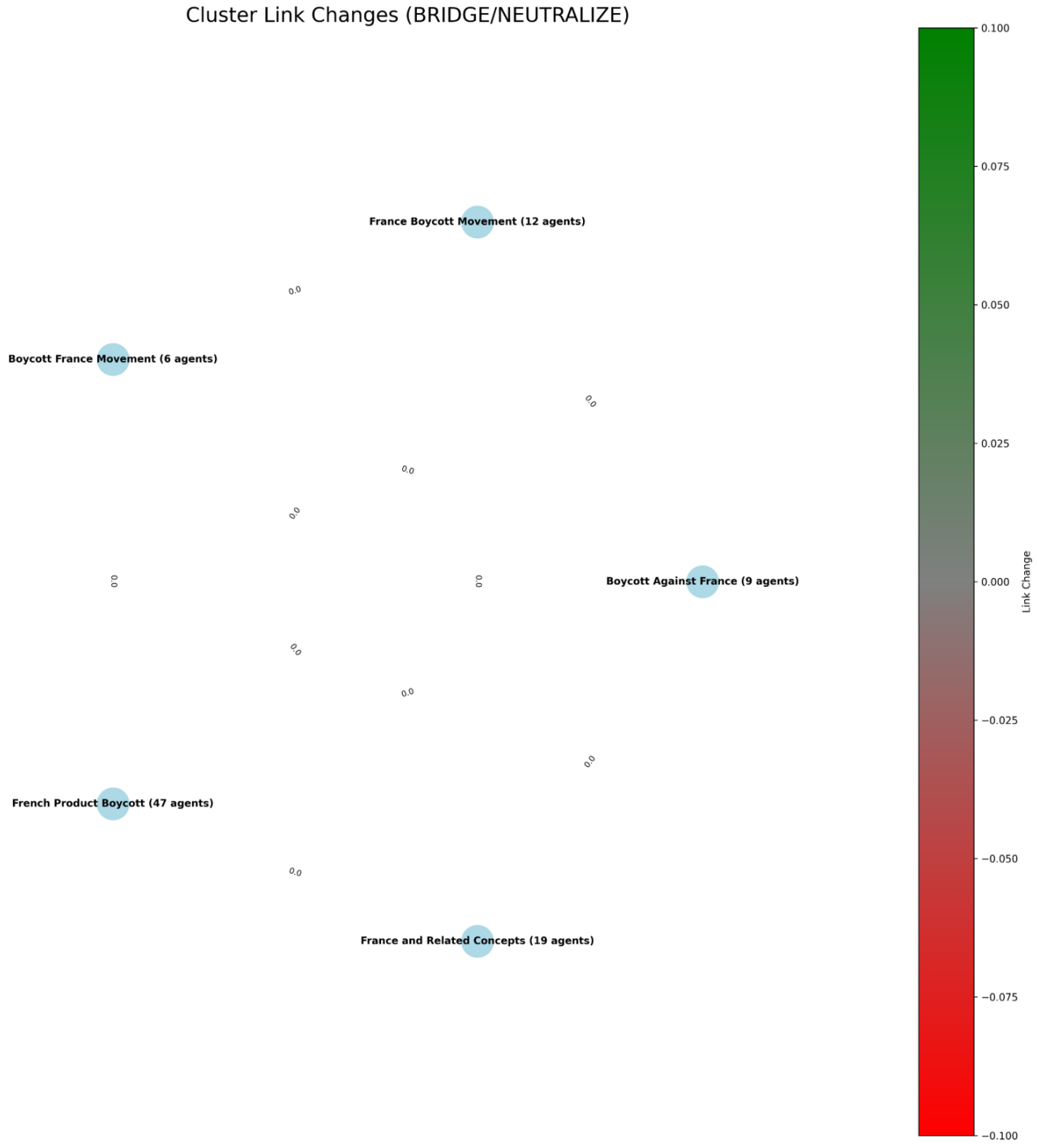
2020-10-30


Cluster Link Changes (BRIDGE/NEUTRALIZE)
France Boycott and Terrorism Response (14 agents)
France Boycott Movement (12 agents)
French Product Boycott (47 agents)
Protests and Boycotts (6 agents)
France and Related Concepts (19 agents)
Sondakika24 Overview (16 agents)
0.0
Link Change
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100

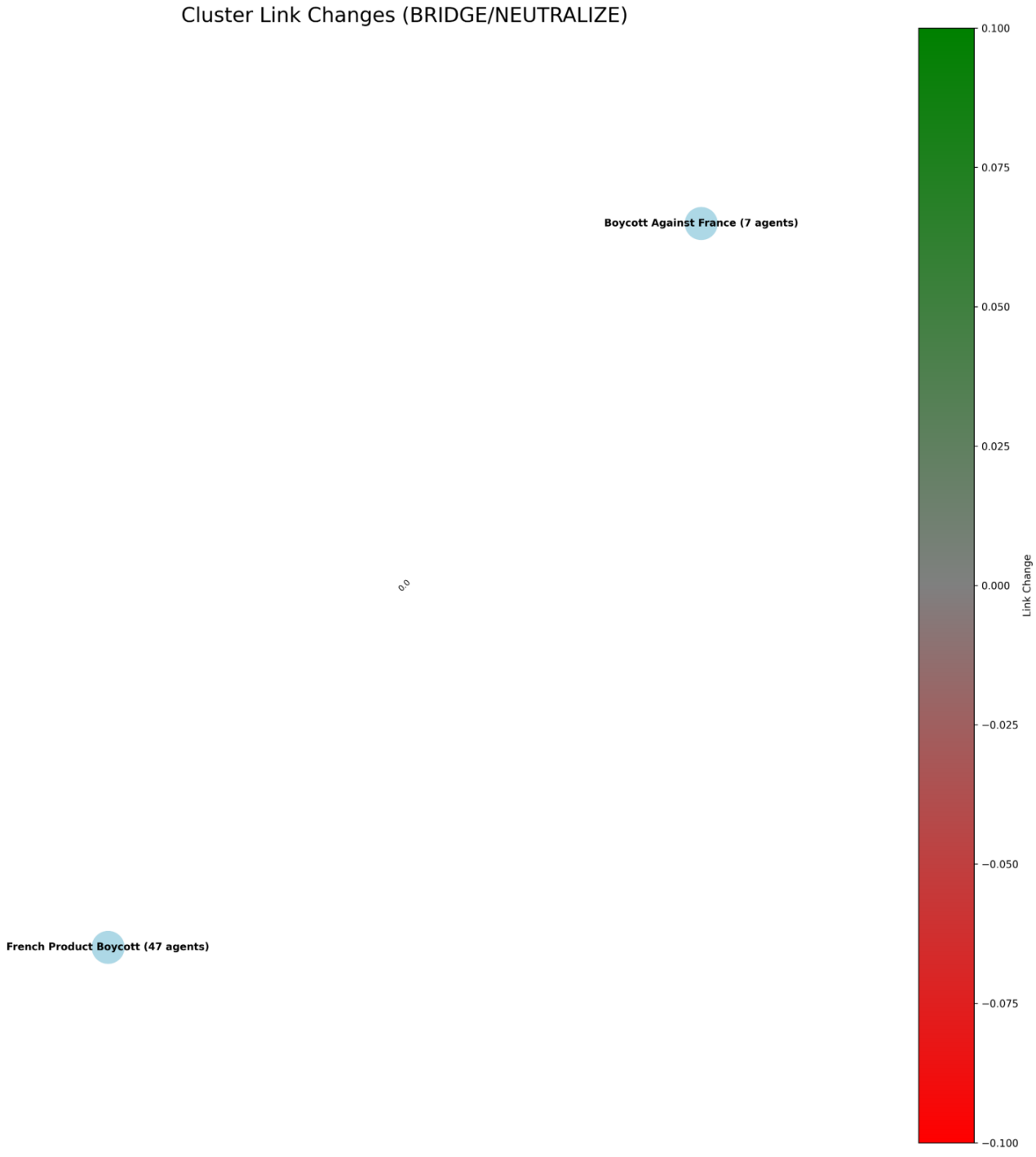
2020-10-31


Cluster Link Changes (BRIDGE/NEUTRALIZE)
France Boycott Movement (12 agents)
Boycott France Movement (6 agents)
Boycott Against France (9 agents)
French Product Boycott (47 agents)
France and Related Concepts (19 agents)
0.0
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100
Link Change

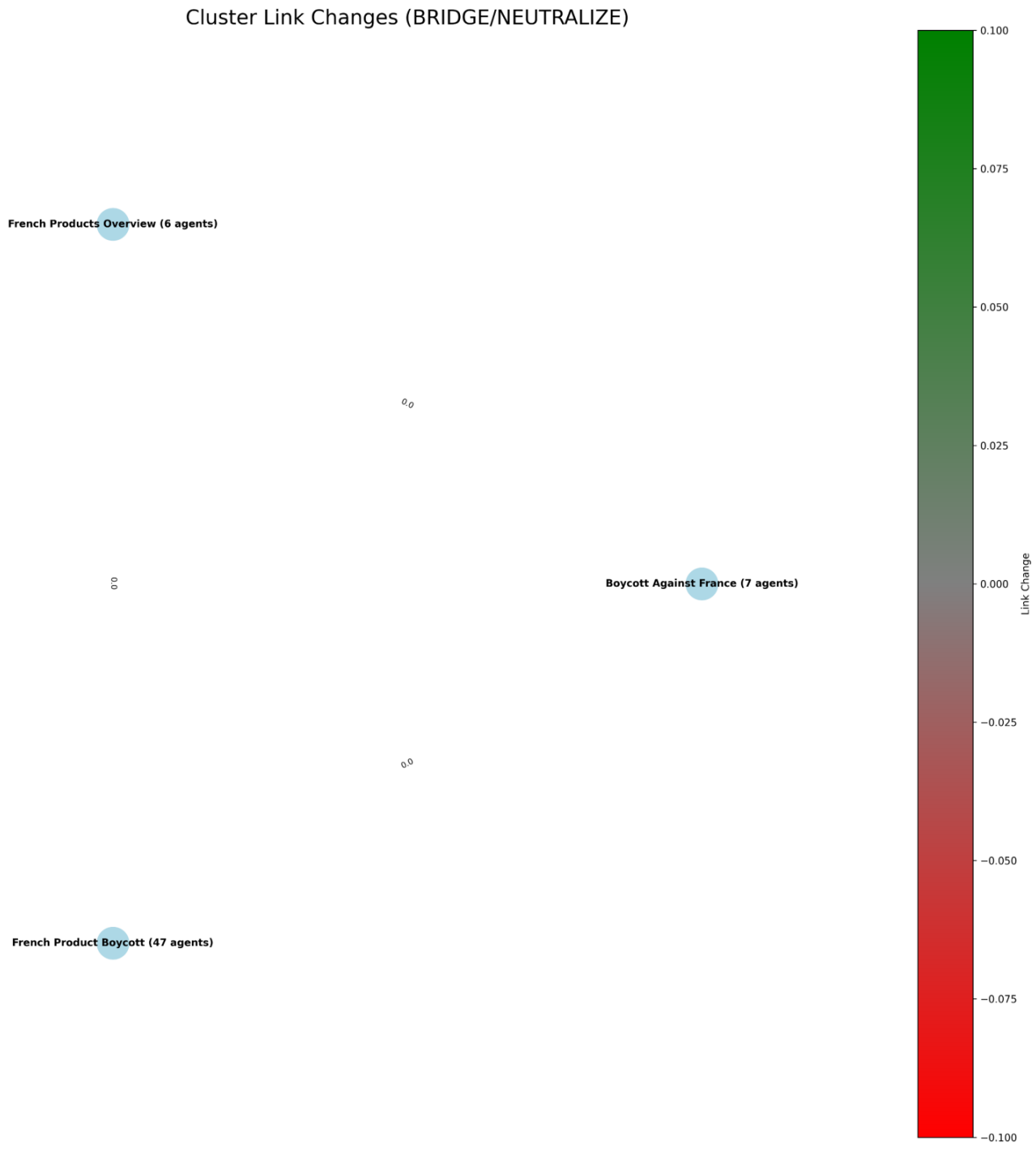
2020-11-01


Cluster Link Changes (BRIDGE/NEUTRALIZE)
France Boycott Movement (12 agents)
Boycott France Movement (6 agents)
Boycott Against France (9 agents)
French Product Boycott (47 agents)
France and Related Concepts (19 agents)
0.0
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100
Link Change

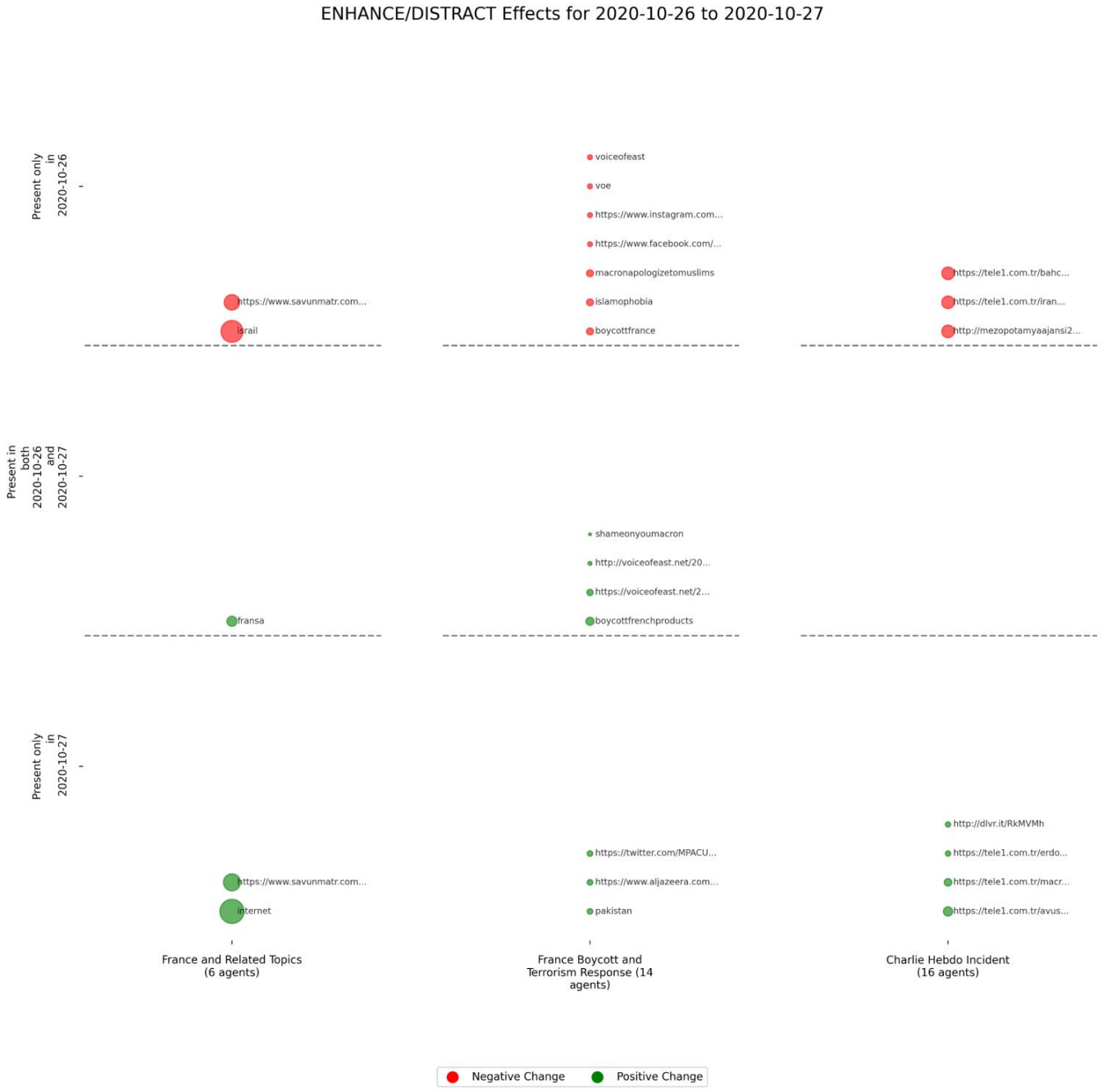
2020-11-02


Cluster Link Changes (BRIDGE/NEUTRALIZE)
Boycott Against France (7 agents)
0.0
French Product Boycott (47 agents)
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100
Link Change

2020-11-03



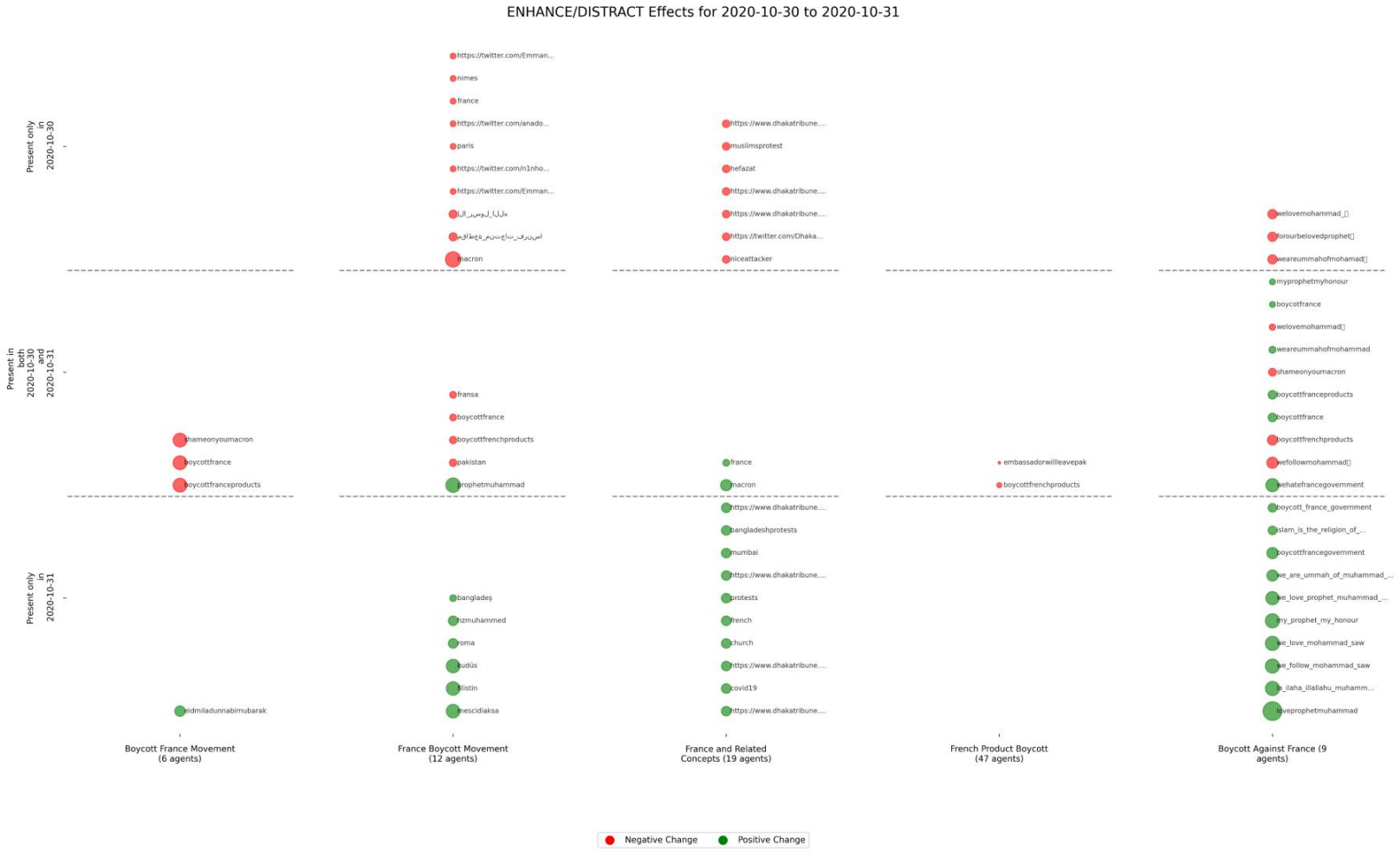
2020-11-04 is blank

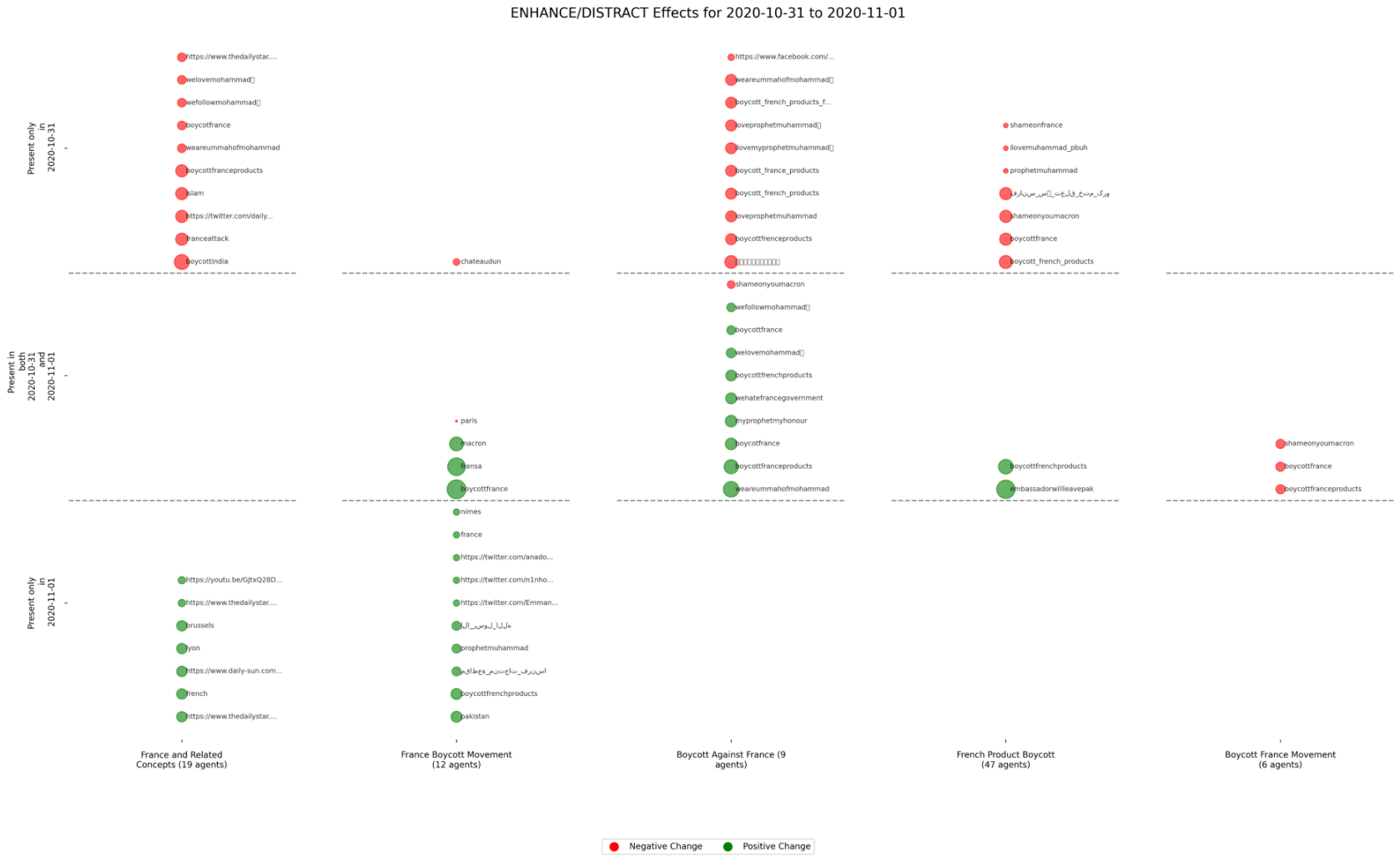

ENHANCE/DISTRACT Effects for 2020-10-26 to 2020-10-27
Present only in 2020-10-26
Present in both 2020-10-26 and 2020-10-27
Present only in 2020-10-27
https://www.savunmatr.com...
israil
voiceofeast
voe
https://www.instagram.com...
https://www.facebook.com/...
macronapologizetomuslims
islamophobia
boycottfrance
https://tele1.com.tr/bahc...
https://tele1.com.tr/iran...
http://mezopotamyaajansi2...
fransa
shameonyoumacron
http://voiceofeast.net/20...
https://voiceofeast.net/2...
boycottfrenchproducts
https://www.savunmatr.com...
internet
https://twitter.com/MPACU...
https://www.aljazeera.com...
pakistan
http://dlvr.it/RkMVMh
https://tele1.com.tr/erdo...
https://tele1.com.tr/macr...
https://tele1.com.tr/avus...
France and Related Topics (6 agents)
France Boycott and Terrorism Response (14 agents)
Charlie Hebdo Incident (16 agents)
Negative Change
Positive Change


ENHANCE/DISTRACT Effects for 2020-10-27 to 2020-10-28
Present only in 2020-10-27
Present in both 2020-10-27 and 2020-10-28
Present only in 2020-10-28
https://www.istiklal.com....
https://bityl.co/4CXU
https://www.istiklal.com....
bangladesh
https://twitter.com/cjwer...
https://www.theguardian.c...
https://reut.rs/3dUioWC
turkey
muslims
iran
islam
america
boycottfrenchproduct
https://www.savunmatr.com...
charliehebdo
https://www.facebook.com/...
https://www.instagram.com...
persian
allamaiqbal
poetry
https://www.sondakika-24....
https://www.haberbuldum.c...
https://www.haberbuldum.c...
https://www.sondakika-24....
https://www.sondakika-24....
https://www.sondakika-24....
http://mezopotamyaajansi2...
http://tele1.com.tr/erdog...
https://tele1.com.tr/kara...
https://tele1.com.tr/erdo...
http://mezopotamyaajansi2...
https://tele1.com.tr/cann...
https://tele1.com.tr/char...
http://mezopotamyaajansi2...
https://tele1.com.tr/erdo...
charliehebdo
islamophobia
whitemedia
boycottfrance
boycottfrenchproducts
macron
madmacron
culturalnazis
france
boycottfrenchproducts
boycottfrance
sondakika24
https://www.thetimes.co.u...
saudiarabia
https://twitter.com/gulf_...
https://f24.my/70wq.t
https://twitter.com/AJEng...
freedomofspeech
https://gn24.ae/ab18e2cee...
antisemitism
https://www.aljazeera.com...
boycottindia
https://www.savunmatr.com...
hamsa
israil
voiceofeast
https://voiceofeast.net/2...
voe
shameonyoumacron
https://www.instagram.com...
https://www.facebook.com/...
macronapologizetomuslims
http://voiceofeast.net/20...
islamophobia
https://www.haberbuldum.c...
https://www.sondakika-24....
https://tele1.com.tr/bahc...
https://tele1.com.tr/iran...
http://mezopotamyaajansi2...
France Overview (15 agents)
France Boycott Concepts (7 agents)
France and Related Topics (6 agents)
France Boycott and Terrorism Response (14 agents)
Sondakika24 Overview (16 agents)
Charlie Hebdo Incident (16 agents)
Negative Change
Positive Change


ENHANCE/DISTRACT Effects for 2020-10-28 to 2020-10-29
Present only in 2020-10-28
Present in both 2020-10-28 and 2020-10-29
Present only in 2020-10-29
charliehebdo
https://twitter.com/asian...
https://www.istiklal.com...
france
https://www.istiklal.com...
https://www.istiklal.com...
https://twitter.com/freeb...
https://en.yabiladi.com/a...
https://twitter.com/Sahar...
https://twitter.com/Reute...
https://ojo.is/kqtby9
sheikhhasina
https://twitter.com/busin...
boycottfrenchproducts
freedomofspeech
charliehebdo
neptunsoyer
macron
https://twitter.com/gohar...
iuvevyt
paris
pakistan
pamefour
pamefourboykot
boycottfrenchproduct
macronapologizetomuslims
https://twitter.com/nfdtv/...
macron
france
francesshameonyou
macronthedevil
macronpsycho
pentest
pyprophethmyhonor
https://www.sondakika-24...
macronsayssorrytomuslims
shameonyousmacron
boycott_french_products
boycottfrance
frenchpresident
boycott_french_products
pranceterrorattack
https://tele1.com.tr/fran...
turkey
madmacron
boycottfrenchproducts
culturalnazis
boycottfrenchproduct
boycottfrance
france
boycottfrenchproducts
boycottfrance
france
weloveyouhammad
boycottfrance
boycottfrenchproducts
pyprophethmyhonour
protestagainstfrance
macronisanenemad
bangladesh
sondakika24
boycottfrenchproducts
embassadorwillleavepak
bangladesh
https://twitter.com/cjwer...
https://www.theguardian.c...
https://mol.rs/8dUwWC
muslims
iran
whitemedia
https://www.istiklal.com...
islam
https://bityl.co/4CXU
america
https://www.istiklal.com...
macron
fransaboykot
https://www.ahaber.com.tr...
moritanya
france
aktaysinanoğlu
https://www.sondakika-24...
https://www.haberbuldum.c...
https://www.haberbuldum.c...
freedomofspeech
espect
macronneedstreatment
pakistan
https://www.sondakika-24...
https://www.sondakika-24...
https://www.sondakika-24...
saudiarabia
respectmuhammad
https://twitter.com/Shubb...
kickoutfrenchambassador
https://www.khaleejtimes....
prophetmuhammad
cartoons
https://www.facebook.com/...
https://www.instagram.com...
persian
allamaiqbal
poetry
boycottfrenchproducts
boycottfrance
http://tele1.com.tr/cenbog...
https://tele1.com.tr/kara...
https://tele1.com.tr/cenbo...
http://mezopotamyaajansi2...
http://mezopotamyaajansi2...
https://tele1.com.tr/cann...
https://tele1.com.tr/char...
http://mezopotamyaajansi2...
https://tele1.com.tr/cenbo...
charliehebdo
France Overview (15 agents)
France Boycott Concepts (7 agents)
France Boycott Movement (12 agents)
Protests and Boycotts (6 agents)
Sondakika24 Overview (16 agents)
French Product Boycott (47 agents)
France Boycott and Terrorism Response (14 agents)
Charlie Hebdo Incident (16 agents)
Negative Change
Positive Change

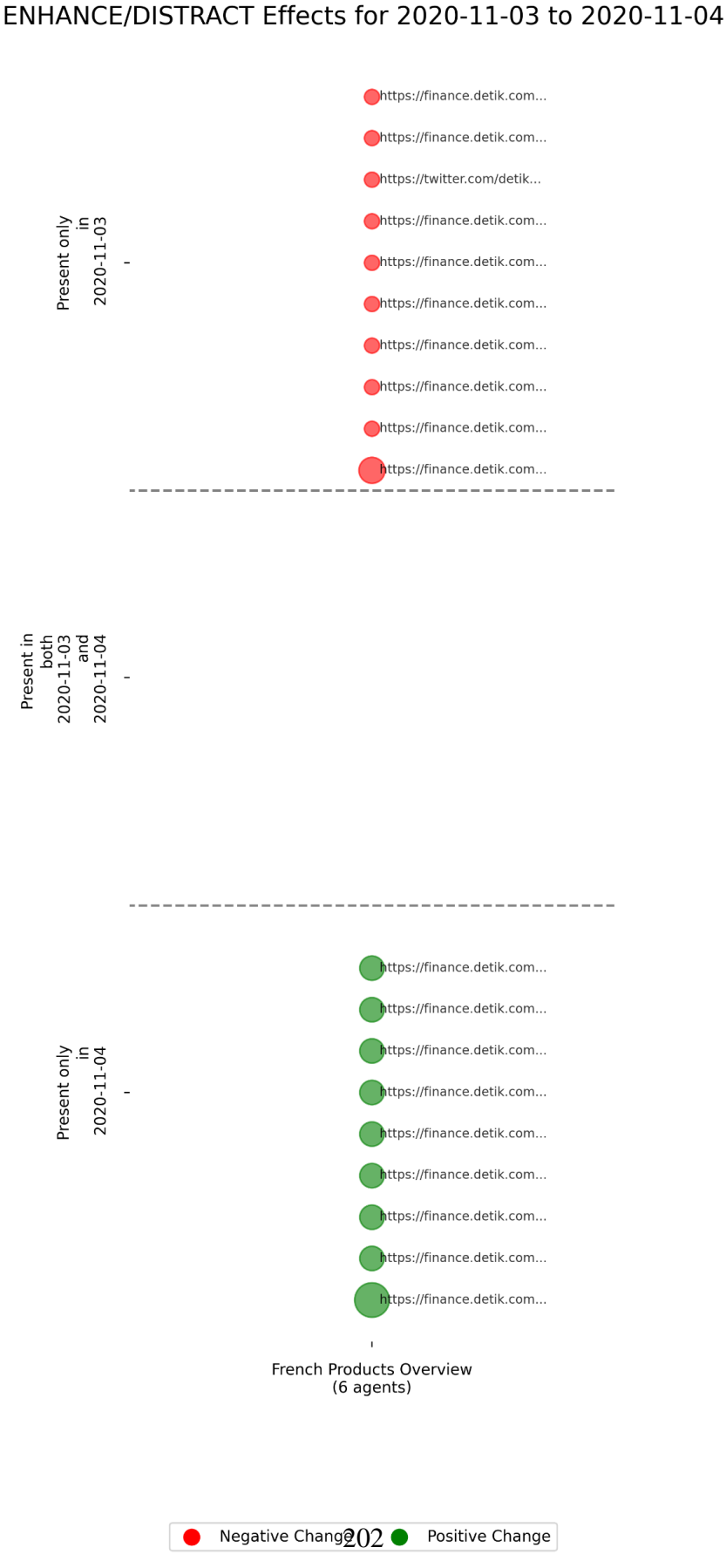

ENHANCE/DISTRACT Effects for 2020-10-29 to 2020-10-30
Present only in 2020-10-29
Present in both 2020-10-29 and 2020-10-30
Present only in 2020-10-30
france
voiceofeast
voe
eidmiladunnabimubarak
jummahmubarak
niceterrorattack
https://english.alaraby.c...
daroodsharif
macron
avignon
bangladeş
hzmuhammed
roma
quds
filistin
mescidiaksa
prophetmuhammad
https://www.thedailystar....
palestine
nice
https://www.pscp.tv/w/cmq...
bds
https://www.thedailystar....
israel
https://p.dw.com/p/3kd48
islamophobia
franceterrorattack
boycottfrenceproducts
weareummahofmuhammad
boycottfranceproducts
wehatefrancegovernment
welovemuhammad_
we_love_muhammad_,_challe...
wefollowmuhammad_
weloveislam
getoutfrenchambassador
loveprophetmuhammad
https://www.sondakika-24....
macronpsycho
protest
bangladesh
boycottfrance
boycottfrenchproducts
myprophetmyhonour
protestagainstfrance
myprophetmyhonor
macrongonemad
welovemuhammad
sondakika24
embassadorwilleavepak
boycottfrenchproducts
franceterrorattack
boycottfrance
pakistan
fransa
boycottfrenchproducts
macron
germany
bangladesh
france
neptünsoyer
macron
https://twitter.com/gohar...
kuveyt
paris
carrefour
carrefourboykot
iran
islam
covid19
https://www.dhakatribune....
https://www.dhakatribune....
zuchel
https://www.dhakatribune....
boycottfrenchproduct
macronapologizetomuslims
https://twitter.com/ndtv/...
macron
francesshameonyou
macronthedevil
https://www.sondakika-24....
macronsaysorrytomuslims
shameonyoumacron
boycott_french_products
boycottfrance
frenchpresident
boycott_french_products
French Product Boycott (47 agents)
France Boycott and Terrorism Response (14 agents)
France Boycott Movement (12 agents)
France and Related Concepts (19 agents)
Protests and Boycotts (6 agents)
Sondakika24 Overview (16 agents)
Negative Change
Positive Change

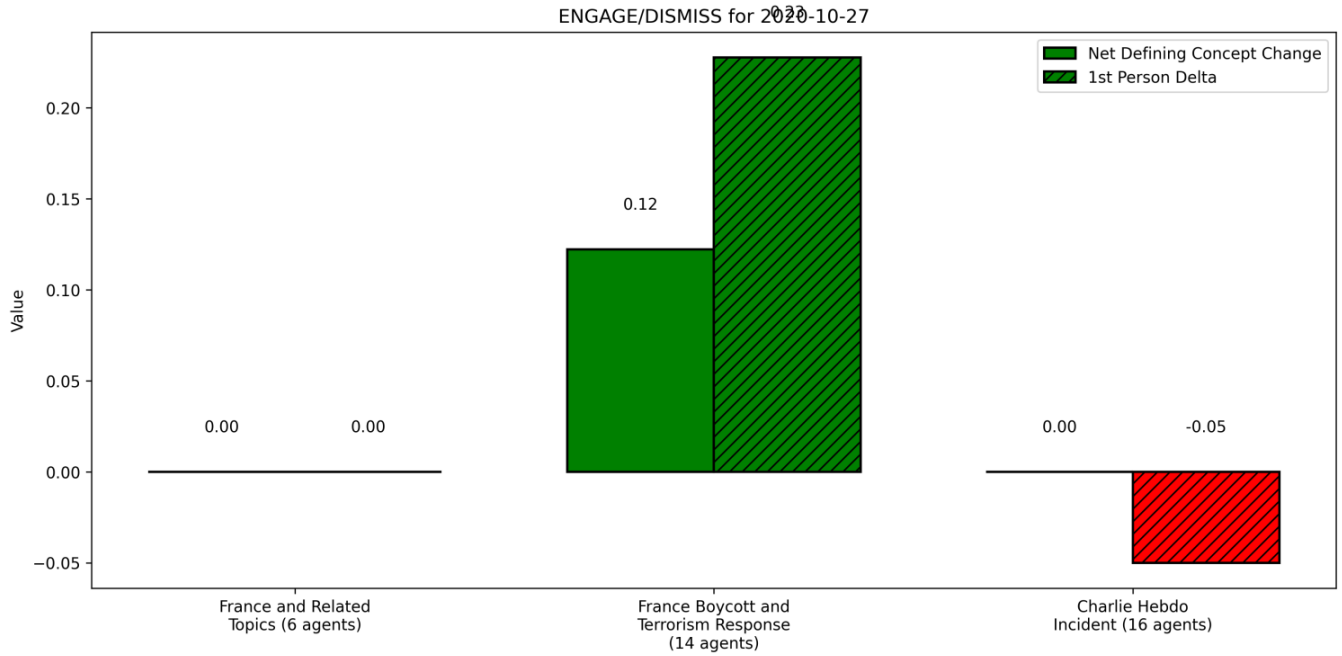

ENHANCE/DISTRACT Effects for 2020-10-30 to 2020-10-31
Present only in 2020-10-30
Present in both 2020-10-30 and 2020-10-31
Present only in 2020-10-31
https://twitter.com/Emman...
nimes
france
https://twitter.com/anado...
paris
https://twitter.com/n1nho...
https://twitter.com/Emman...
الا_رسول_لله
#مقاطعة_منتجات_فرنسا
macron
https://www.dhakatribune....
muslimsprotest
hefazat
https://www.dhakatribune....
https://www.dhakatribune....
https://twitter.com/Dhaka...
niceattacker
welovemohammad_
forourbelovedprophet
weareummahofmohamad
myprophetmyhonour
boycotfrance
welovemohammad
weareummahofmohammad
shameonyoumacron
boycottfranceproducts
boycottfrance
boycottfrenchproducts
wefollowmohammad
wehatefrancegovernment
boycott_france_government
islam_is_the_religion_of_...
boycottfrancegovernment
we_are_ummah_of_muhammad_...
we_love_prophet_muhammad_...
my_prophet_my_honour
we_love_mohammad_saw
we_follow_mohammad_saw
la_ilaha_illallahu_muhamm...
loveprophetmuhammad
fransa
boycottfrance
boycottfrenchproducts
pakistan
prophetmuhammad
shameonyoumacron
boycottfrance
boycottfranceproducts
france
macron
https://www.dhakatribune....
bangladeshprotests
mumbai
https://www.dhakatribune....
protests
french
church
https://www.dhakatribune....
covid19
https://www.dhakatribune....
embassadorwilleavepak
boycottfrenchproducts
banglades
nzmuhammed
roma
kudüs
filistin
mescidiaksa
eidmiladunnabimubarak
Boycott France Movement (6 agents)
France Boycott Movement (12 agents)
France and Related Concepts (19 agents)
French Product Boycott (47 agents)
Boycott Against France (9 agents)
Negative Change
Positive Change

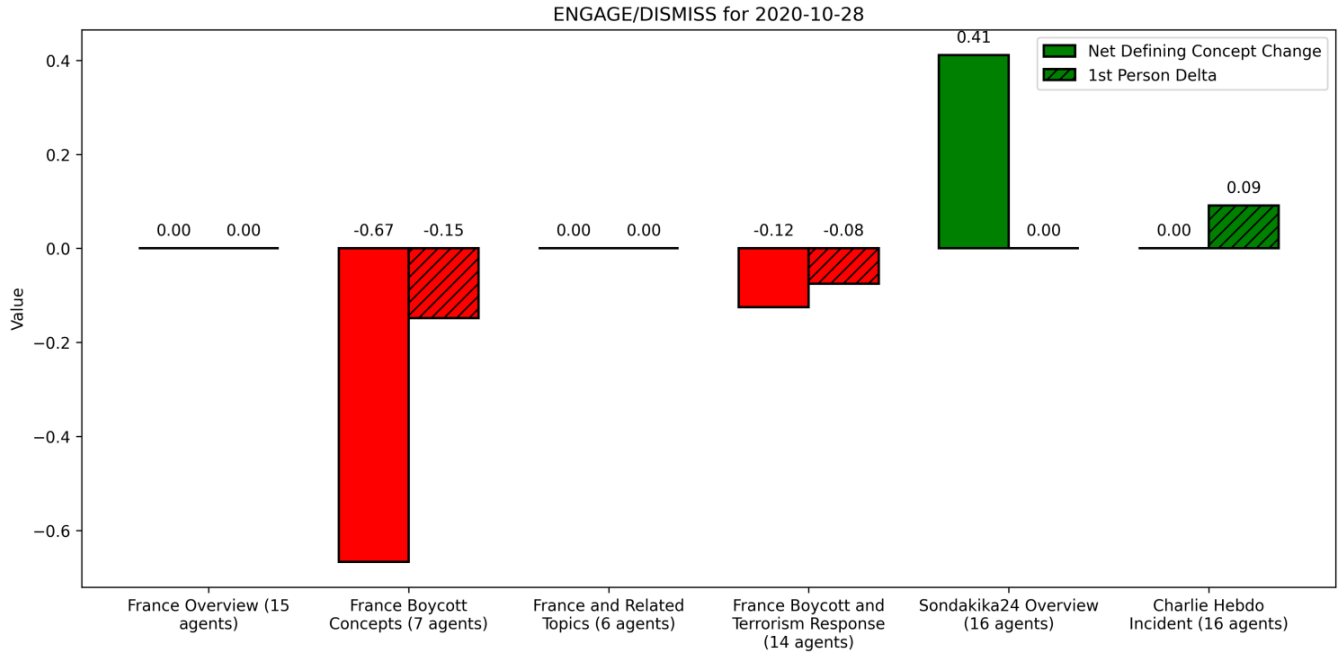

ENHANCE/DISTRACT Effects for 2020-10-31 to 2020-11-01
Present only in 2020-10-31
Present in both 2020-10-31 and 2020-11-01
Present only in 2020-11-01
https://www.thedailystar....
welovemohammad
wefollowmohammad
boycotfrance
weareummahofmohammad
boycottfranceproducts
islam
https://twitter.com/daily...
franceattack
boycottindia
chateaudun
https://www.facebook.com/...
weareummahofmohammad
boycott_french_products_f...
loveprophetmuhammad
ilovemyprophetmuhammad
boycott_france_products
boycott_french_products
loveprophetmuhammad
boycottfrenceproducts
shameonfrance
ilovemuhammad_pbuh
prophetmuhammad
boycottfrance
boycott_french_products
shameonyoumacron
wefollowmohammad
boycottfrance
welovemohammad
boycottfrenchproducts
wehatefrancegovernment
myprophetmyhonour
boycottfrance
boycottfranceproducts
weareummahofmohammad
paris
macron
fransa
boycottfrance
nimes
france
https://twitter.com/anado...
https://twitter.com/n1nho...
https://twitter.com/Emman...
prophetmuhammad
boycottfrenchproducts
pakistan
boycottfrenchproducts
embassadorwillleavepak
shameonyoumacron
boycottfrance
boycottfranceproducts
https://youtu.be/GJtxQ28D...
https://www.thedailystar....
brussels
lyon
https://www.daily-sun.com...
french
https://www.thedailystar....
France and Related Concepts (19 agents)
France Boycott Movement (12 agents)
Boycott Against France (9 agents)
French Product Boycott (47 agents)
Boycott France Movement (6 agents)
Negative Change
Positive Change

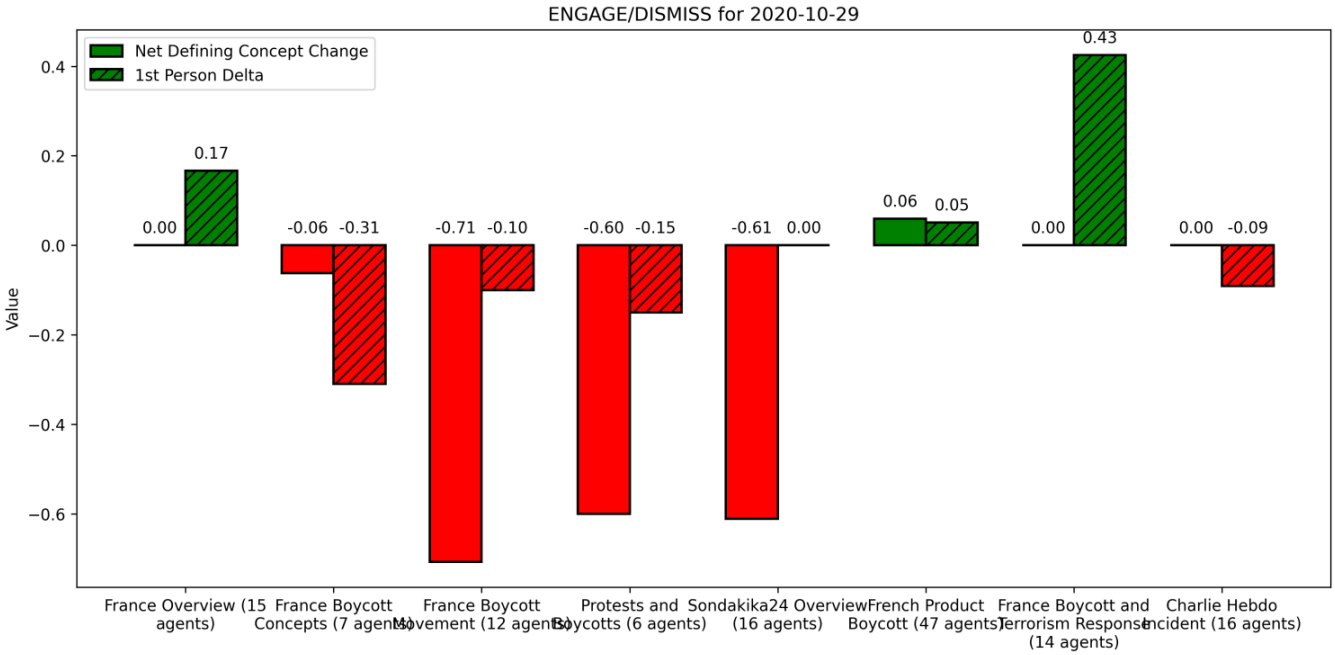

ENHANCE/DISTRACT Effects for 2020-11-01 to 2020-11-02
Present only in 2020-11-01
welovemuhammad
myprophetmyhonour
boycotfrance
wefollowmuhammad
alhamdulillah
loveprophetmuhammad
wefollowmuhammad
shameonpresidentoffrance
welovemuhammad
lailahaillallahumuhammadu...
https://twitter.com/Shubb...
Present in both 2020-11-01 and 2020-11-02
boycottfranceproducts
welovemuhammad_
boycottfrance
wehatefrancegovernment
boycottfrench
boycottfrenchproducts
boycott_france
boycott_french_products
boycottfrenchproducts
embassadorwillleavepak
Present only in 2020-11-02
liarmacron
boycottfrenchproductsfore...
we_hate_french_govornment
my_prophet_my_pride
the_dust_will_never_satte...
we_are_ummah_of_mohammad_
stop_islam_phobia_in_fran...
for_our_beloved_prophet
we_follow_mohammad_
we_love_mohammad_
shameonfrance
ilovemuhammad_pbuh
prophetmuhammad
فرانس_س_تعلق_ختم_کرو
shameonyoumacron
boycottfrance
boycott_french_products
Boycott Against France (7 agents)
French Product Boycott (47 agents)
Negative Change
Positive Change

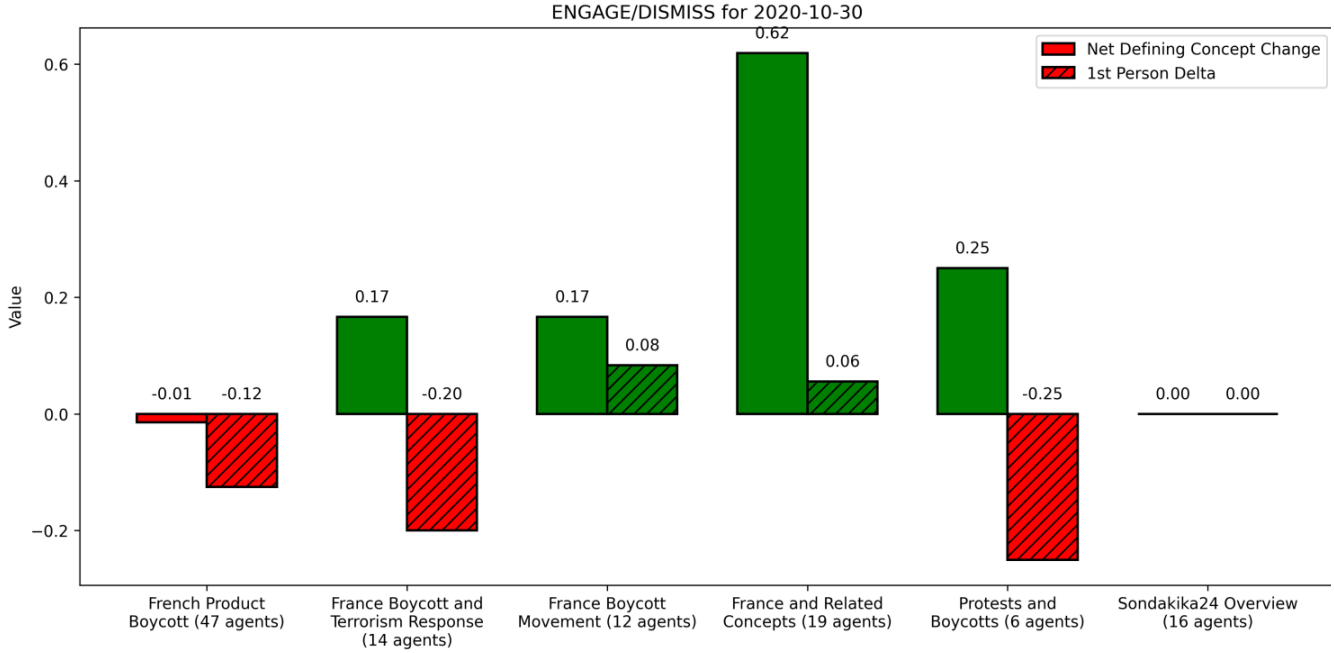

ENHANCE/DISTRACT Effects for 2020-11-02 to 2020-11-03
Present only in 2020-11-02
Present in both 2020-11-02 and 2020-11-03
Present only in 2020-11-03
shubban_khatm_e_nubuwat
pressclub
shameonyoumacron
boycott_french_products
lahore
boycottfrance
embassadorwillleavepak
boycottfrenchproducts
https://twitter.com/Shubb...
https://finance.detik.com...
aqua
prancis
danone
produkprancis
stopmacron
myprophetmyhonour
boycottfrenchproructs
macronbin
https://twitter.com/Samia...
welovemohammad
wefollowmohammad
myprophetmypride
weareummahofmohammad
boycottfrenchproduct
welovemuhammad_
wehatefrancegovernment
boycott_france
myprophetmyhonour
boycotfrance
loveprophetmuhammad
boycottfranceproducts
boycottfrench
macrobin
weareummahofmuhammad
welovemuhammad
wefollowmuhammad
alhamdulillah
allahuakbar
shameonpresidentoffrance
welovemuhammad
lailahaillallahumuhammadu...
French Product Boycott (47 agents)
French Products Overview (6 agents)
Boycott Against France (7 agents)
Negative Change
Positive Change

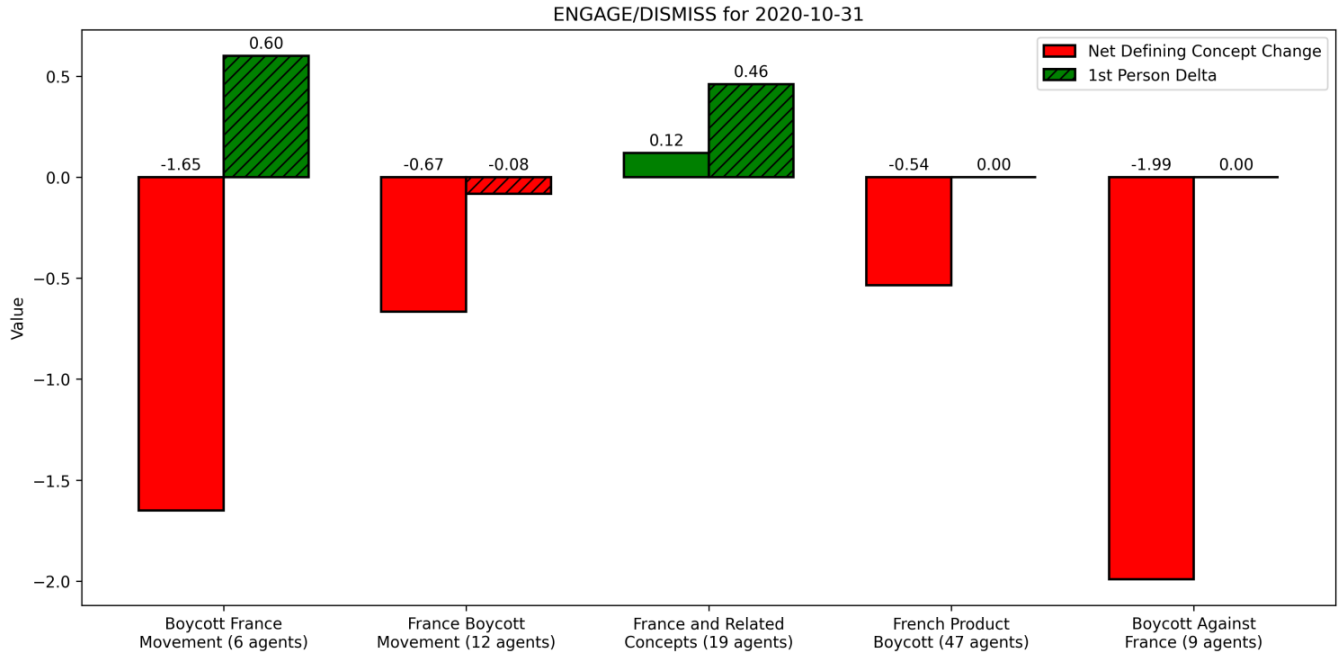

ENHANCE/DISTRACT Effects for 2020-11-03 to 2020-11-04
Present only in 2020-11-03
https://finance.detik.com...
https://finance.detik.com...
https://twitter.com/detik...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
Present in both 2020-11-03 and 2020-11-04
Present only in 2020-11-04
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
https://finance.detik.com...
French Products Overview
(6 agents)
Negative Change
Positive Change

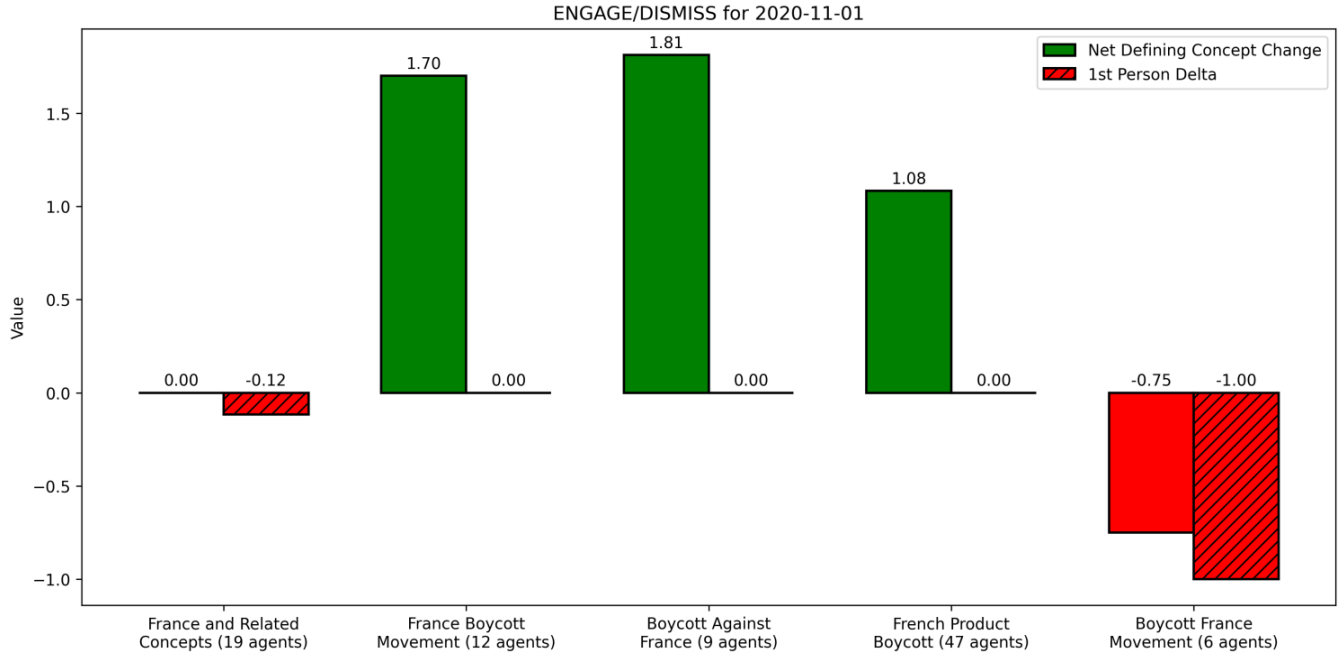

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Value
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0.10
0.05
0.00
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0.00
0.00
0.12
0.23
0.00
-0.05
France and Related Topics (6 agents)
France Boycott and Terrorism Response (14 agents)
Charlie Hebdo Incident (16 agents)

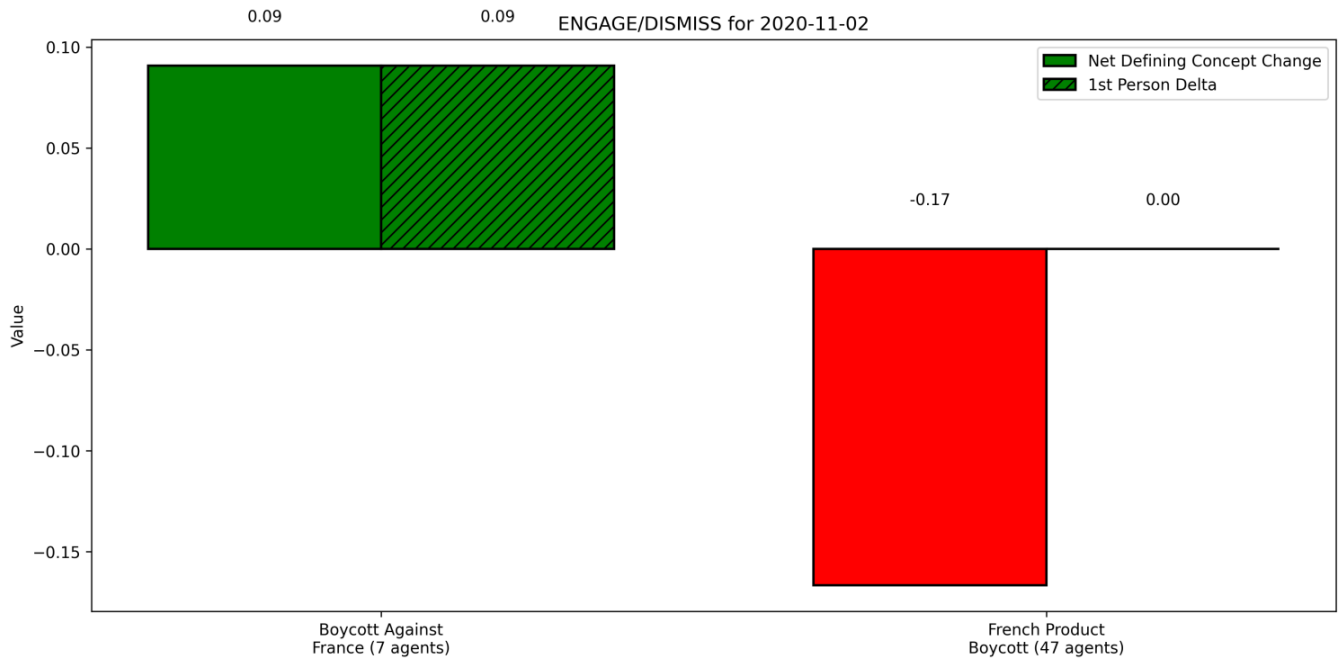

ENGAGE/DISMISS for 2020-10-28
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−0.4
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0.00
-0.67
-0.15
0.00
0.00
-0.12
-0.08
0.41
0.00
0.00
0.09
France Overview (15 agents)
France Boycott Concepts (7 agents)
France and Related Topics (6 agents)
France Boycott and Terrorism Response (14 agents)
Sondakika24 Overview (16 agents)
Charlie Hebdo Incident (16 agents)

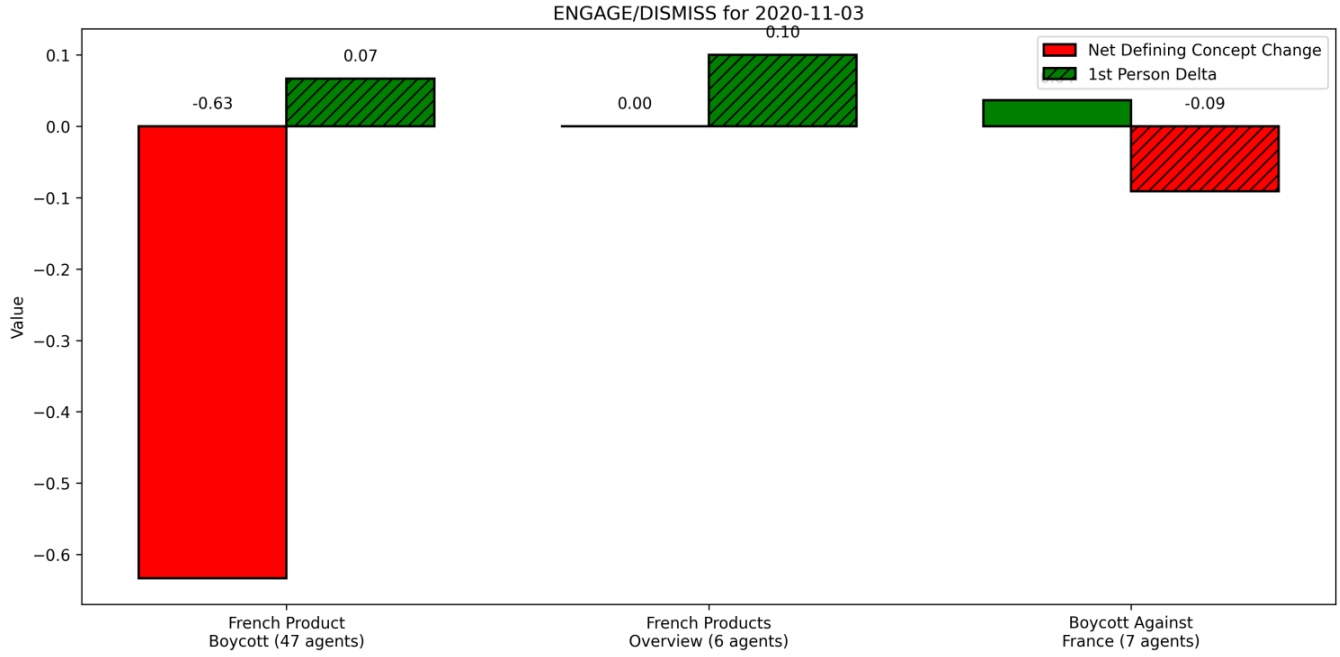

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1st Person Delta
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−0.2
−0.4
−0.6
0.00
0.17
-0.06
-0.31
-0.71
-0.10
-0.60
-0.15
-0.61
0.00
0.06
0.05
0.00
0.43
0.00
-0.09
France Overview (15 agents)
France Boycott Concepts (7 agents)
France Boycott Movement (12 agents)
Protests and Boycotts (6 agents)
Sondakika24 Overview (16 agents)
French Product Boycott (47 agents)
France Boycott and Terrorism Response (14 agents)
Charlie Hebdo Incident (16 agents)

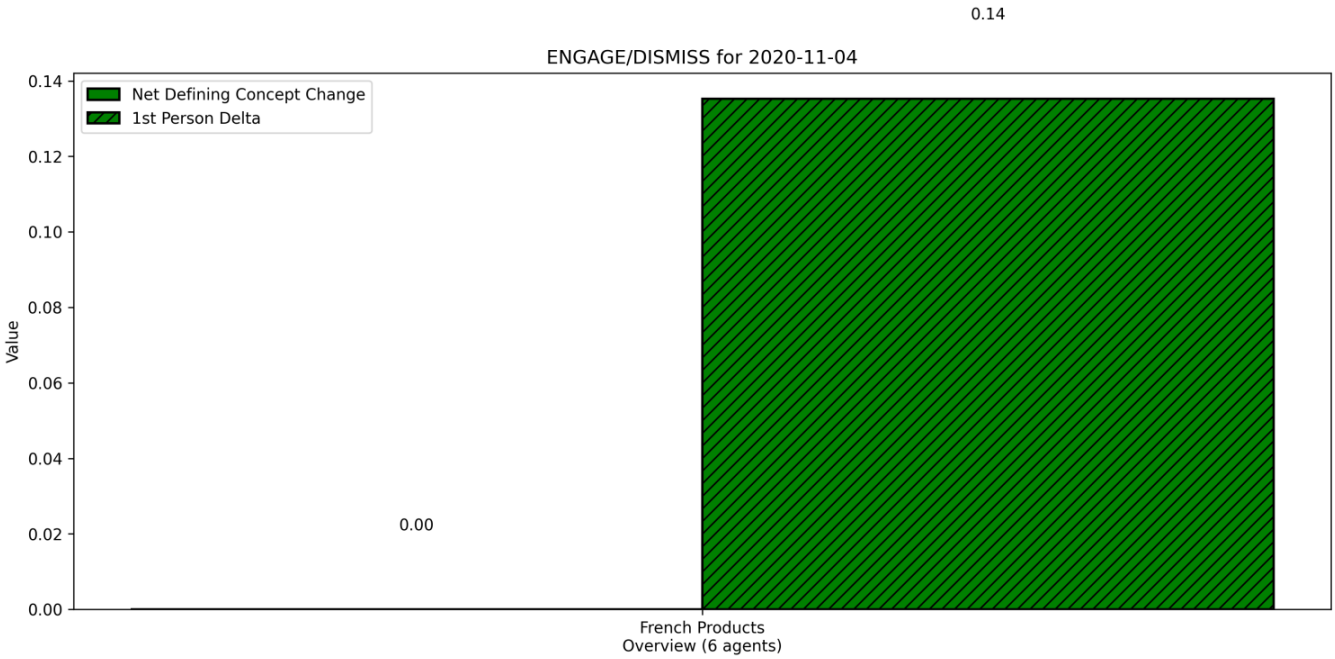

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0.0
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-0.01
-0.12
0.17
-0.20
0.17
0.08
0.62
0.06
0.25
-0.25
0.00
0.00
French Product Boycott (47 agents)
France Boycott and Terrorism Response (14 agents)
France Boycott Movement (12 agents)
France and Related Concepts (19 agents)
Protests and Boycotts (6 agents)
Sondakika24 Overview (16 agents)

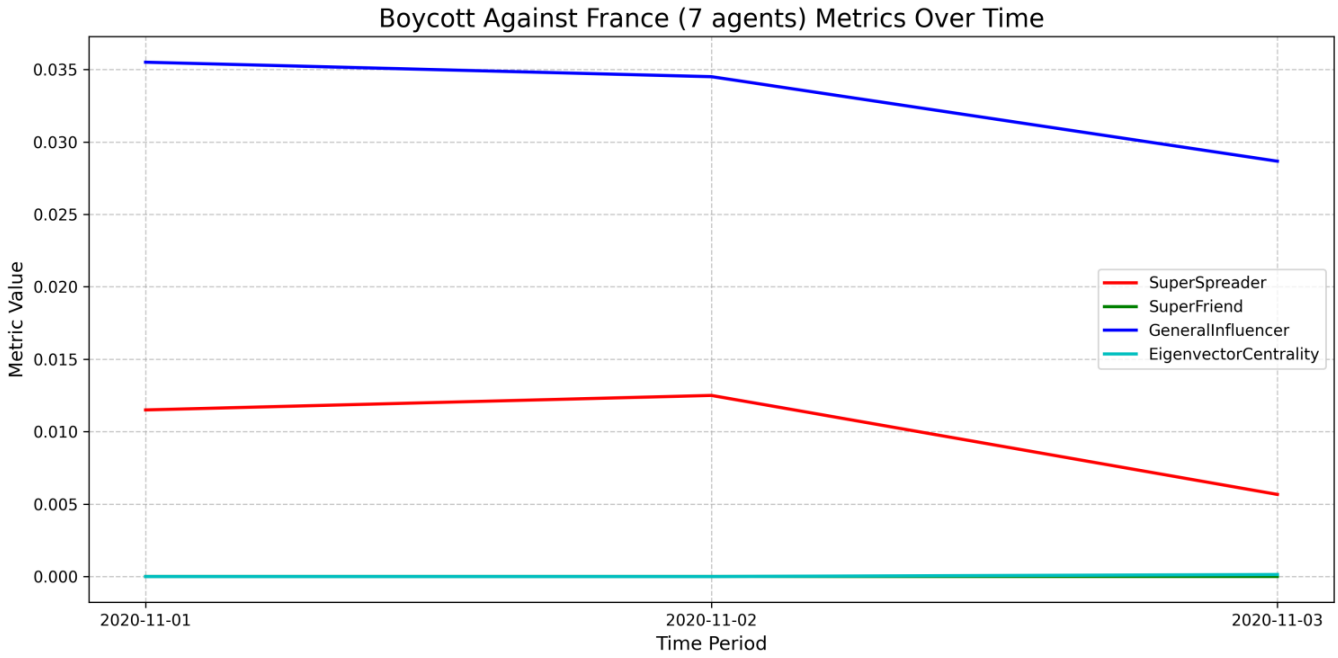

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−1.0
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-1.65
0.60
-0.67
-0.08
0.12
0.46
-0.54
0.00
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0.00
Boycott France Movement (6 agents)
France Boycott Movement (12 agents)
France and Related Concepts (19 agents)
French Product Boycott (47 agents)
Boycott Against France (9 agents)

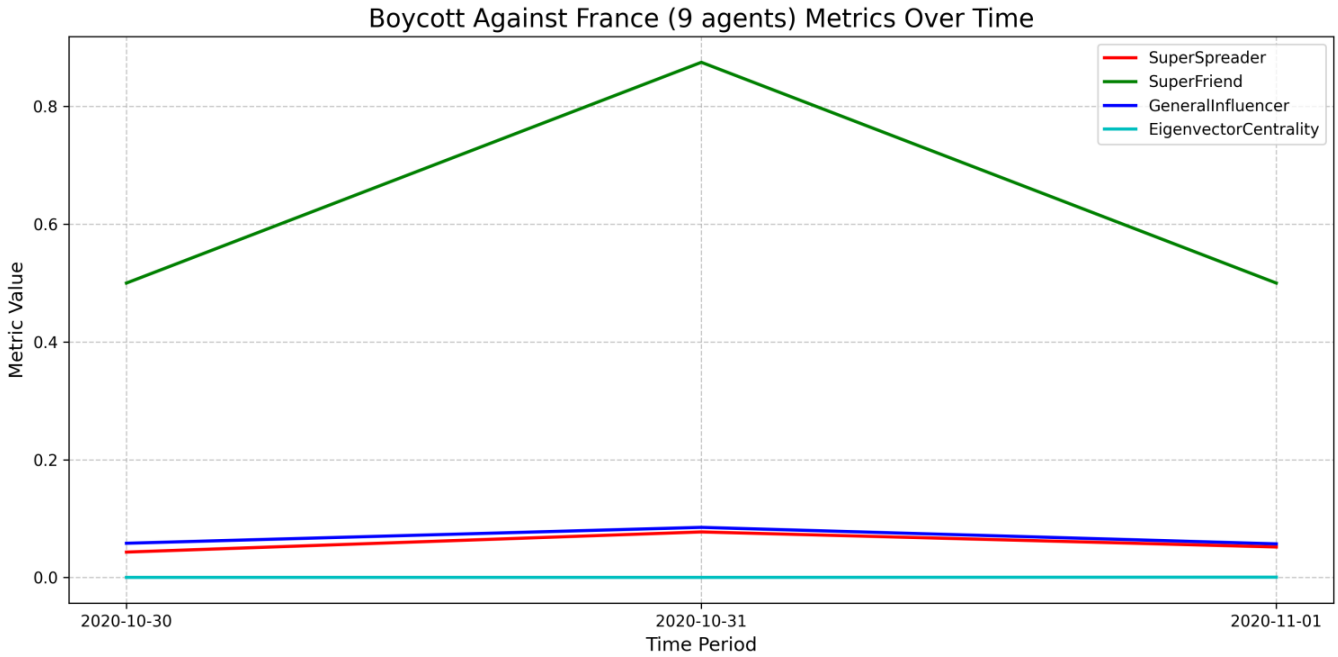

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Value
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−1.0
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-0.12
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0.00
1.81
0.00
1.08
0.00
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-1.00
France and Related Concepts (19 agents)
France Boycott Movement (12 agents)
Boycott Against France (9 agents)
French Product Boycott (47 agents)
Boycott France Movement (6 agents)

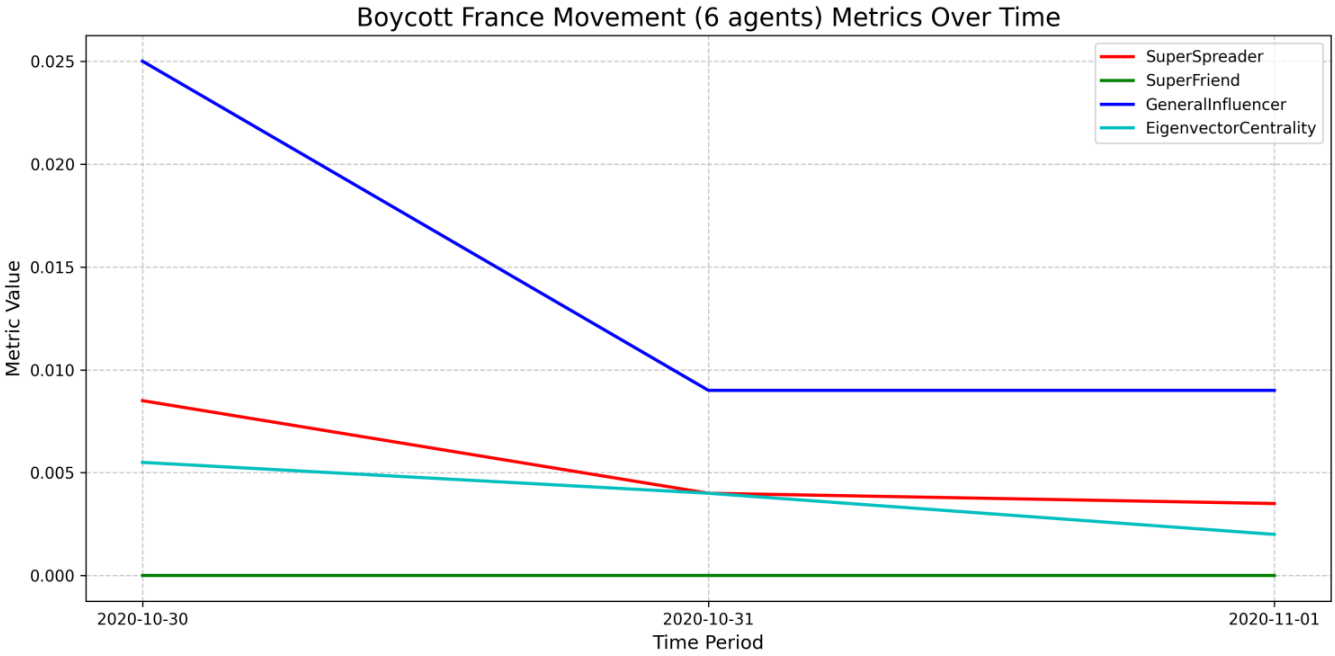

ENGAGE/DISMISS for 2020-11-02
Net Defining Concept Change
1st Person Delta
0.09
0.09
-0.17
0.00
Value
0.10
0.05
0.00
−0.05
−0.10
−0.15
Boycott Against
France (7 agents)
French Product
Boycott (47 agents)

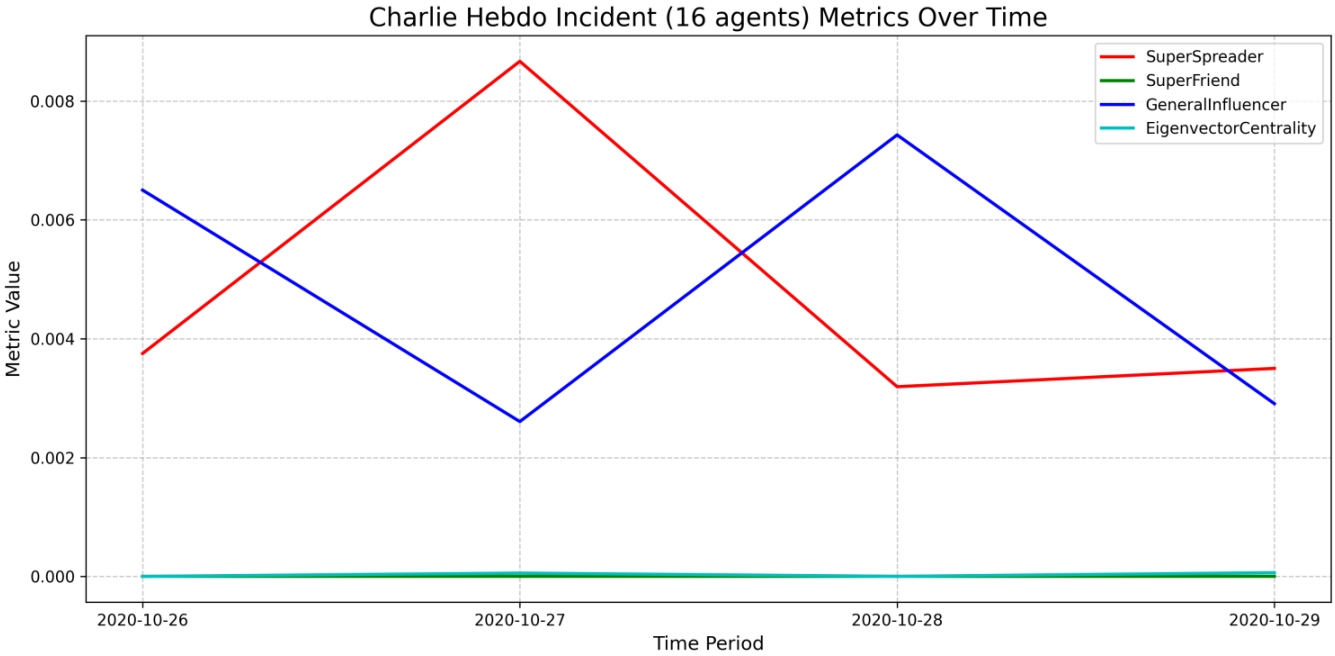

ENGAGE/DISMISS for 2020-11-03
Net Defining Concept Change
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0.00
0.10
-0.09
Value
0.1
0.0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
French Product
Boycott (47 agents)
French Products
Overview (6 agents)
Boycott Against
France (7 agents)

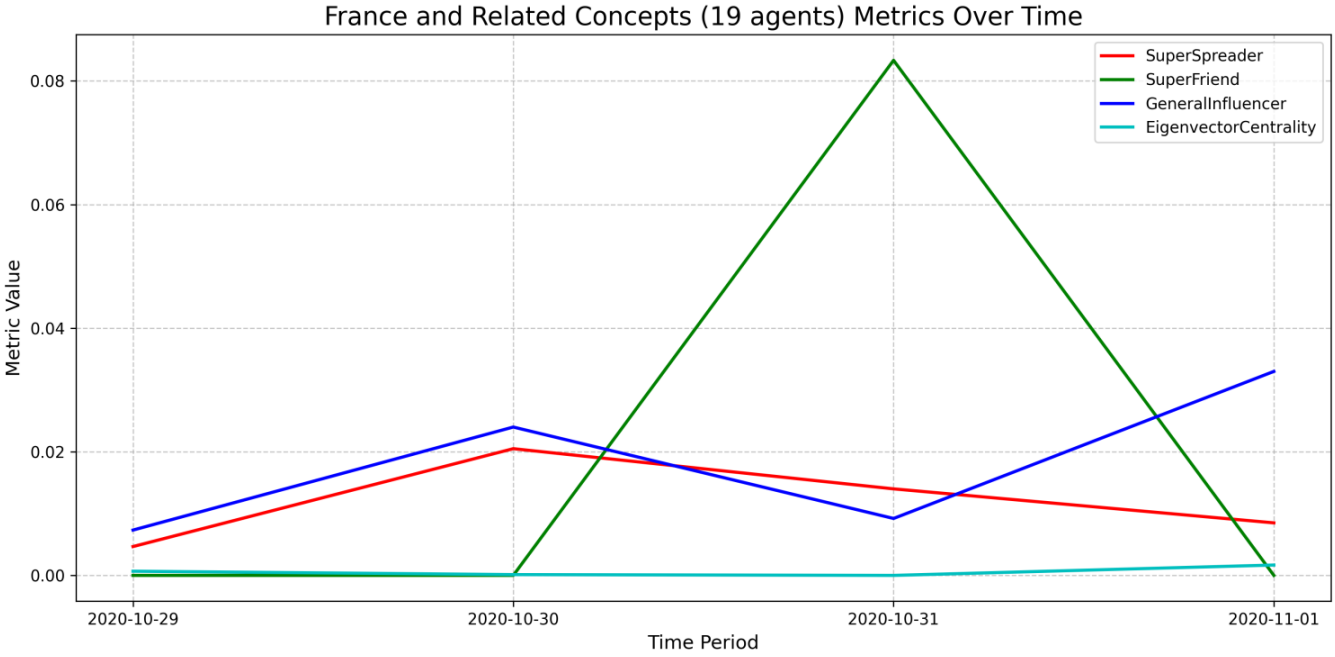

0.14
ENGAGE/DISMISS for 2020-11-04
Net Defining Concept Change
1st Person Delta
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0.12
0.10
0.08
0.06
0.04
0.02
0.00
Value
0.00
French Products
Overview (6 agents)

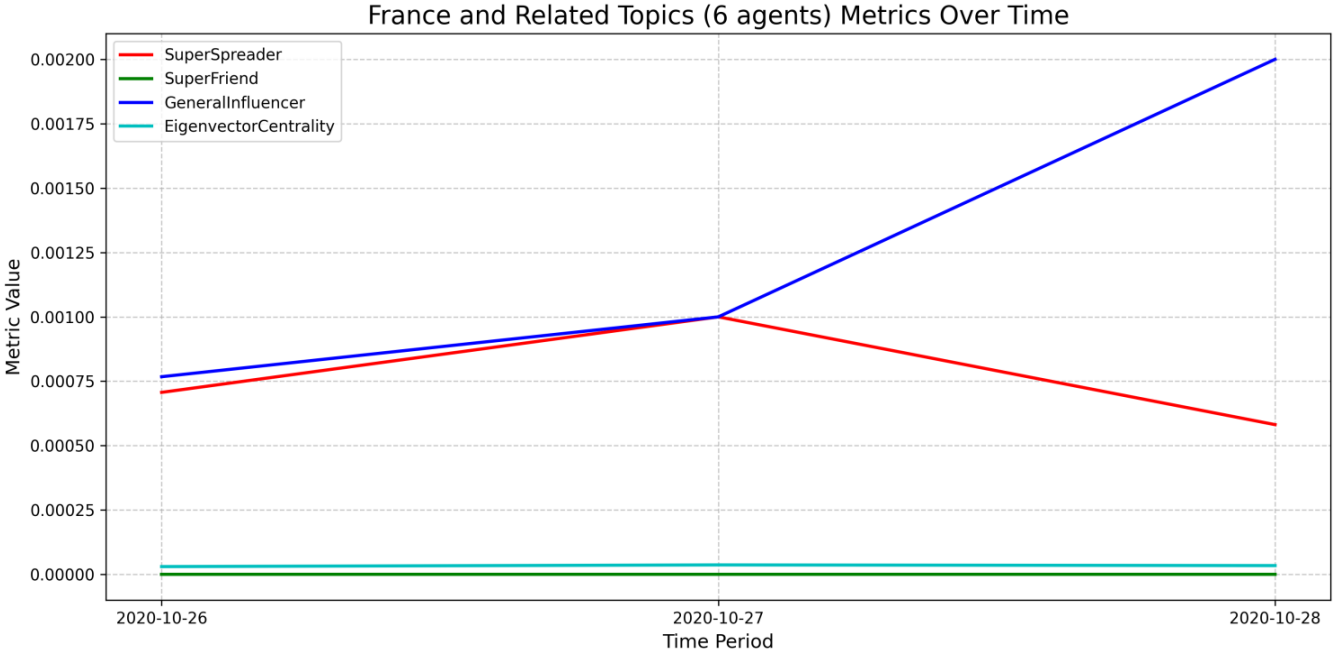

Boycott Against France (7 agents) Metrics Over Time
Metric Value
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
2020-11-01
2020-11-02
2020-11-03
Time Period
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality

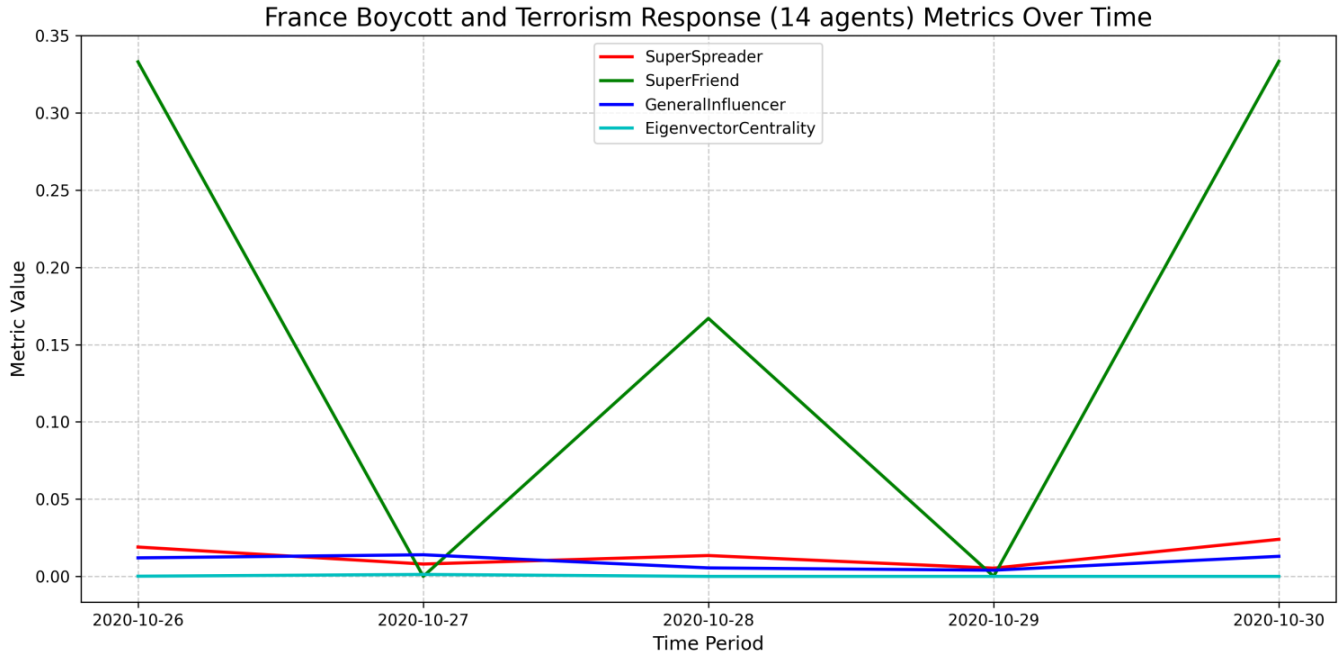

Boycott Against France (9 agents) Metrics Over Time
Metric Value
0.8
0.6
0.4
0.2
0.0
2020-10-30
2020-10-31
2020-11-01
Time Period
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality

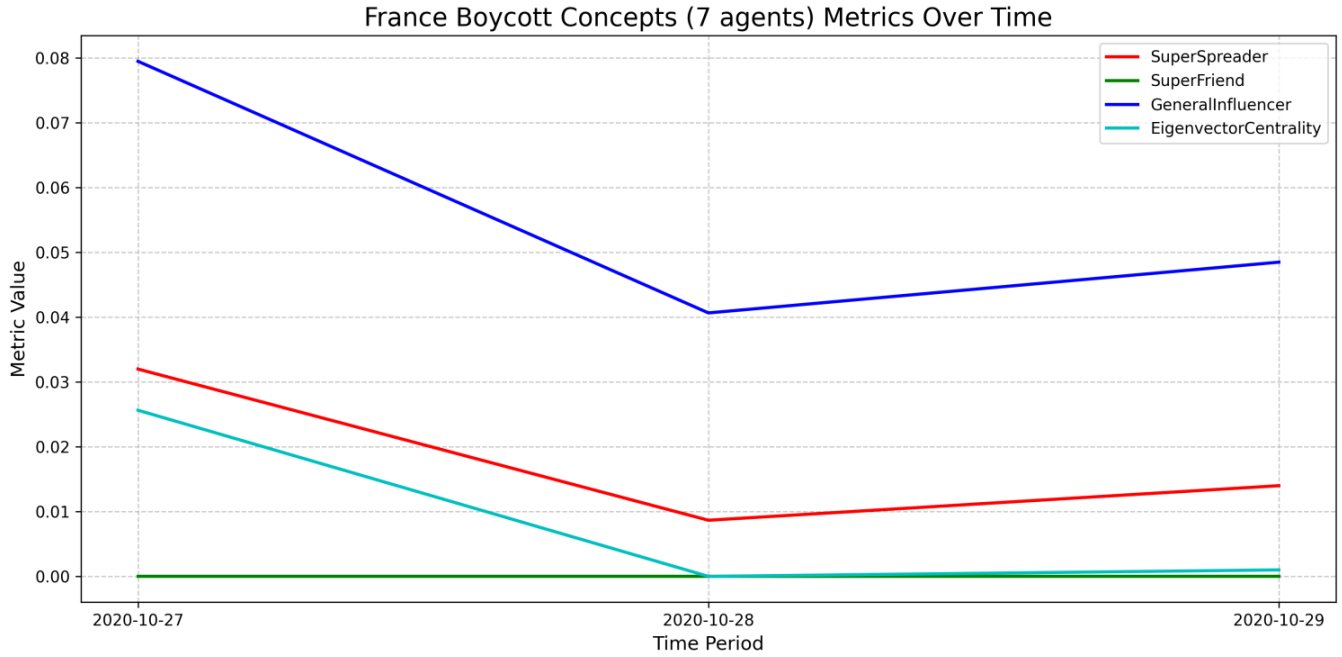

Boycott France Movement (6 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.025
0.020
0.015
0.010
0.005
0.000
2020-10-30
2020-10-31
2020-11-01
Time Period

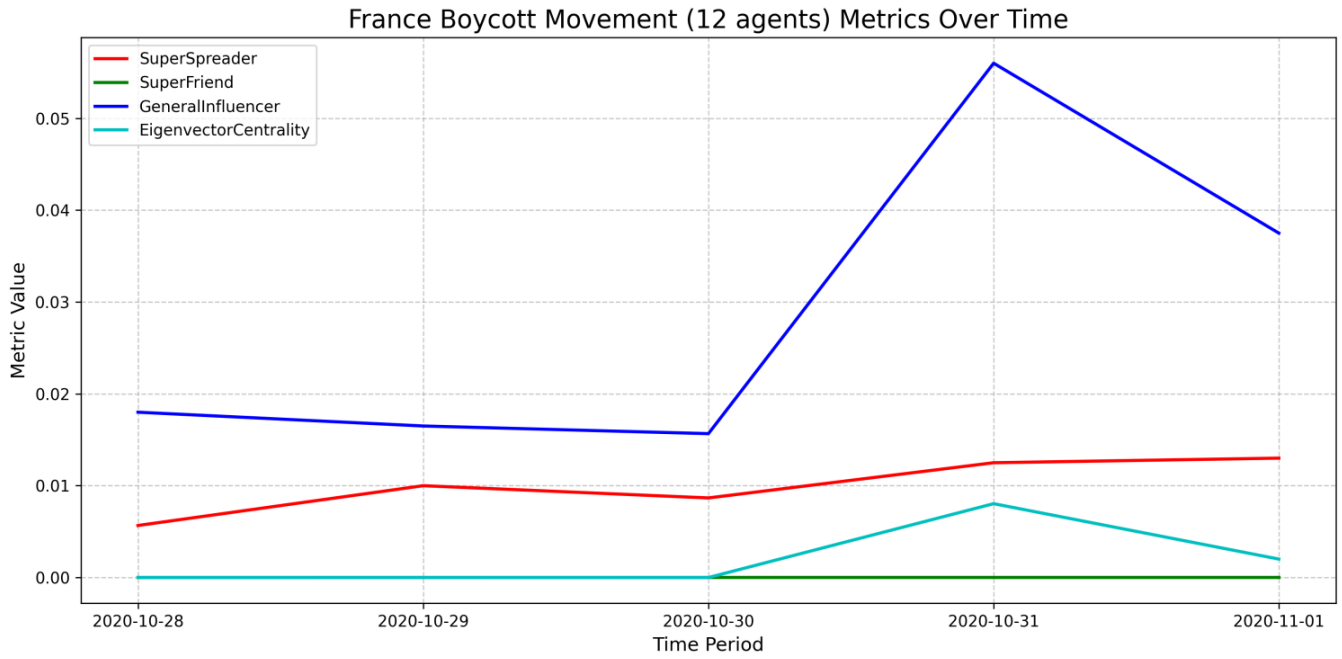

Charlie Hebdo Incident (16 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.008
0.006
0.004
0.002
0.000
2020-10-26
2020-10-27
2020-10-28
2020-10-29
Time Period

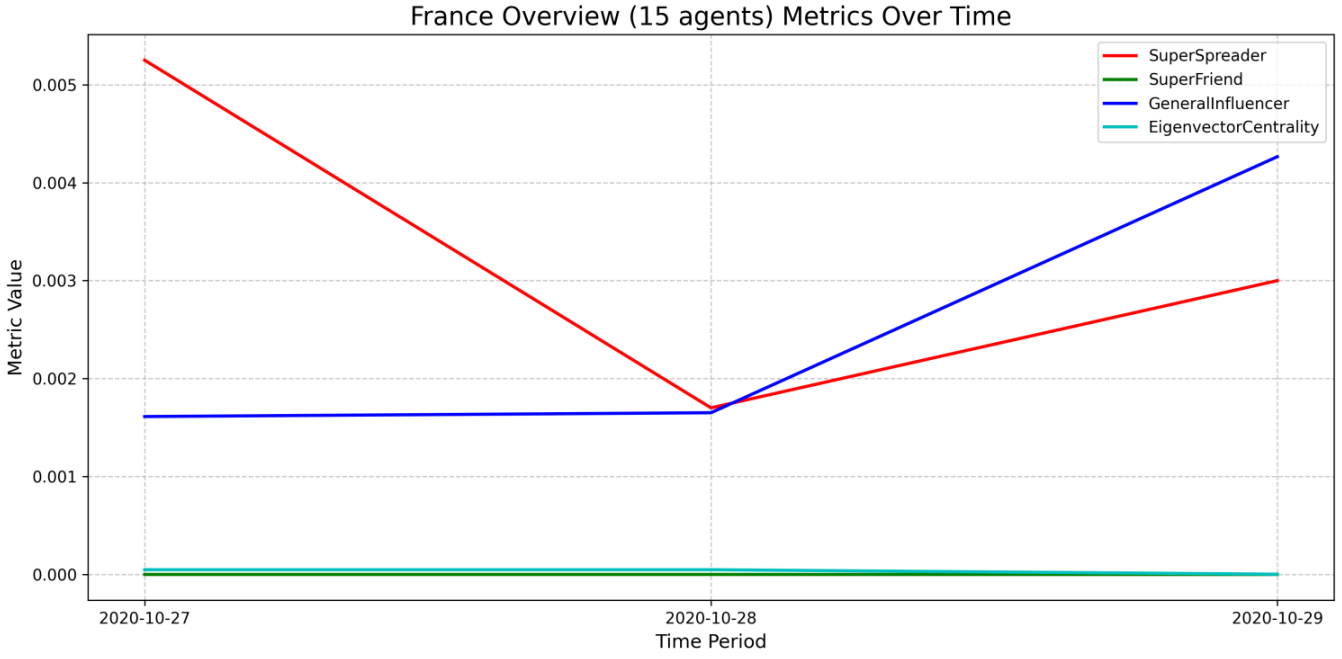

France and Related Concepts (19 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.00
0.02
0.04
0.06
0.08
2020-10-29
2020-10-30
2020-10-31
2020-11-01
Time Period

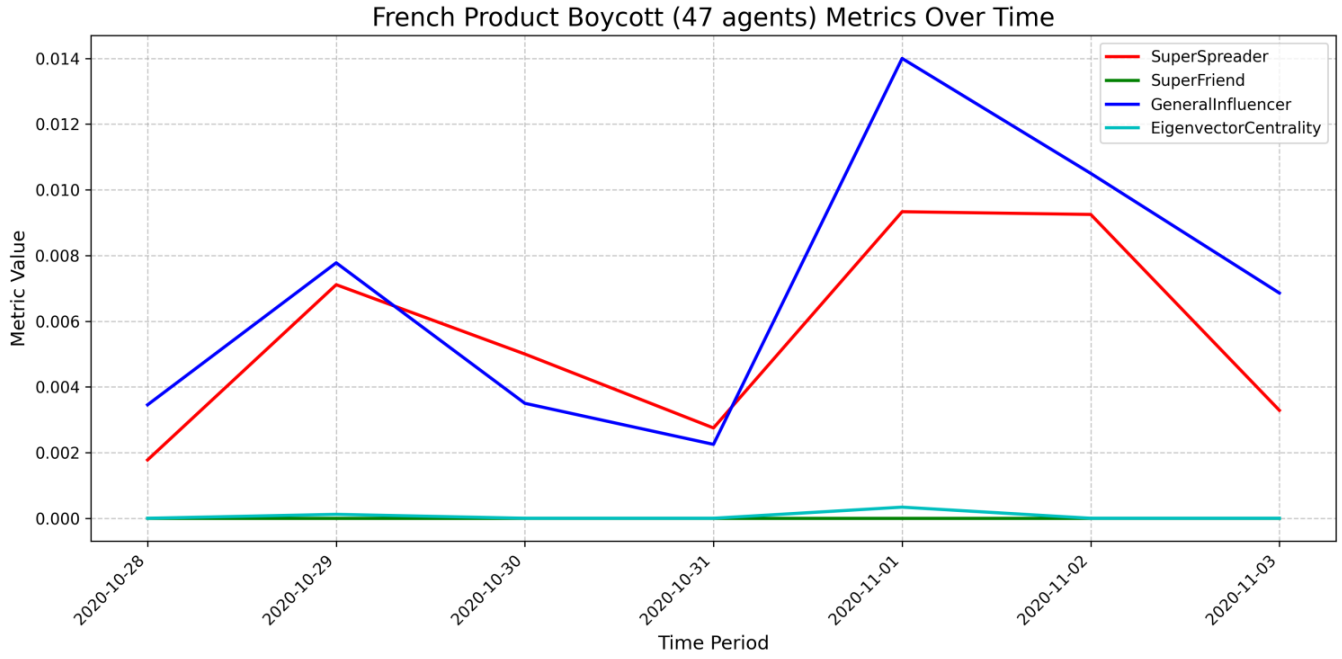

France and Related Topics (6 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.00000
0.00025
0.00050
0.00075
0.00100
0.00125
0.00150
0.00175
0.00200
2020-10-26
2020-10-27
2020-10-28
Time Period

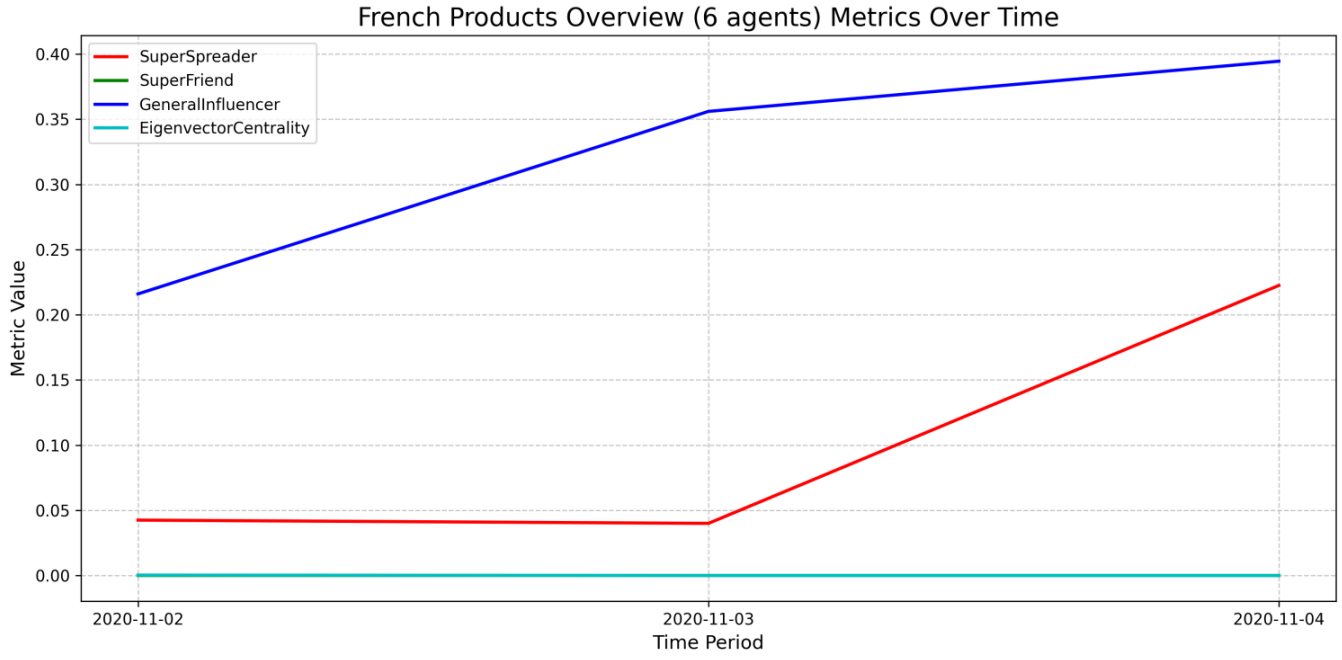

France Boycott and Terrorism Response (14 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2020-10-26
2020-10-27
2020-10-28
2020-10-29
2020-10-30
Time Period

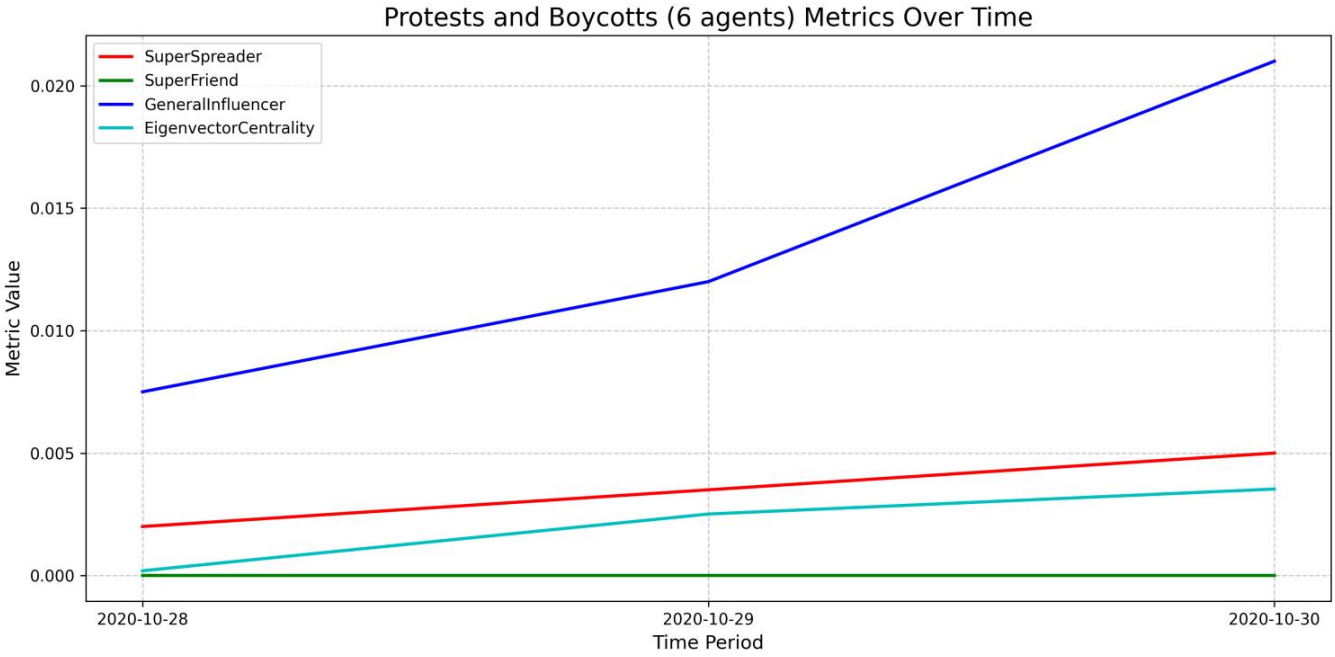

France Boycott Concepts (7 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
2020-10-27
2020-10-28
2020-10-29
Time Period

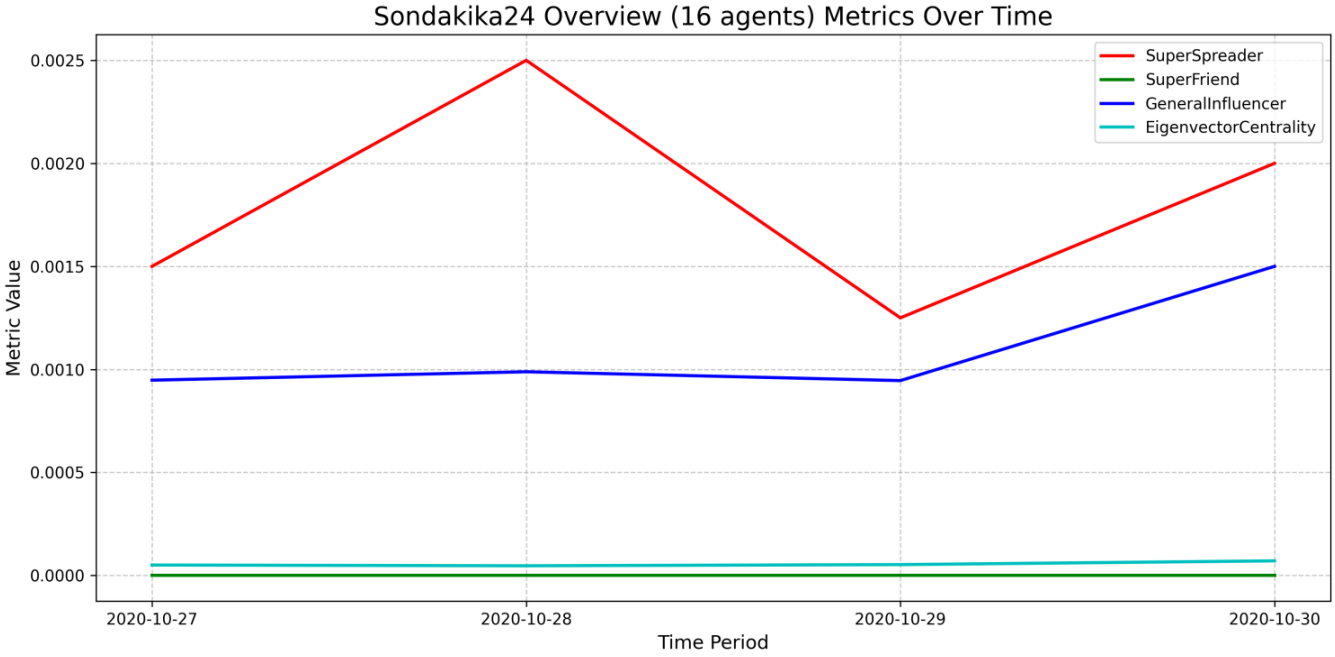

France Boycott Movement (12 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.05
0.04
0.03
0.02
0.01
0.00
2020-10-28
2020-10-29
2020-10-30
2020-10-31
2020-11-01
Time Period


France Overview (15 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.005
0.004
0.003
0.002
0.001
0.000
2020-10-27
2020-10-28
2020-10-29
Time Period


French Product Boycott (47 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
2020-10-28
2020-10-29
2020-10-30
2020-10-31
2020-11-01
2020-11-02
2020-11-03
Time Period


French Products Overview (6 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2020-11-02
2020-11-03
2020-11-04
Time Period


Protests and Boycotts (6 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.020
0.015
0.010
0.005
0.000
2020-10-28
2020-10-29
2020-10-30
Time Period


Sondakika24 Overview (16 agents) Metrics Over Time
SuperSpreader
SuperFriend
GeneralInfluencer
EigenvectorCentrality
Metric Value
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
2020-10-27
2020-10-28
2020-10-29
2020-10-30
Time Period

Appendix C

Synthetic Social Media Creation for Social-Cybersecurity Training

The following is a forthcoming publication that includes research from this thesis.

Synthetic Social Media Creation for Social-Cybersecurity Training

Matthew Hicks[1*], Mohamed Farag[2] and Kathleen M. Carley[1]

[1]School of Computer Science, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, 15213, PA, USA.
[2]College of Engineering, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, 15213, PA, USA.

*Corresponding author(s). E-mail(s): mhicks3@andrew.cmu.edu;
Contributing authors: mfarag@andrew.cmu.edu ;
kathleen.carley@cs.cmu.edu ;

Abstract

This paper discusses the creation of realistic, dynamic, and controllable synthetic social media data to support instruction on evaluating social-cybersecurity maneuvers in social media. We propose an agent-based simulation called SynX that takes as input the scenario templates created by Netanomics' AI-Enabled Scenario Orchestration and Planning (AESOP) tool and outputs an X/Twitter API v1 message corpus by leverage a large language model (LLM). We conduct an experiment on LLM prompting and evaluate the output of SynX using network metrics and the BEND framework.

Keywords: social-cybersecurity, BEND, AI, synthetic data, agent-based modeling

1 Introduction

Social media platforms have an immense impact on information dissemination, influence operations, and narrative shaping. This provides an avenue for interested actors to influence public opinion, manipulate people, and even conduct war by other means.[1] This intersection between human behavior, social dynamics, and cyberspace is part of the emerging field known as social cybersecurity.[2] [3] As social media becomes increasingly important, the BEND framework provides the scaffolding for an analysis solution for this complex space. BEND is shorthand for the social-cyber maneuvers:

back, build, bridge, boost, engage, explain, excite, enhance, negate, neutralize, narrow, neglect, dismiss, distort, dismay, and distract. These maneuvers and their definitions are taken from the work of Beskow and Carley in 2019 [4] as refined and validated by Blane et al. in 2022 [5]. Importantly, BEND breaks possible actions down into two sets of dichotomies: positive maneuvers vs. negative maneuvers, and maneuvers that affect the narrative vs. those that affect the network. Fig. 1 provides a chart of the BEND maneuvers by their purpose.

Narrative Maneuvers			**Network Maneuvers**		
Impact what is being said and how it is being said			"Community" maneuvers. Alter who is connected to whom, the strength of those connections, and so alters who is influential and what groups exist		
Emotional Messaging	**Develop Narrative**	**Counter Narrative**	**Individual Centric**	**Make Groups**	**Unmake Groups**
Excite	Explain	Distort	Back	Build	Narrow
Dismay	Engage	Dismiss	Negate	Bridge	Neutralize
	Enhance	Distract		Boost	Neglect

Fig. 1 BEND maneuvers by effect

In order to facilitate training individuals on the BEND framework, we foresee the need for the construction of synthetic social media datasets that mimic real-world networks. The generation of these synthetic social media data is critical to the emerging field of social cybersecurity. Fig. 2 shows one methodology for creating those datasets. Of particular note are the scenario creation tool and the synthetic generator:

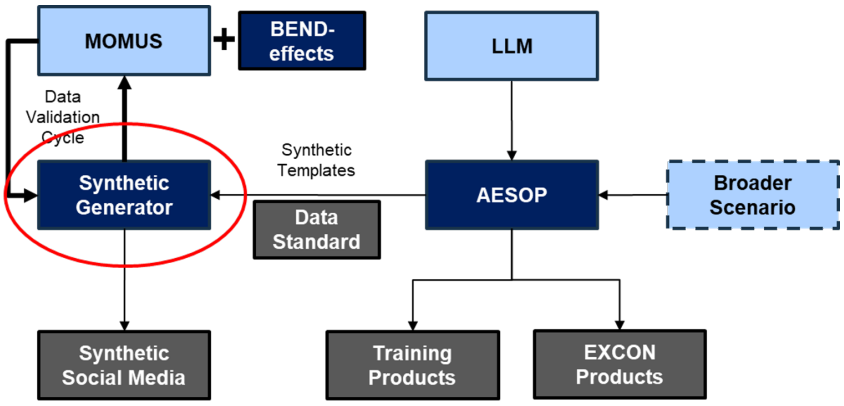


Fig. 2 A flow chart showing the construction steps for a synthetic social media dataset, SynX - as the actual synthetic generator - is highlighted by a red circle

- AESOP (AI-Enabled Scenario Orchestration and Planning) tool, a standalone Python-based application, empowers planners to construct, edit, and generate social-cyber scenarios grounded in real-world dynamics using configurable large-language models (LLMs) and structured inputs.
- SynX, an agent-based generator for Twitter/X that combines traditional simulation logic with LLM-driven message creation to produce realistic, platform-specific datasets.

These tools lower the barrier to high-quality scenario generation and provide a replicable method for developing training-ready content tailored to a variety of domains, including military, emergency response, public health, and law enforcement. These two tools act in concert to produce a dataset. First, AESOP is manipulated by a planner to produce synthetic templates for a scenario. Next, these templates are handed off as inputs into SynX where the actual synthetic generation of the dataset occurs.

There are two main approaches to this synthetic generation, top-down and bottom-up. These are also referred to as macro-level or system-based and micro-level.[6] [7] In the top-down approach, a simulation assumes a desired heterogeneous/multi-modal network fabric based on real data and then fills that fabric with appropriate actors, message types, and narratives that match nodes and link types. Alternatively, using the bottom-up approach, the simulation starts with agents programmed from first principles with detailed interaction rule sets. The agents then interact with each other hoping for emergent networks and narratives that are realistic and relevant.[8] This dichotomy mirrors approaches by others, including Chang et al. in 2024.[9] Interestingly, Chang et al. also point out a new dichotomy - the use of large-language models (LLMs) versus traditional network construction algorithms. They explore an LLM-only methodology that revealed the strength of the bottom-up approach but also found

limitations with their LLM-only system. That is, their LLM-only methodology is not capable of scaling when combined with the bottom-up approach. The LLM prompts require iterating through all personas with each persona provided the information about all other personas. This is unwieldy, even if there are only dozens of actors in a network.

SynX is grounded in agent-based simulation, with each Actor/Account acting independently based upon an action rule-set derived from their attributes and features. However, rather than let agents organically build their own networks and form narratives, we dictate who their groups members are and what narratives they can express based on the scenario input provided by AESOP.

Furthermore, rather than using an LLM-only system, SynX incorporates LLMs only in the final stages of generation. Network construction is done entirely by traditional algorithms, and LLMs are leveraged only for narrative construction - this eliminates the need for prompts to have information about every other actor, solving scalability issues, and also leverages LLMs for what they are best at - sounding like real people.[10] [11]

2 Related Works

SynX's hybrid approach reflects a difference in the desired outcome compared to other efforts. Generally, other approaches are looking to maximize one of three outcomes: the re-creation of the structure of real social media,[9] the recreation of human social media text output,[12] or the generation of a specific set of synthetic data for classifier training purposes.[13][14][15] The SynX output needs to accomplish the first two, but can eschew the latter. In order to provide realistic training, SynTel/X needs to produce social media data equivalent to the social media data collected directly from an API of a real-world platform.

There are three related simulations from which SynX draws:

The twitter_sim2.0 model – as outlined by Blane, Moffit and Carley in 2021 [16] – is a model focused on Twitter interactions. The simulation accounts for both emotion and logic – ensuring tweets that emotionally correspond with a recipient have magnified effects. Importantly, it cannot take in existing or user generated tweets as context and while it includes BEND maneuvers it is not interpretable by ORA-Pro. It also does not produce a message corpus for external evaluation.

Construct is a simulation framework for implementing agent-based modeling in C++20[17]. Construct can parse DynetML files from ORA or CSV. It allows for the custom creation of models - including those for information diffusion. However, it does not produce a message corpus.

LLM-Social-Network by Chang et al. in 2024, leverages large language models to reconstruct agent x agent networks.[9] It also stops short of generating an associated message corpus and also offloads agent-based decision making to an LLM.

Table 1 shows a comparison between these simulations with respect to their nodes and features of network construction - it does not take into account their simulation processes.

Table 1 Docking Lite

Feature	SynX	twitter_sim2.0	Construct	LLM-Social-Network
Media Agents	✓	✓	✓	✓
Opinion Leaders	✓	✓	✓	
Information Access	✓	✓	✓	
General Memory	✓	✓	✓	
Homophily	✓	✓	✓	✓
Limited Attention	✓	✓	✓	
Dynamic Network	✓	✓	✓	
Emotional Response		✓	✓	
All BEND Maneuvers	✓		✓	
Full Diffusion			✓	
Live Visualization			✓	
AESOP inputs	✓			
Full Messages	✓			
Context Inputs	✓		✓	
X APIv1/v2 Format	✓			

3 Model Description

SynX is a synthetic generator that takes synthetic templates from AESOP (required), existing X corpora (optional), and injected messages from the training audience (optional) and uses agent based simulation and an LLM to output synthetic social media data. SynX produces data in the X/Twitter APIv1 format.

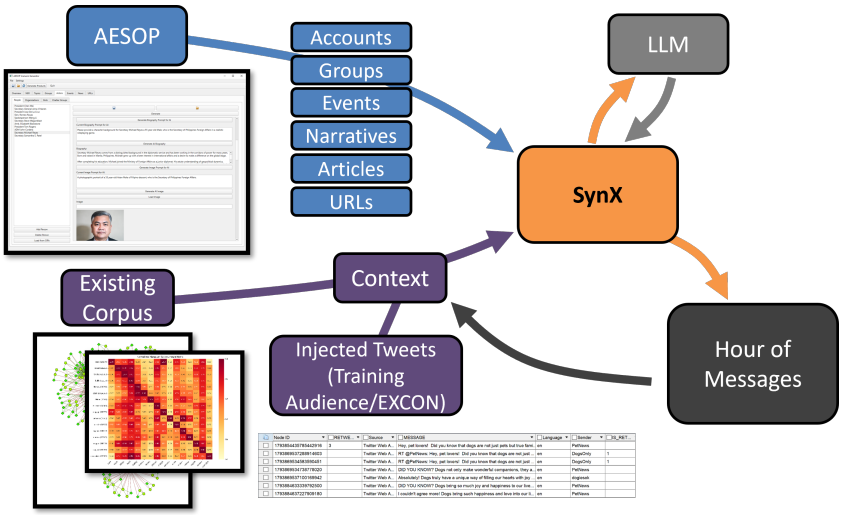


Fig. 3 Overview diagram of SynX

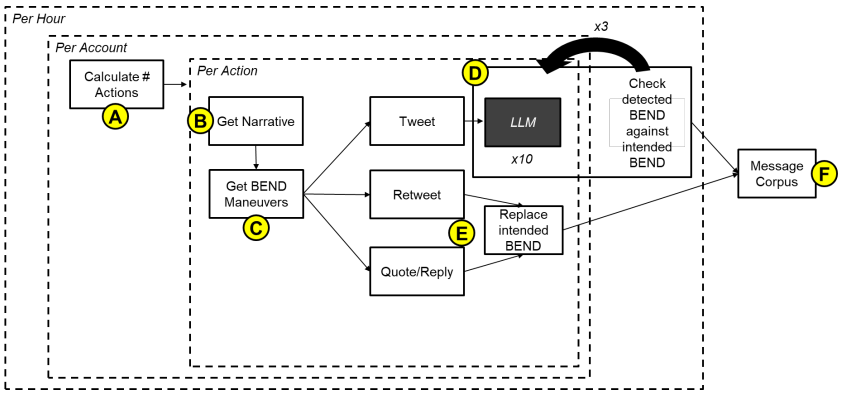


Fig. 4 Example SynX logic flow

3.1 SynX Flow Overview

- A) Calculate Actions: Per hour, per account, SynX determines the number of actions to be taken by the account.
- B) Find a Narrative: For each action, SynX determines a narrative from a weighted sampling of all narratives associated with groups of which the Actor/Account is a member.
- C) Determine BEND Maneuvers: Based on the BEND maneuvers associated with that narrative and conflated with the BEND maneuvers associated with the Actor/Account, a seed BEND maneuver is selected and then a full chain of maneuvers is determined.
- D) Construct the Prompt: If the BEND maneuvers suggest an original message, then a message shell is created and metadata adjusted to match the intended BEND maneuvers. Then a prompt is constructed and an LLM call is made to create a message - this may happen several times as SynX attempts to make sure that the intended BEND maneuvers are detected within the output message.
- E) Find Another Message: If the BEND maneuvers suggest a derivative message, then an original message is selected from this narrative, and the derivative message is constructed with a partial replacement of the BEND maneuvers.
- F) Produce Output: All of the messages are combined into the message corpus.

A) Calculate Actions

SynX simulates an hour of X messages at a time. To do this, all X accounts go through the decision-flow process summarized above. First, the account determines how many actions to take in a given hour.

Let:

- $R_o = [r_{o,\min}, r_{o,\max}]$ be the range of original tweets per day
- $R_r = [r_{r,\min}, r_{r,\max}]$ be the range of retweets per day
- $R_q = [r_{q,\min}, r_{q,\max}]$ be the range of quote/reply tweets per day
- E be the excite number for the day (the max of all excite variables from scenario events occurring during that day)

Then:

$$\begin{aligned} \text{min\_posts} &= r_{o,\min} + r_{r,\min} + r_{q,\min} \\ \text{max\_posts} &= r_{o,\max} + r_{r,\max} + r_{q,\max} \\ \text{adjusted\_min} &= \lfloor \text{min\_posts} \times E \rfloor \\ \text{adjusted\_max} &= \lfloor \text{max\_posts} \times E \rfloor \end{aligned}$$

Finally, the number of posts to generate is randomly selected from the integer interval:

$$\text{post\_count} \sim \mathcal{U}(\text{adjusted\_min}, \text{adjusted\_max})$$

However, the number of posts per day is not sufficient for SynX, because the accounts are run per hour. In order to transform the total posts per day into a probability of a post(s) occurring during a single hour, we also need the active daily schedule of an account - this is given in the synthetic template for that account.

Let $h \in \{0, 1, \ldots, 23\}$ be the hour of the day, and let T be the total number of posts the account will make in a day. If the active schedule of the account is from 0900 to 1800 then we want higher probabilities during that time and reduced but tapering probabilities during other times.

We can therefore define the unnormalized hourly probability $P(h)$ as:

$$P(h) = \begin{cases} 1 & \text{if } 9 \leq h < 19 \quad \text{(flat period)} \\ 1 - \dfrac{r(h)}{11} & \text{if } h \in \{18, 19, \ldots, 23, 0, 1, 2, 3, 4\} \quad \text{(tapering)} \\ \dfrac{s(h)}{5} & \text{if } 5 \leq h < 9 \quad \text{(rising)} \\ 0 & \text{otherwise} \end{cases}$$

Where:

- $r(h)$ is the rank (0-indexed) of hour h in the tapering list: $[18, 19, 20, 21, 22, 23, 0, 1, 2, 3, 4]$
- $s(h)$ is the rank (0-indexed) of hour h in the rising list: $[4, 5, 6, 7, 8]$

Normalize the probabilities:

$$\tilde{P}(h) = \frac{P(h)}{\sum_{i=0}^{23} P(i)}$$

Then the final expected number of posts at hour h is:

$$\text{ExpectedPosts}(h) = T \cdot \tilde{P}(h)$$

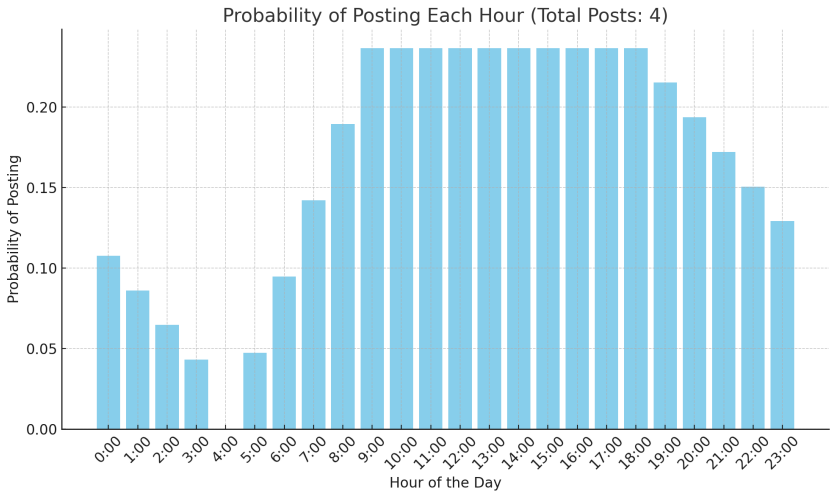


Fig. 5 Graph of probability of posting each hour for a user active from 0900 to 1800 who posts 4 times a day.

Fig. 5, graphically depicts the probability of posting each hour for a user with four total posts in a day. The distribution is flat from 09:00 to 18:00, tapers off between 18:00 and 04:00, and gradually increases from 04:00 to 09:00.

B) Find a Narrative

Now that we have calculated the number of actions to be taken in a period, we need to know what type of actions will be taken. Naively, original posts, retweets, quotes/replies would each be run separately. However, because certain BEND maneuvers are closely associated with each type of X post, we must first have accounts choose narrative associated BEND maneuvers that then determine a post type rather than choosing a post type that then dictates BEND maneuvers.

Therefore, for each action to be taken in a period, the account finds a narrative. This narrative is drawn as a weighted random selection from all narratives associated with all groups of which the account's owning actor is a member - information contained in the AESOP inputs to SynX.

Let:

- A be an actor
- $\mathcal{G}(A) = \{G_1, G_2, \ldots, G_m\}$ be the set of groups that actor A belongs to
- $\mathcal{N}(G_j)$ be the set of narratives associated with group G_j
- $\mathcal{N}_A = \bigcup_{j=1}^{m} \mathcal{N}(G_j)$ be the full set of candidate narratives for actor A
- Each narrative $N_i \in \mathcal{N}_A$ has an associated weight $w_i > 0$

Define the probability of selecting narrative $N_i \in \mathcal{N}_A$ as:

$$P(N_i \mid A) = \frac{w_i}{\sum\limits_{N_j \in \mathcal{N}_A} w_j}$$

Then, the selected narrative N^* for the message is drawn from the categorical distribution:

$$N^* \sim \text{Categorical}\left(\{P(N_i \mid A)\}_{N_i \in \mathcal{N}_A}\right)$$

C) Determine BEND Maneuvers

After a narrative is selected per action, a second weighted random selection is executed. The algorithm for this is similar to the narrative selection above except this time the algorithm is choosing BEND maneuvers based upon weights associated with that narrative conflated with the individual account BEND maneuver weights.

Let:

- $M = \{M_1, M_2, \ldots, M_{16}\}$ be the set of BEND maneuvers
- $w_i^{(n)}$ be the weight of maneuver M_i from the selected narrative
- $w_i^{(a)}$ be the weight of maneuver M_i from the actor profile

Define the combined weight for each maneuver M_i as:

$$w_i^{(\text{combined})} = \left(w_i^{(n)}\right)^{2/3} \cdot \left(w_i^{(a)}\right)^{1/3}$$

Normalize to obtain a probability distribution over the 16 maneuvers:

$$P(M_i) = \frac{w_i^{(\text{combined})}}{\sum\limits_{j=1}^{16} w_j^{(\text{combined})}}$$

Then sample one maneuver M^* from the categorical distribution:

$$M^* \sim \text{Categorical}\left(\{P(M_i)\}_{i=1}^{16}\right)$$

From this seed BEND maneuver we can determine the total BEND maneuvers for the action using a variable-order Markov model with set-based context and non-replacement sampling. This model is built from BEND co-occurrence matrices derived from real-world data sets.

Given a starting maneuver m_0, we build a sequence $S = [m_0, m_1, \ldots, m_k]$ by repeatedly sampling from the conditional probability distribution.

We define the initial maneuver as:

$$S_0 = [m_0]$$

At each step, let the current sequence be $S_t = [m_0, m_1, \ldots, m_t]$, and let

$$\mathcal{S}_t = \text{sorted}(S_t)$$

Then, compute the conditional probabilities for the next maneuver m_{t+1}:

$$P(m_{t+1} \mid \mathcal{S}_t)$$

To ensure uniqueness, set:

$$P(m \mid \mathcal{S}_t) = 0 \quad \text{if } m \in \mathcal{S}_t$$

Next, we normalize probabilities:

$$\hat{P}(m \mid \mathcal{S}_t) = \frac{P(m \mid \mathcal{S}_t)}{\sum_{m' \notin \mathcal{S}_t} P(m' \mid \mathcal{S}_t) + P(\text{END} \mid \mathcal{S}_t)}$$

And then we sample for the next maneuver: Sample $m_{t+1} \sim \hat{P}(\cdot \mid \mathcal{S}_t)$
Or we terminate with no more maneuvers for this message: If $m_{t+1} = \text{END}$, stop.

From this we arrive at our full sequence of BEND maneuvers: $S = [m_0, m_1, \ldots, m_k]$. This set of BEND maneuvers determines if this message is an original tweet, a retweet, a reply, or a quote. If the BEND maneuvers include back, engage, or neutralize, then the post is likely a derived type (retweet, reply, or a quote) as these BEND maneuvers are closely associated with these types of posts.

Let:

- $B = \text{BEND}(narrative)$
- $D = \text{isDerived}(B) = \begin{cases} 1 & \text{if } B_{\text{back}} = 1 \text{ or } B_{\text{engage}} = 1 \text{ or } B_{\text{neutralize}} = 1 \\ 0 & \text{otherwise} \end{cases}$

Then the tweet type T is sampled as follows:

$$T = \begin{cases} \text{DerivedType()} & \text{with probability } \frac{2}{3}, \text{ if } D = 1 \\ \text{Tweet} & \text{with probability } \frac{1}{3}, \text{ if } D = 1 \\ \text{Tweet} & \text{if } D = 0 \end{cases}$$

Where:

$$\text{DerivedType()} = \begin{cases} \text{Retweet} & \text{with probability } \frac{3}{5} \\ \text{Reply} & \text{with probability } \frac{1}{5} \\ \text{Quote} & \text{with probability } \frac{1}{5} \end{cases}$$

D) Construct the Prompt

If the BEND maneuvers suggest an original message, then a message shell is created and metadata adjusted to match the intended BEND maneuvers. This is important because current methods of detecting BEND maneuvers using ORA-PRO operate on a per message level and evaluate for maneuvers based on both the content of the message and the metadata. As a general rule, metadata is more influential in determining

network maneuvers, while the content of the message itself is more influential in determining narrative maneuvers. Both URLs and mentions are handled by the simulation and considered metadata rather than parts of the message. SynX therefore makes changes to the metadata of the original message based on the BEND maneuvers. Table 2 illustrates which BEND maneuvers are derivative (associated with retweets, replies, quotes), which maneuvers are associated with the presence of mentions, and which are associated with the presence of URLs.

Table 2 Metadata by BEND Category

	Derivative	**Mentions**	**URLs**
Bridge		✓	
Build		✓	
Boost		✓	
Back	✓	✓	
Engage	✓		✓
Explain			✓
Excite			
Enhance			✓
Negate		✓	
Neutralize	✓	✓	
Narrow			
Neglect		No Mentions	
Dismiss			
Distort			
Dismay			
Distract			

Once the metadata adjustments are made, a prompt is constructed in preparation to request a message from the LLM. Prompt construction has two major components - the system prompt and the user prompt. The system prompt is used to outline the role given to the LLM and provide background information and context. It has four major parts:

- *An introduction:* You will be participating in a role playing game to help users identify misinformation, disinformation, and manipulation on social media. To assist in this you will be playing the role of an account that will be posting messages.
- *Formatting instructions:* 'Provide your response as a JSON object in the following example format: { "topic": "dogs", "hashtags" : ["yaydogs", "dogscool"], "full_text" : "Dogs are great, #yaydogs #dogscool", "refuse_to_answer" : 0 } The "refuse_to_answer" field is where you should return a 1 if you do not feel comfortable generating a tweet about the subject. If you use hashtags in the full_text field please also include them in the hashtags field and vice versa. Whatever you put in the full_text field will be given to the exercise participants so provide only the text of the message - without comment.
- *BEND Definitions:* As you craft the message/tweet you are trying to accomplish something - what you are trying to accomplish is defined by the BEND Framework. BEND is a framework for describing social-cyber maneuvers. BEND includes 16

different maneuvers. These 16 maneuvers have the following definitions: The BUILD maneuver primarily creates a community. The BACK maneuver primarily increases the importance or effectiveness of a leader... *other maneuvers...*

- *Identity:* You are a Twitter user who is trying to make a post that will be engaging and interesting to your followers. You have a unique style and voice that you want to maintain in your posts. Here are your personal details: {Name}, {Title}, {Age}, {Race}, {Gender}, {Nationality}, {Biography}.

The user prompt is where the LLM is given details about this specific message:

- *Narrative:* You will be posting on the following narrative: {narrative description}
- *Last three messages by this account:* The last three messages you posted looked like this - say something different than these: *Last three messages here...*
- *Last three messages on this narrative:* The last three messages others posted on this narrative looked like this - say something different than these:"*Last three messages from narrative here...*
- *Suggested Hashtags: List of suggested hashtags...*
- *BEND Maneuvers:* "The message you send will include some BEND maneuvers. In this case: *List of BEND maneuvers...*

The system and user prompts are sent to the LLM and a message is returned. For this paper, we aim SynX at the OpenAI API[18] and use a GPT4o mini model (gpt-4o-mini) for text. No effort was made to jailbreak any LLM - if the OpenAI commercial LLM were to refuse to create a tweet, we would mark it as a failure and move on. However, there were no prompt refusals during the validation or experimentation of SynX.

The returned text is added to the tweet and there is now a complete post. However, there is no guarantee that the message returned by the LLM contains the intended BEND messages. Because SynX is creating synthetic data for training on BEND maneuvers, ideally it should check the synthetic data for those BEND maneuvers using the same tools that the training audience would have available to them. Thus, SynX uses a combination of NetMapper and ORA-PRO to check for BEND maneuvers in each message. For scalability purposes, SynX can evaluate all posts in an hour together or wait and conduct the evaluation on a full day at a time.

BEND Check Process

- Messages are cleaned for processing
- NetMapper processes the posts and returns a .tsv of cues per message
- The posts are converted into DyNetML (XML) format for processing by ORA
- The cues .tsv is parsed and the cues injected into the DyNetML
- The BEND calculations are done using templates from ORA-PRO's batch mode
- Each message now has vectors for intended BEND (variable-order Markov selected) and detected BEND (ORA-PRO discovered)

This process is complex; however, ORA-Pro + NetMapper is the only definitive, validated way to detect BEND maneuvers.[19][1] NetMapper extracts cues from each message and ORA-Pro uses these cues - as well as additional metadata from the message itself - to detect BEND maneuvers. Because this part of the process is computationally expensive, SynX can simultaneously ask the LLM for multiple variations of a message - evaluating and then keeping only the message with the highest score. The scoring algorithm requires that the detected BEND maneuvers in a message at least encompass the intended maneuvers. Then it gives higher scores to those messages that have the fewest detected BEND maneuvers that are not in the intended BEND maneuvers set.

Let:

- $\mathbf{i} = [i_1, i_2, \ldots, i_{16}]$ be the intended BEND maneuver vector
- $\mathbf{d} = [d_1, d_2, \ldots, d_{16}]$ be the detected BEND maneuver vector
- $i_k, d_k \in \{0, 1\}$ for $k = 1, 2, \ldots, 16$

Define the score $S(\mathbf{i}, \mathbf{d})$ as:

$$S(\mathbf{i}, \mathbf{d}) = \begin{cases} 1 - \dfrac{\sum_{k=1}^{16} [d_k = 1 \wedge i_k = 0]}{16}, & \text{if } \forall k,\ i_k \leq d_k \\ 0, & \text{otherwise} \end{cases}$$

That is:

- If all intended maneuvers are present in the detected set ($i_k \leq d_k$ for all k),
- then subtract the proportion of "extra" detected maneuvers from 1,
- else, assign a score of 0.

If no suitable messages are found within the batch (all have scores of 0), then SynX will ask for an entirely new batch of messages up to three times. Ultimately, only the best message is kept and added to the corpus.

E) Find Another Message

If the BEND maneuvers suggest a derivative message - a retweet, reply, or quote - then SynX will need to find an appropriate message to be derivative of. The first step in this process is to determine a subset of messages available for derivative use. This step is done for each hour all at once - reducing computational requirements.

Messages less than or equal to 1 day old have a 100 percent probability of remaining available for derivative use. For older messages, the probability decays exponentially based on age.

$$P(\text{keep}) = \begin{cases} 1 & \text{if } \Delta t \leq 1 \\ \beta^{(\Delta t - 1)} & \text{if } \Delta t > 1 \end{cases} \tag{1}$$

From this set of eligible messages, SynX will only consider those messages that contain the previously selected narrative and then it will make a selection based on

[1] Both NetMapper and ORA-Pro are Netanomics tools and are available at https://netanomics.com/ora-pro and https://netanomics.com/netmapper respectively.

a hybrid of leader-based selection and preferential attachment. The intent is that the network should reflect the scale-free structure provided by preferential attachment; however, the beneficiaries of that scale-freeness need to be the enumerated leaders provided by the group synthetic template from AESOP.

Let T be the set of candidate tweets, where each tweet $t \in T$ has an associated retweet/reply/quote count $R(t) \geq 0$, and a leader indicator $L(t) \in \{0, 1\}$, where $L(t) = 1$ if the tweet was posted by a leader of the group.

Define $T_L \subseteq T$ as the subset of tweets authored by leaders:

$$T_L = \{t \in T \mid L(t) = 1\}$$

We define the probability $\mathbb{P}(t)$ of selecting tweet t as follows:

$$\mathbb{P}(t) = \begin{cases} \dfrac{1}{|T_L|} & \text{with probability } \frac{1}{3}, \quad \text{if } t \in T_L \\ \dfrac{R(t)}{\sum_{s \in T} R(s)} & \text{with probability } \frac{2}{3}, \quad \text{for all } t \in T \end{cases}$$

To sample a tweet t^*, first choose a mode of selection:

- With probability $\frac{1}{3}$, sample uniformly from T_L.
- With probability $\frac{2}{3}$, sample from T using retweet counts as weights.

Once a tweet is chosen, metadata is adjusted as appropriate (see D above). If the derived tweet is a retweet then most of the intended BEND maneuvers for the derivative tweet are overwritten with the intended BEND maneuvers from the original tweet - the exceptions being back, engage, and neutralize - the determining BEND factors for derivatives. However, if the derived tweet is a reply or quote, then it keeps its intended BEND maneuvers and moves to a modified version of step D above - where the LLM is asked to comment on the tweet derived from.

F) Produce Output

Finally, the tweet, retweet, reply, or quote is complete and is added to the full set of output tweets for the hour. These tweets will be added the list of available for derivative use tweets in the next iteration. The entire process is repeated for each simulated hour.

X/Twitter and Telegram Bots

No social network would be complete without bots. However, there is an unusual problem with bots and synthetic datasets - every actor in this fabricated information environment is an automated persona - it is all bots. The challenge is that for the training audience, some of these automated personas need to be detectable as "bots" and others need to remain undetected as "humans". Planners can enumerate bots in AESOP for SynX to simulate using bot-specific agent rule sets for amplifier, news,

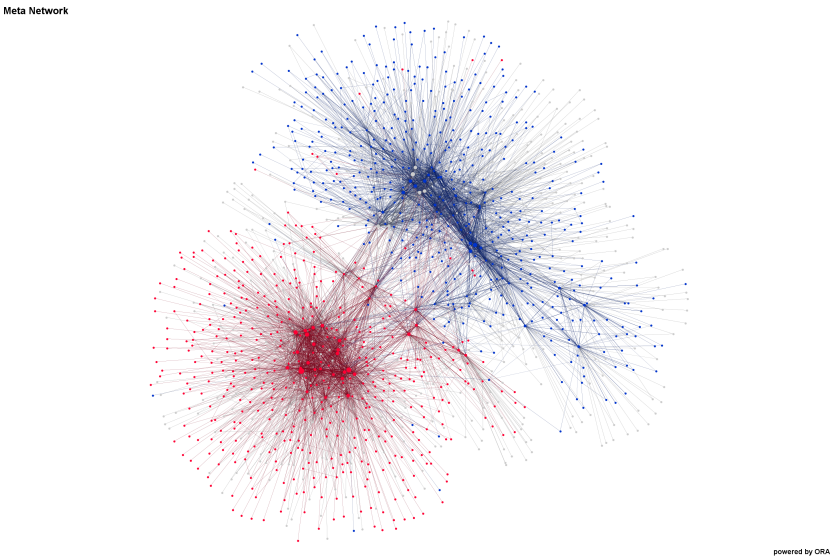


Fig. 6 An output network from SynX with stance detection run through ORA-PRO. Blue nodes are pro-stance actors and red nodes are anti-stance actors with gray nodes being neutral. Nodes are sized by total degree centrality.

bridging, and repeater bots. Amplifier bots boost content through retweets/posts and the SynX rule-set ensures that amplifier bots have an abnormally high retweet/post to tweet/post ratio. Additionally, they target only content with a specified narrative. Repeater bots are similar to amplifier bots but repeat the same message within their in-group continuously. Both of these types of bots operate similarly to those seen by Ng and Carley in 2023[20]. News bots are news aggregators and have a rule-set that forces them to retweet/post content from a target set of news agencies. Bridging bots use mentions and retweets/posts to attempt to connect two specified narratives. These types of bots operate similarly to those observed by Jacobs et al. in 2023 [21]

4 Experiment

For the virtual experiment, we will manipulate the presence of the BEND definitions in the prompt and whether SynX attempts to query the LLM for different text based on incorrect BEND assessments. We will be evaluating how well the presence of BEND maneuvers and their co-occurrences match a real world dataset. The real world comparison dataset is approximately 2500 tweets pulled from the X/Twitter API during the Balikatan 22 exercise in April 2022. Balikatan is a bilateral military exercise between the US and the Philippines.[22] The input scenario from AESOP is meant to be similar in topic and content.

Table 3 3x2 Virtual Experiment

Independent Variables	# Test Cases	Values Used
BEND Definitions	3	None/User Prompt/System Prompt
Regen Messages for BEND	2	0x/3x
Control Variables	# Test Cases	Values Used
Time Periods	1	1 hour
Messages per Hour	1	600-800
Target BEND	1	Balikatan 22
AESOP Input	1	Scenario
Dependent Variables		Values Expected
BEND Distribution		0-1 z-scores
3x2		8 cells
Replications per cell		30
180 total runs (108,000+ messages)		

In this experiment, we looked at how much benefit is gained by including the comprehensive BEND definitions and the NetMapper cues that ORA-Pro will be looking for when evaluating BEND in the prompt to the LLM. We consider three cases for the prompt - 1) No BEND definitions, 2) BEND definitions fit into the user prompt to the LLM, and 3) BEND definitions in the system prompt to the LLM. The user prompt is generally understood to be the prompt that asks the question, while the system prompt is the prompt that lets the LLM general context and purpose.

We also investigated iterating with the LLM multiple times to get better BEND results by letting the LLM know what BEND maneuvers were not detected in its initial responses and re-iterating the associated BEND cues with those maneuvers.

We will run SynX on one hour of the AESOP scenario (12:00-13:00 on Day 6 of the exercise) producing between 600-800 messages. This day occurs during the midpoint of the exercise when there is high traffic per hour, as well as a diverse range of actors and messages. However, because we match the detected BEND (in the LLM return) to the intended BEND (asked of the LLM), any day of exercise would be suitable.

5 Results

Table 4 Overall BEND Maneuver Analysis Results

Experiment	Mean Z-Score	Standard Error	CI Lower	CI Upper	p-value
No Definitions	-0.3366	0.0252	-0.3881	-0.2851	0.000000
Definitions_user	-0.4053	0.0270	-0.4605	-0.3501	0.000000
Definitions_system	-0.1053	0.0263	-0.1592	-0.0515	0.000396
Definitions_repull	-0.1257	0.0218	-0.1703	-0.0812	0.000003

[1] Significance determined at $p < 0.05$ level.
[2] Z-scores represent deviation from expected co-occurrence patterns in real data.

Table 5 BEND Maneuver Analysis - Intended/Requested (Row Means)

Maneuver	No Definitions	Definitions_user	Definitions_system	Definitions_repull
back	**0.35**$^{+}$	**-0.42**$^{-}$	**-0.26**$^{-}$	**-0.22**$^{-}$
boost	**-0.67**$^{-}$	**-0.89**$^{-}$	**-0.69**$^{-}$	**-0.66**$^{-}$
bridge	**-0.44**$^{-}$	**-0.38**$^{-}$	-0.10	-0.05
build	-0.24	-0.07	0.17	0.21
dismay	**-0.87**$^{-}$	**-0.80**$^{-}$	**-0.35**$^{-}$	**-0.50**$^{-}$
dismiss	-0.21	-0.11	**0.17**$^{+}$	0.11
distort	**-0.71**$^{-}$	**-0.65**$^{-}$	-0.29	**-0.31**$^{-}$
distract	**-0.73**$^{-}$	**-0.64**$^{-}$	**-0.31**$^{-}$	**-0.34**$^{-}$
engage	-0.12	**-0.47**$^{-}$	**-0.28**$^{-}$	**-0.24**$^{-}$
enhance	0.11	0.17	**0.45**$^{+}$	**0.39**$^{+}$
excite	**-0.64**$^{-}$	**-0.71**$^{-}$	**-0.39**$^{-}$	**-0.44**$^{-}$
explain	**-0.46**$^{-}$	**-0.46**$^{-}$	0.04	-0.06
narrow	**-0.41**$^{-}$	**-0.30**$^{-}$	0.13	0.13
negate	**-1.00**$^{-}$	**-1.08**$^{-}$	**-0.70**$^{-}$	**-0.76**$^{-}$
neglect	**0.98**$^{+}$	**0.95**$^{+}$	**1.22**$^{+}$	**1.18**$^{+}$
neutralize	**-0.33**$^{-}$	**-0.63**$^{-}$	**-0.50**$^{-}$	**-0.44**$^{-}$

Table 6 BEND Maneuver Analysis - Detected (Column Means)

Maneuver	No Definitions	Definitions_user	Definitions_system	Definitions_repull
back	**0.35**$^{+}$	**0.36**$^{+}$	**0.37**$^{+}$	**0.37**$^{+}$
boost	**-1.24**$^{-}$	**1.20**$^{+}$	**1.95**$^{+}$	**1.85**$^{+}$
bridge	**-1.27**$^{-}$	**-0.55**$^{-}$	**0.51**$^{+}$	**0.43**$^{+}$
build	**-1.83**$^{-}$	**-1.34**$^{-}$	**-0.85**$^{-}$	**-0.75**$^{-}$
dismay	**-0.42**$^{-}$	**-1.47**$^{-}$	**-1.02**$^{-}$	**-1.13**$^{-}$
dismiss	**-2.35**$^{-}$	**-1.96**$^{-}$	**-1.52**$^{-}$	**-1.61**$^{-}$
distort	**1.14**$^{+}$	**1.21**$^{+}$	**1.16**$^{+}$	**1.04**$^{+}$
distract	**0.34**$^{+}$	**-0.76**$^{-}$	**-0.59**$^{-}$	**-0.56**$^{-}$
engage	-0.02	-0.01	0.02	0.02
enhance	**0.85**$^{+}$	**0.85**$^{+}$	**0.87**$^{+}$	**0.85**$^{+}$
excite	**-0.83**$^{-}$	**-1.43**$^{-}$	**-0.65**$^{-}$	-0.30
explain	**-0.41**$^{-}$	**-0.61**$^{-}$	**-0.29**$^{-}$	**-0.35**$^{-}$
narrow	0.18	**0.51**$^{+}$	**0.89**$^{+}$	**0.83**$^{+}$
negate	**1.38**$^{+}$	**-0.46**$^{-}$	-0.26	**-0.52**$^{-}$
neglect	**1.16**$^{+}$	**0.43**$^{+}$	**0.17**$^{+}$	**0.25**$^{+}$
neutralize	**-2.42**$^{-}$	**-2.43**$^{-}$	**-2.43**$^{-}$	**-2.43**$^{-}$

For the results, we can analyze both the presence of BEND maneuvers and the mixture of these maneuvers by creating a co-occurrence matrix. Fig 7 gives an example of the heatmap from a single run of the experiment. Notice that it is a comparison between the intended BEND maneuvers - those requested from the LLM - and the detected BEND in the results.

It is obvious from this that SynX is not perfect - there should be ones in the diagonal such that the maneuvers we ask for the LLM returns. However, it is also important to note that where a BEND maneuver is detected as something else - everywhere else but the diagonal - this is not necessarily bad. There is some level of

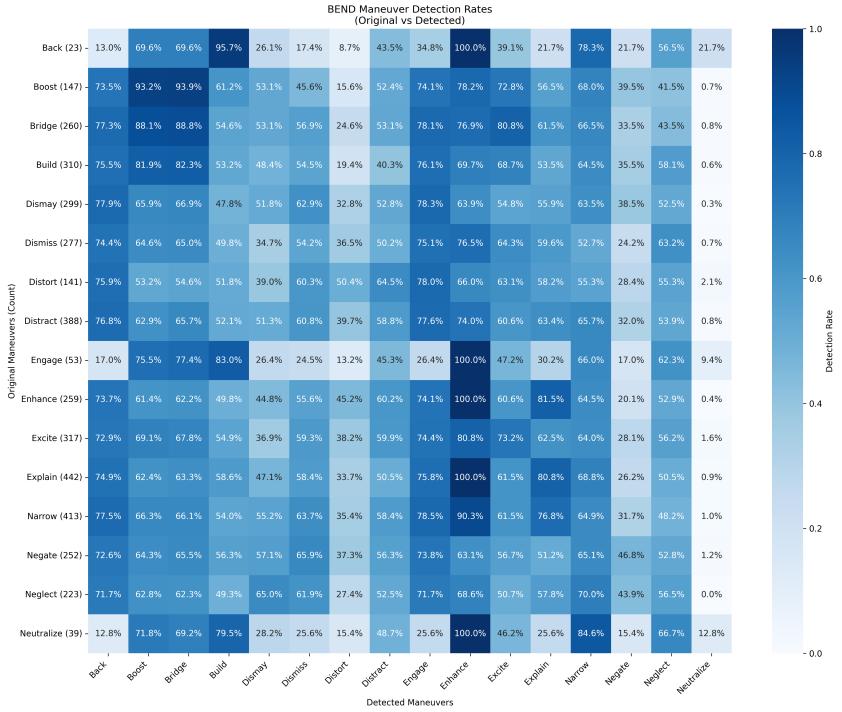


Fig. 7 Example co-occurrence heatmap (that shows intended BEND maneuvers mapped to detected BEND maneuvers.

co-detection and co-occurrence naturally even in real data, i.e. rarely do maneuvers occur in isolation independent of one another. In order to account for this we need to use the same correlation matrix derived from real data - specifically the Balikatan 22 X/Twitter dataset. We take the mean co-occurrence for each day and construct a standard deviation for each combination.

This allows us to then compare a single run of results and get a distance from the mean in terms of standard deviation. We can also put the runs from a single experimental set-up together to see how well any given set-up does, as in Fig. 9.

We can also compare the average z-score from the runs within an experimental setup. Fig. 10 shows an example of these results. Finally, we can compare the overall distance from the mean across the four main configurations as in Fig. 11. From Fig. 11 we can determine that overall, SynX under-represents BEND maneuvers within the synthetic messages. Also, there was no significant difference between including the BEND definitions in the user prompt versus leaving them out entirely. This might be due to the relative proximity of extraneous definitions - i.e. those BEND maneuvers not

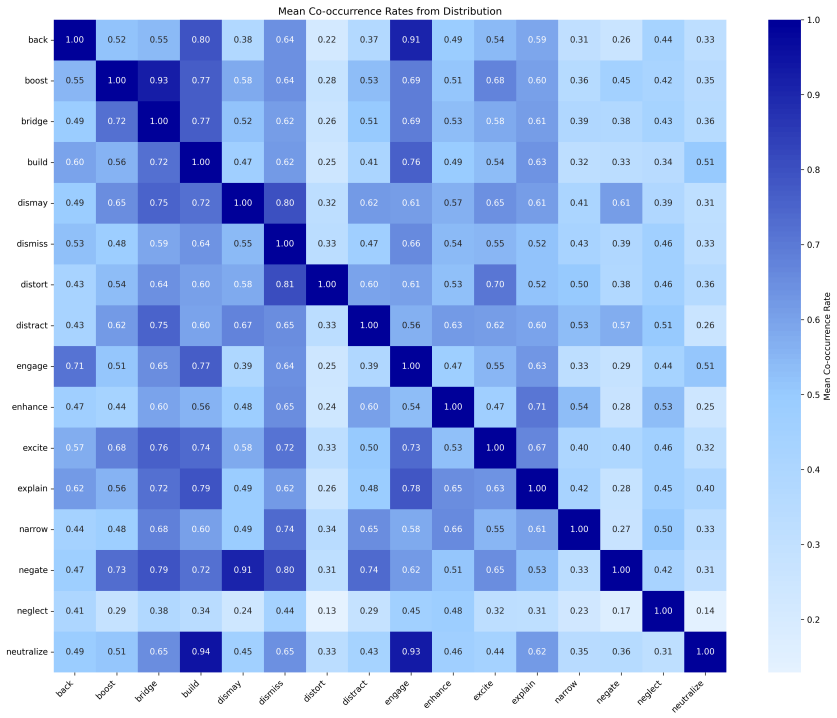


Fig. 8 Co-occurrence heatmap of the Balikatan 22 data - note that there is no concept of intended vs detected BEND maneuvers in real data

being requested for this particular message - with the BEND maneuver requests specific to the message. However, placing the definitions in the system prompt - increasing the distance between overall BEND definitions and the specific ones being requested - significantly increases the accuracy of the LLM returned responses. However, the methodology we take for trying to re-request the LLM for a better BEND response provided no significant improvement. Finally, the statistically significant prevalence of negative z-scores indicates that the LLM - based on our prompts - is under-representing BEND maneuvers on average.

6 Validation

Additional validation comes from directly comparing network metrics between the outputs of SynX + AESOP scenario and the Balikatan 22 dataset. We evaluated SynX outputs on five different network metrics. Three were suggested by Chang et al. in 2024 during their development of an LLM-based synthetic network simulation.[9] We

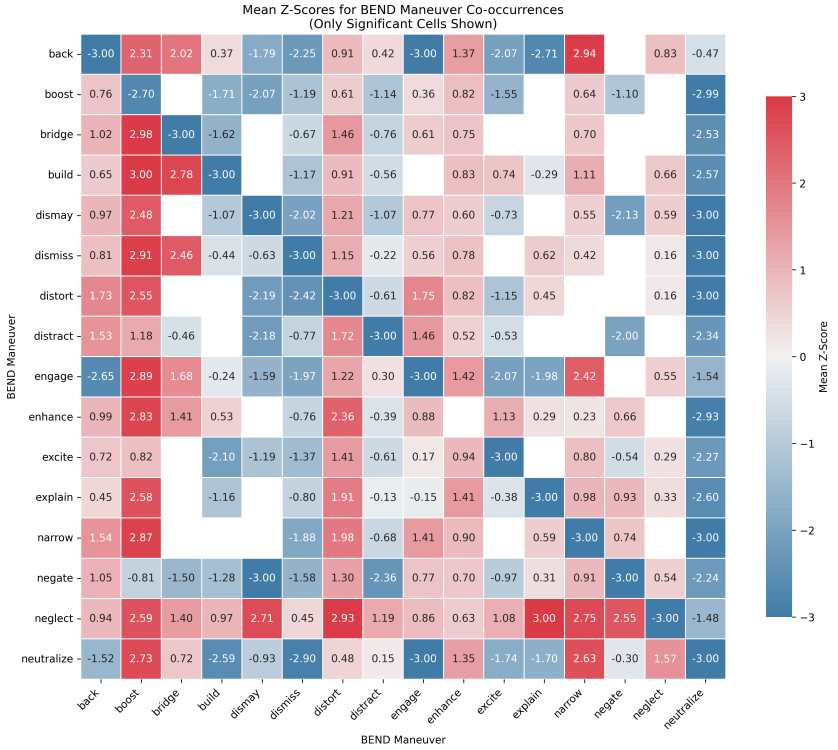


Fig. 9 Co-occurrence matrix across all runs that had the BEND definitions in the system prompt but did not repoll the LLM

added Degree Distribution of the Tweet x Tweet (Retweet) network because ORA-Pro's primary method for stance propagation depends upon this network being well-connected. It is not necessary that SynX be be precisely equivalent to the Balikatan 22 scenario but that the differences should be plausible. We are more concerned with matching shape and form than exact values. The four metrics are:

- Average Shortest Path of Agent x Agent (All Communication)
- Proportion of nodes in the Largest Connected Component of Agent x Agent (All Communication)
- Modularity of Agent x Agent (All Communication)
- Degree Distribution of Tweet x Tweet (Retweet)

From the results in Table 8 we can see that SynX falls within acceptable ranges (within 10%) for two of the three Agent x Agent network metrics when compared with

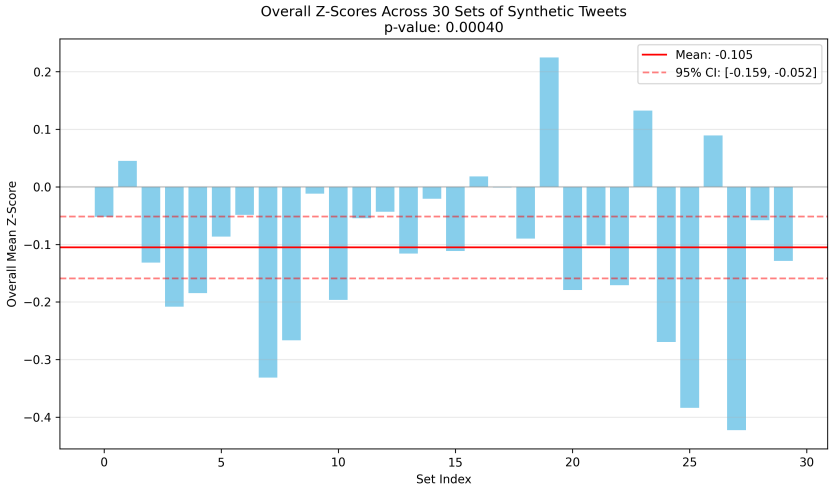


Fig. 10 A comparison of the overall distance from the mean for all runs that had the BEND definitions in the system prompt but did not repoll the LLM

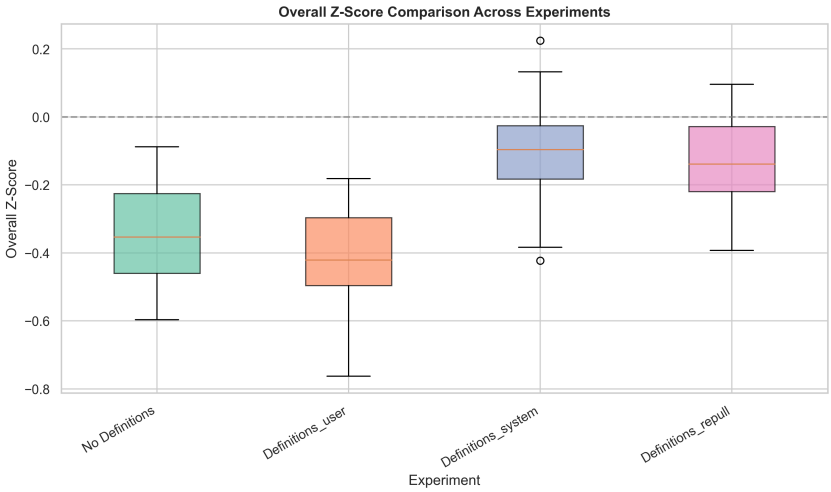


Fig. 11 A comparison of the overall distance from the mean across all BEND maneuvers from each of the four major experiment setups

Table 7 Stylized Facts

Summary	Effect	Source
Attentions spans limit how many users are affected	Reach is determined by leadership	Kang and Lerman, 2013. [23] Lu et al., 2014. [24]
Commonality of reposts	High level of derivative messages (50+%)	Beskow and Carley's "Agent Based Simulation of Bot Disinformation Maneuvers in Twitter" from 2019.[25]
Which messages are being reposted	Power law distribution	Lu et al., 2014. [24]
Real world likelihood of BEND maneuvers	variable-order Markov model with set-based context and non-replacement sampling based on tweets covering the Balikatan 22 exercise in APR 2022	Lepird, 2024.[22]

Table 8 Network Metrics Comparison for Agent x Agent Network

Metric	Real	Sim Mean	Sim Std	Abs. Diff.	Perc. Diff.(%)
Normalized Avg. Shortest Path	0.4158	0.4429	0.0294	-0.0272	-6.54
LCC Proportion	0.8738	0.9583	0.0123	-0.0845	-9.67
Modularity	0.5006	0.9174	0.003	-0.4169	-83.28

Table 9 Degree Distribution Statistics for Tweet x Tweet Network

Network	Node Count	Mean Degree	Median Degree	Max Degree	Std Dev
Real Data	2230	0.92	0.0	154	6.64
Simulation Avg	10457	0.88	0.0	148	4.74

the Balikatan 22 real dataset. SynX produces data sets that have agents that are too modular when compared to the example set. This is likely due to the constraints placed upon SynX by adhering to the AESOP scenario which has rigidly defined narrative groups. Regardless, more work will need to be done to improve AESOP and SynX in this area.

Finally, when looking at the Tweet x Tweet (Retweet) network results we can see that Synx faithfully recreates a scale-free network and closely mimics the Balikatan network - see Table 9 and Figs. 12 and 13.

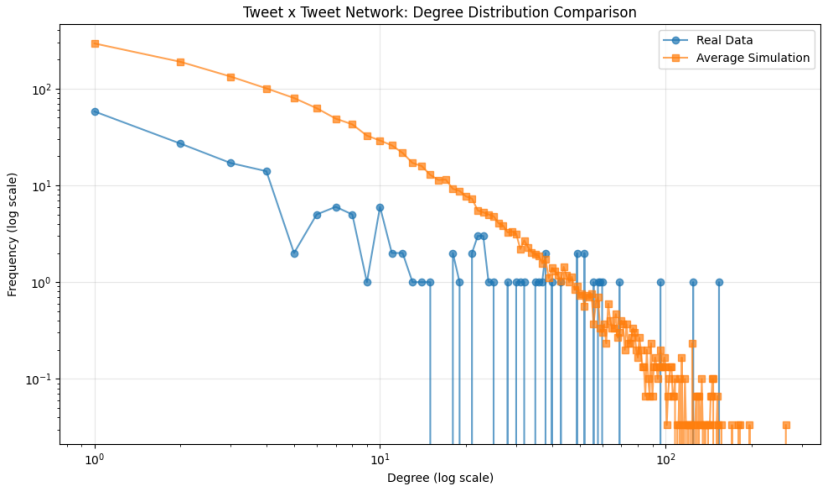


Fig. 12 Both the real data and the SynX display appropriate power-law properties for the Tweet x Tweet (Retweet) network

7 Future Work and Limitations

There are significant limitations to the current model that can be corrected in future work. First, the agents in the current model have opinions matrices that map their stance on each topic in the scenario; however, there is currently no population modeling implemented to feed these matrices nor is there information diffusion implemented such that theses stances change over time. Thus, while the actors respond in accordance with their opinions, the simulation is currently a perfect model of arguing on Internet forums - no one ever changes their mind.

Furthermore, more validation should be done. If the goal is simply to train on BEND maneuver detection and response, then the current validation network metrics and BEND evaluations show that SynX is sufficient. However, training and instruction on other aspects of social networks might require additional, unevaluated, network properties. This includes more research into matching the Agent x Agent modularity against real world datasets. Netanomics does have a fully featured evaluation tool for synthetic social media data sets, MOMUS. MOMUS will verify the synthetic dataset's adherence to the AESOP scenario, the semantic and syntactic content of the messages, and the overall network structure against real world data. This will provide a more thorough evaluation of the dataset.

Additional work should be done to improve the re-request methodology from the LLM. We provided the same prompt to the LLM again but added the original returned results as well as an explanation of what was present and what was missing. Other

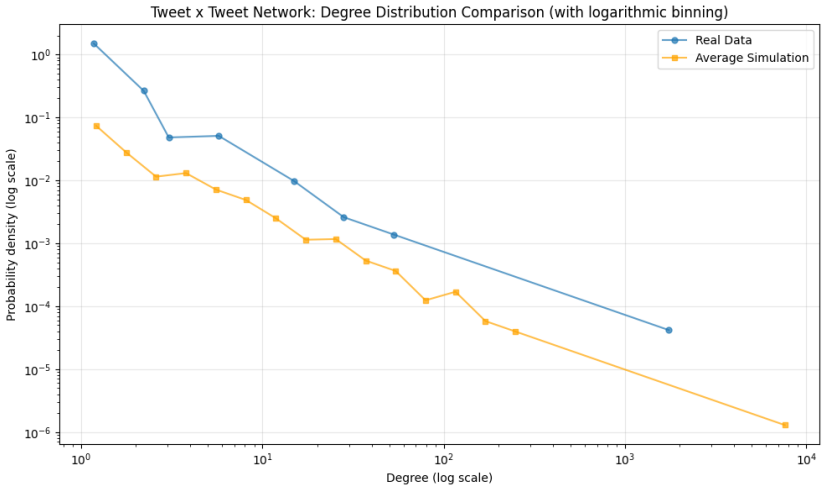


Fig. 13 Binning is not always a good idea, but with the discontinuous data from the real data this chart helps depict the form convergence between the real and synthetic data sets

methodologies should be explored, including asking the LLM itself to improve the message.

Finally, work is also required within the BEND evaluations. While the AESOP scenario comes with images and news sites, the current ORA-Pro and NetMapper BEND evaluation is done only on the meta-data and the text. Future detection should include an evaluation of the included images or referenced URLs. Current detection is also focused on deriving the intention of the author of a message rather than measuring the actual effects the message has on the narratives and networks in the corpus. Future studies should include effectiveness measures evaluated against real datasets.

8 Conclusion

We create an agent-based simulation, SynX, to model synthetic social media based on input scenario templates from Netanomics' AESOP tool. Our validation testing shows that SynX is capable of creating highly dynamic datasets that present BEND maneuvers similar to those of real world datasets. Additionally, we experimented with different techniques for interaction with an LLM and found that the inclusion of BEND definitions in system prompts was most effective. The validation and results show that SynX provides an effective way to create tailored social media datasets for analyst training on BEND maneuvers.

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References

[1] Badawy, A., Addawood, A., Lerman, K., Ferrara, E.: Characterizing the 2016 russian IRA influence campaign **9**(1), 31 https://doi.org/10.1007/s13278-019-0578-6 . Accessed 2024-04-19

[2] Carley, K.M.: Social cybersecurity: An emerging science. Computational and Mathematical Organization Theory **26**(4), 365–381 (2020) https://doi.org/10.1007/s10588-020-09322-9

[3] National Academies of Sciences, Engineering, and Medicine: A Decadal Survey of the Social and Behavioral Sciences: A Research Agenda for Advancing Intelligence Analysis. The National Academies Press, Washington, DC (2019). https://doi.org/10.17226/25335 . See chapter 6

[4] Beskow, D.M., Carley, K.M.: Social cybersecurity: an emerging national security requirement **99**(2), 117–127. Accessed 2024-04-18

[5] Blane, J.T., Bellutta, D., Carley, K.M.: Social-cyber maneuvers during the COVID-19 vaccine initial rollout: Content analysis of tweets **24**(3), 34040 https://doi.org/10.2196/34040 . Accessed 2024-04-18

[6] Meadows, D.L., Behrens, W.W., Meadows, D.H., Naill, R.F., Randers, J., Zahn, E.: Dynamics of Growth in a Finite World. Wright-Allen Press, Cambridge, MA (1974). https://elmoukrie.com/wp-content/uploads/2020/12/dynamics-of-growth-in-a-finite-world_nodrm.pdf

[7] Chopard, B., Droz, M.: Cellular automata: Modelling of physical systems. In: Cellular Automata Modeling of Physical Systems, pp. 6–13. Cambridge University Press, Cambridge, MA (1998). https://doi.org/10.1017/CBO9780511549755

[8] Goldstein, J.: Emergence as a construct: History and issues. Emergence **1**(1), 49–72 (1999) https://doi.org/10.1207/s15327000em0101_4

[9] Chang, S., Chaszczewicz, A., Wang, E., Josifovska, M., Pierson, E., Leskovec, J.: LLMs generate structurally realistic social networks but overestimate political homophily. These authors contributed equally: Serina Chang, Alicja Chaszczewicz (2024). https://arxiv.org/abs/2408.16629

[10] Hämäläinen, P., Tavast, M., Kunnari, A.: Evaluating large language models in generating synthetic hci research data: a case study. In: Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems. CHI '23. Association for Computing Machinery, New York, NY, USA (2023). https://doi.org/10.1145/3544548.3580688 . https://doi.org/10.1145/3544548.3580688

[11] Park, J.S., O'Brien, J.C., Cai, C.J., Morris, M.R., Liang, P., Bernstein, M.S.: Generative agents: Interactive simulacra of human behavior. arXiv preprint arXiv:2304.03442 (2023)

[12] Veselovsky, V., Ribeiro, M.H., Arora, A., Josifoski, M., Anderson, A., West, R.: Generating faithful synthetic data with large language models: A case study in computational social science. arXiv preprint arXiv:2305.15041 (2023)

[13] Vongthongsri, K.: Using LLMs for Synthetic Data Generation: The Definitive Guide. https://www.confident-ai.com/blog/the-definitive-guide-to-synthetic-data-generation-using-llms. Confident AI Blog, Accessed: 2025-03-14 (2023)

[14] Guo, X., Chen, Y.: Generative ai for synthetic data generation: Methods, challenges and the future. arXiv preprint arXiv:2403.04190 (2024)

[15] Kulkarni, S., Banerjee, J., Panchumarthy, M.: Generate Synthetic Counterparty (CR) Risk Data with Generative AI Using Amazon Bedrock LLMs and RAG. Amazon Web Services Machine Learning Blog (2025). https://aws.amazon.com/blogs/machine-learning/generate-synthetic-counterparty-cr-risk-data-with-generative-ai-using-amazon-bedrock-llms-and-rag/

[16] Blane, J.T., Moffitt, J.D., Carley, K.M.: Simulating social-cyber maneuvers to deter disinformation campaigns. In: Thomson, R., Hussain, M.N., Dancy, C., Pyke, A. (eds.) Social, Cultural, and Behavioral Modeling vol. 12720, pp. 153–163. Springer. https://doi.org/10.1007/978-3-030-80387-2_15 . https://link.springer.com/10.1007/978-3-030-80387-2_15 Accessed 2024-04-18

[17] Dipple, S., Carley, K.M.: Construct User Guide. https://www.cmu.edu/casos-center/publications/cmu-s3d-23-104.pdf

[18] OpeanAI: The Official Python Library for the OpenAI API. OpeanAI. original-date: 2020-10-25T23:23:54Z. https://github.com/openai/openai-python Accessed 2024-04-19

[19] Carley, K.M.: ORA: A Toolkit for Dynamic Network Analysis and Visualization. In: Alhajj, R., Rokne, J. (eds.) Encyclopedia of Social Network Analysis and Mining. Springer, New York, NY (2017). https://doi.org/10.1007/978-1-4614-7163-9_309-1

[20] Ng, L.H.X., Carley, K.M.: Deflating the chinese balloon: types of twitter bots in us-china balloon incident. EPJ Data Science **12**(1), 63 (2023) https://doi.org/10.1140/epjds/s13688-023-00440-3

[21] Jacobs, C.S., Ng, L.H.X., Carley, K.M.: Tracking china's cross-strait bot networks against taiwan. In: Social, Cultural, and Behavioral Modeling (SBP-BRiMS 2023), pp. 115–125. Springer, New York, NY (2023). https://doi.org/10.1007/978-3-031-43129-6_12 . https://link.springer.com/chapter/10.1007/978-3-031-43129-6_12

[22] Lepird, C.S.: Pink slime: Measuring, finding, and countering online threats to local news. PhD thesis, Carnegie Mellon University (October 2024). https://christine-lepird.github.io/Lepird_Thesis_Oct2024.pdf

[23] Kang, J.-H., Lerman, K.: LA-CTR: A limited attention collaborative topic regression for social media **27**(1), 1128–1134 https://doi.org/10.1609/aaai.v27i1.8451 . Accessed 2024-04-18

[24] Lu, Y., Zhang, P., Cao, Y., Hu, Y., Guo, L.: On the frequency distribution of retweets **31**, 747–753 https://doi.org/10.1016/j.procs.2014.05.323 . Accessed 2024-04-18

[25] Beskow, D.M., Carley, K.M.: Agent based simulation of bot disinformation maneuvers in twitter. In: 2019 Winter Simulation Conference (WSC), pp. 750–761. IEEE. https://doi.org/10.1109/WSC40007.2019.9004942 . https://ieeexplore.ieee.org/document/9004942/ Accessed 2024-04-18

Appendix D

JSON Schema for Data Standard

The following is a schema for the AESOP-¿SynTel/X Data Standard and examples

JSON SCHEMA

ACTOR SCHEMA


```
{
    "$schema": "https://json-schema.org/draft/2020-12/schema",
    "title": "Actor",
    "type": "object",
    "properties": {
        "aesop_id": {
            "type": "string",
            "description": "Unique AESOP ID for the actor."
        },
        "name": {
            "type": "string",
            "description": "The name of the actor (person, organization, or bot)."
        },
        "type": {
            "type": "string",
            "description": "Type of actor (e.g., 'Bot', 'Organization', 'Person')."
        },
        "leader_type": {
            "type": "string",
            "description": "Describes if the actor is a leader in a political, social, or organizational sense."
        },
        "title": {
            "type": "string"
        },
        "leads": {
            "type": "string"
        },
        "age": {
            "type": "string"
        },
        "gender": {
            "type": "string"
        },
        "race": {
            "type": "string"
        },
        "nationality": {
            "type": "string"
        },
        "real_person": {
            "type": "boolean",
            "description": "Indicates whether this actor represents a real individual or an artificial entity."
        },
        "description": {
            "type": "string"
        },
        "bio_prompt": {
            "type": "string",
            "description": "Text prompt used to generate an AI biography for the actor."
        },
        "ai_bio": {
            "type": "string",
            "description": "AI-generated biography for this actor."
        },
        "image_prompt": {
            "type": "string"
        },
        "ai_image": {
            "type": "string"
        },
        "day_zero": {
            "type": "boolean"
        },
        "legal": {
            "type": "string",
```

```
            "description": "Legal disclaimer regarding data ownership and confidentiality."
        }
    },
    "required": [
        "aesop_id",
        "name",
        "type"
    ]
}
```

ACTOR ORG SCHEMA


```
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    "type": "object",
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            "description": "Unique AESOP ID for the actor."
        },
        "name": {
            "type": "string",
            "description": "The name of the actor (person, organization, or bot)."
        },
        "type": {
            "type": "string",
            "description": "Type of actor (e.g., 'Bot', 'Organization', 'Person')."
        },
        "leader_type": {
            "type": "string",
            "description": "Describes if the actor is a leader in a political, social, or organizational sense."
        },
        "title": {
            "type": "string"
        },
        "leads": {
            "type": "string"
        },
        "age": {
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        "gender": {
            "type": "string"
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        "race": {
            "type": "string"
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        "nationality": {
            "type": "string"
        },
        "real_person": {
            "type": "boolean",
            "description": "Indicates whether this actor represents a real individual or an artificial entity."
        },
        "description": {
            "type": "string"
        },
        "bio_prompt": {
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            "description": "Text prompt used to generate an AI biography for the actor."
        },
        "ai_bio": {
            "type": "string",
            "description": "AI-generated biography for this actor."
        },
        "image_prompt": {
            "type": "string"
        },
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        "day_zero": {
            "type": "boolean"
        },
        "legal": {
            "type": "string",
            "description": "Legal disclaimer regarding data ownership and confidentiality."
        }
```

```
    },
    "required": [
        "aesop_id",
        "name",
        "type"
    ]
}
```

ACCOUNT SCHEMA


```
{
    "$schema": "https://json-schema.org/draft/2020-12/schema",
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    "type": "object",
    "properties": {
        "owner_aesop_id": {
            "type": "string",
            "description": "Unique AESOP ID of the actor owning this account."
        },
        "twitter_id": {
            "type": "string",
            "description": "Unique Twitter ID for this account."
        },
        "screen_name": {
            "type": "string",
            "description": "Public-facing Twitter username of the account."
        },
        "day_zero": {
            "type": "boolean",
            "description": "Indicates if this account is known to the Training Audience from the first day of an event."
        },
        "user_active_start_date": {
            "type": "string",
            "format": "date",
            "description": "Date when the account activity starts."
        },
        "user_active_end_date": {
            "type": "string",
            "format": "date",
            "description": "Date when the account activity ends."
        },
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            "items": {
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            },
            "description": "Boolean feature flags indicating various account attributes."
        },
        "bend_maneuvers": {
            "type": "array",
            "items": {
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            },
            "description": "BEND maneuvers associated with this account."
        },
        "maneuvering_upon": {
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        },
        "tweet_distribution": {
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            "description": "Pattern of tweets over time (e.g., Day 1: 10%, Day 2: 30%)."
        },
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            "type": "string",
            "description": "Twitter bio of the account."
        },
        "account_location": {
            "type": "string"
        },
        "account_url": {
            "type": "string"
        },
        "account_creation_date": {
            "type": "string",
            "format": "date"
        },
        "number_of_followers": {
```

```
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    "description": "Number of followers for this account."
},
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    "type": "string"
},
"number_of_languages_user_tweets_in": {
    "type": "string"
},
"percent_tweets_in_language": {
    "type": "string"
},
"num_original_tweets_per_day": {
    "type": "array",
    "items": {
        "type": "integer"
    },
    "description": "Range of original tweets per day."
},
"top_topics": {
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},
"num_mentions_per_tweet": {
    "type": "array",
    "items": {
        "type": "integer"
    },
    "description": "Range of mentions per tweet."
},
"accounts_to_mention": {
    "type": "string"
},
"mention_others": {
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},
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"other_accounts_retweet_quote": {
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    "items": {
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        },
        "other_words_used": {
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        },
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            }
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        },
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        },
        "stylistic_markers": {
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        },
        "legal": {
            "type": "string",
            "description": "Legal disclaimer regarding data ownership and confidentiality."
        }
    },
    "required": [
        "owner_aesop_id",
        "twitter_id",
        "screen_name"
    ]
}
```

ACCOUNT BOT SCHEMA


```
{
    "$schema": "https://json-schema.org/draft/2020-12/schema",
    "title": "Account",
    "type": "object",
    "properties": {
        "owner_aesop_id": {
            "type": "string",
            "description": "Unique AESOP ID of the actor owning this account."
        },
        "twitter_id": {
            "type": "string",
            "description": "Unique Twitter ID for this account."
        },
        "screen_name": {
            "type": "string",
            "description": "Public-facing Twitter username of the account."
        },
        "day_zero": {
            "type": "boolean",
            "description": "Indicates if this account is known to the Training Audience from the first day of an event."
        },
        "user_active_start_date": {
            "type": "string",
            "format": "date",
            "description": "Date when the account activity starts."
        },
        "user_active_end_date": {
            "type": "string",
            "format": "date",
            "description": "Date when the account activity ends."
        },
        "features": {
            "type": "array",
            "items": {
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            },
            "description": "Boolean feature flags indicating various account attributes."
        },
        "bend_maneuvers": {
            "type": "array",
            "items": {
                "type": "string"
            },
            "description": "BEND maneuvers associated with this account."
        },
        "maneuvering_upon": {
            "type": "string"
        },
        "tweet_distribution": {
            "type": "string",
            "description": "Pattern of tweets over time (e.g., Day 1: 10%, Day 2: 30%)."
        },
        "account_bio": {
            "type": "string",
            "description": "Twitter bio of the account."
        },
        "account_location": {
            "type": "string"
        },
        "account_url": {
            "type": "string"
        },
        "account_creation_date": {
            "type": "string",
            "format": "date"
        },
        "number_of_followers": {
            "type": "string",
```

```
    "description": "Number of followers for this account."
},
"number_following": {
    "type": "string"
},
"number_of_languages_user_tweets_in": {
    "type": "string"
},
"percent_tweets_in_language": {
    "type": "string"
},
"num_original_tweets_per_day": {
    "type": "array",
    "items": {
        "type": "integer"
    },
    "description": "Range of original tweets per day."
},
"top_topics": {
    "type": "string"
},
"num_mentions_per_tweet": {
    "type": "array",
    "items": {
        "type": "integer"
    },
    "description": "Range of mentions per tweet."
},
"accounts_to_mention": {
    "type": "string"
},
"mention_others": {
    "type": "string"
},
"num_retweets_per_day": {
    "type": "array",
    "items": {
        "type": "integer"
    }
},
"num_replies_per_day": {
    "type": "array",
    "items": {
        "type": "integer"
    }
},
"num_quotes_per_day": {
    "type": "array",
    "items": {
        "type": "integer"
    }
},
"retweet_quote_valence": {
    "type": "string"
},
"retweet_quote_categories": {
    "type": "string"
},
"accounts_to_retweet_quote": {
    "type": "string"
},
"other_accounts_retweet_quote": {
    "type": "string"
},
"num_hashtags_per_post": {
    "type": "array",
    "items": {
        "type": "integer"
    }
},
```

```
        "top_hashtags": {
            "type": "string"
        },
        "other_hashtags": {
            "type": "string"
        },
        "top_words": {
            "type": "string"
        },
        "other_words_used": {
            "type": "string"
        },
        "when_does_account_tweet_gmt": {
            "type": "array",
            "items": {
                "type": "integer"
            }
        },
        "percent_tweets_pos_neg_neut": {
            "type": "string"
        },
        "text_ratio": {
            "type": "string"
        },
        "image_ratio": {
            "type": "string"
        },
        "video_ratio": {
            "type": "string"
        },
        "identity_markers": {
            "type": "string"
        },
        "stylistic_markers": {
            "type": "string"
        },
        "legal": {
            "type": "string",
            "description": "Legal disclaimer regarding data ownership and confidentiality."
        }
    },
    "required": [
        "owner_aesop_id",
        "twitter_id",
        "screen_name"
    ]
}
```

EVENT SCHEMA


```
{
    "$schema": "https://json-schema.org/draft/2020-12/schema",
    "title": "Event",
    "type": "object",
    "properties": {
        "aesop_id": {
            "type": "string",
            "description": "Unique AESOP ID for the event."
        },
        "name": {
            "type": "string",
            "description": "Name of the event."
        },
        "type": {
            "type": "string",
            "description": "Categorization of the event (e.g., 'Political', 'Accident')."
        },
        "excite_number": {
            "type": "integer",
            "description": "Numeric indicator of how much excitement the event generates."
        },
        "active_date_range": {
            "type": "array",
            "items": {
                "type": "string",
                "format": "date-time"
            },
            "description": "Date range in which the event is active."
        },
        "summary": {
            "type": "string",
            "description": "Short textual summary of the event."
        },
        "ai_description": {
            "type": "string",
            "description": "AI-generated detailed description of the event."
        },
        "legal": {
            "type": "string",
            "description": "Legal disclaimer regarding data ownership and confidentiality."
        }
    },
    "required": [
        "aesop_id",
        "name",
        "type",
        "active_date_range"
    ]
}
```

GROUP SCHEMA


```
{
    "$schema": "https://json-schema.org/draft/2020-12/schema",
    "title": "Group",
    "type": "object",
    "properties": {
        "aesop_id": {
            "type": "string",
            "description": "Unique AESOP ID for the group."
        },
        "name": {
            "type": "string",
            "description": "Name of the group."
        },
        "leaders": {
            "type": "array",
            "items": {
                "type": "string"
            },
            "description": "List of AESOP IDs representing group leaders."
        },
        "people": {
            "type": "array",
            "items": {
                "type": "string"
            },
            "description": "List of AESOP IDs representing full members of the group."
        },
        "people_src": {
            "type": "array",
            "items": {
                "type": "string"
            },
            "description": "List of AESOP IDs representing members that this group will source from."
        },
        "orgs": {
            "type": "array",
            "items": {
                "type": "string"
            }
        },
        "orgs_src": {
            "type": "array",
            "items": {
                "type": "string"
            }
        },
        "bots": {
            "type": "array",
            "items": {
                "type": "string"
            },
            "description": "List of bot AESOP IDs affiliated with this group."
        },
        "bots_src": {
            "type": "array",
            "items": {
                "type": "string"
            }
        },
        "chatters": {
            "type": "array",
            "items": {
                "type": "string"
            }
        },
        "chatters_src": {
            "type": "array",
            "items": {
```

```
            "type": "string"
          }
        },
        "groups": {
          "type": "array",
          "items": {
            "type": "string"
          }
        },
        "groups_src": {
          "type": "array",
          "items": {
            "type": "string"
          },
          "description": "List of AESOP IDs representing groups that this group will source from."
        },
        "legal": {
          "type": "string",
          "description": "Legal disclaimer regarding data ownership and confidentiality."
        }
      },
      "required": [
        "aesop_id",
        "name"
      ]
}
```

TOPIC SCHEMA


```
{
    "$schema": "https://json-schema.org/draft/2020-12/schema",
    "title": "Topic",
    "type": "object",
    "properties": {
        "aesop_id": {
            "type": "string",
            "description": "Unique AESOP ID for the topic."
        },
        "topic_name": {
            "type": "string",
            "description": "Name of the topic."
        },
        "topic_description": {
            "type": "string",
            "description": "Brief description of the topic."
        },
        "number_of_narratives": {
            "type": "integer",
            "description": "Number of narratives associated with this topic."
        },
        "narratives": {
            "type": "array",
            "items": {
                "type": "object",
                "properties": {
                    "aesop_id": {
                        "type": "string",
                        "description": "Unique AESOP ID for the narrative."
                    },
                    "narrative_name": {
                        "type": "string",
                        "description": "Name of the narrative."
                    },
                    "narrative_date_start": {
                        "type": "string",
                        "format": "date-time",
                        "description": "Start date of the narrative."
                    },
                    "narrative_date_end": {
                        "type": "string",
                        "format": "date-time",
                        "description": "End date of the narrative."
                    },
                    "narrative_stance": {
                        "type": "string",
                        "description": "Stance on the topic (e.g., 'Pro', 'Anti', 'Neutral')."
                    },
                    "narrative_description": {
                        "type": "string",
                        "description": "Description of the narrative."
                    },
                    "narrative_group": {
                        "type": "array",
                        "items": {
                            "type": "string"
                        },
                        "description": "AESOP IDs of groups associated with this narrative."
                    },
                    "narrative_event": {
                        "type": "array",
                        "items": {
                            "type": "string"
                        },
                        "description": "AESOP IDs of events linked to this narrative."
                    },
                    "narrative_hashtags": {
                        "type": "array",
```

```
                    "items": {
                        "type": "string"
                    },
                    "description": "Hashtags associated with this narrative."
                },
                "bend_maneuvers": {
                    "type": "array",
                    "items": {
                        "type": "string"
                    },
                    "description": "BEND maneuvers related to this narrative."
                }
            },
            "required": [
                "aesop_id",
                "narrative_name",
                "narrative_date_start",
                "narrative_date_end"
            ]
        },
        "description": "List of narratives under this topic."
    },
    "legal": {
        "type": "string",
        "description": "Legal disclaimer regarding data ownership and confidentiality."
    }
  },
  "required": [
    "aesop_id",
    "topic_name",
    "number_of_narratives"
  ]
}
```

JSON EXAMPLES

ACTOR PERSON EXAMPLE


```
{
    "aesop_id": "3916147220",
    "name": "Bob J",
    "type": "Organizational",
    "title": "President",
    "leads": "Dog Enthusiasts of America",
    "age": "25",
    "gender": "Male",
    "race": "Caucasian",
    "nationality": "American",
    "real_person": false,
    "entourage_size": 0,
    "entourage": [],
    "bio_prompt": "Please provide a character background for Bob J a 25 year-old Male, who is the President of Dog Enthusiasts of America in a realistic roleplaying game. Bob loves dogs and wants everyone else to love them as well.",
    "ai_bio": "Character Background: Bob J\n\nName: Bob J\nAge: 25\nGender: Male\nRole: President of Dog Enthusiasts of America\n\nBackground:\n\nBob J is a passionate and enthusiastic 25-year-old man with a deep love for dogs. Growing up in a small rural town, Bob always had a special connection with animals, especially dogs. He was raised in a household that instilled in him a sense of compassion and responsibility towards animals from an early age. Bob's parents encouraged his love for dogs by adopting several rescue animals, including dogs, which further solidified his bond with them.\n\nAfter graduating from high school, Bob pursued a degree in Animal Sciences, with a particular focus on canine behavior and training. He spent his college years actively working with local animal shelters, volunteering his time to help rehabilitate and find homes for abandoned dogs. Bob's dedication and hands-on experience allowed him to develop a deep understanding and empathy for these animals.\n\nDuring his college years, Bob also started the Dog Enthusiasts Club, a community-driven group focused on advocating for responsible pet ownership, supporting local animal shelters, and promoting dog welfare. This club aimed to educate the public about the benefits of owning dogs while also addressing the importance of proper training, nutrition, and healthcare.\n\nFollowing his graduation, Bob's passion for dogs led him to take on the role of President of Dog Enthusiasts of America, a national organization aiming to bridge the gap between dog owners, enthusiasts, and professionals across the country. As President, Bob spearheads campaigns and initiatives that promote awareness, education, and responsible ownership.\n\nBob is known for his unwavering dedication and infectious enthusiasm for his cause. He regularly organizes adoption drives and fundraising events, leveraging both his extensive network and social media presence. Bob believes that fostering a love for dogs amongst others will create a positive impact not only on the lives of these animals but also on society as a whole.\n\nOn a personal level, Bob's own love for dogs is reflected in his own household. He has a loyal and affectionate dog named Max, an adopted mixed breed. Bob and Max share a deep bond and are often seen accompanying each other on adventures, from exploring nature trails to participating in dog-friendly events.\n\nThrough his role as President, Bob hopes to inspire and mobilize others to recognize the importance of dogs in our daily lives. He believes that, with the right support, dogs can serve as sources of companionship, emotional well-being, and personal growth. Bob's ultimate goal is to create a world where every dog is loved, cherished, and cared for in a responsible and compassionate manner.",
    "image_prompt": "",
    "ai_image": "no_image.png",
    "description": "Bob loves dogs and wants everyone else to love them as well.",
    "day_zero": false,
    "ATM": {},
    "legal": "All material contained is confidential and proprietary to Netanomics and the CASOS center at CMU."
}
```

ACTOR ORG EXAMPLE


```
{
    "aesop_id": "3362094714",
    "name": "CoolCats",
    "type": "News",
    "organizational_leader": "",
    "main_account_handle": "",
    "other_associated_handles": "",
    "region_targeted": [],
    "news_bias": "Extreme Left",
    "organizational_credibility": "High",
    "questionable_characteristics": [],
    "bio_prompt": "Please provide several paragraphs of the organizational biography and history for CoolCats.\nIt is an organization that:\nCoolCats is a media company that is only interested in driving the cat narrative forward.\nAdditional descriptors include:\n",
    "ai_bio": "innovative, forward-thinking, creative, and passionate.\nCoolCats was founded in 2010 by a group of cat enthusiasts with a shared vision of promoting all things related to cats and felines. The organization was born out of a desire to not only celebrate the beloved companionship that cats provide but also to create a platform that showcases their unique qualities and stories. From the beginning, CoolCats set out to be a media company that focuses solely on driving the cat narrative forward and captivating audiences worldwide.\n\nWith a commitment to innovation, CoolCats strives to constantly push boundaries and challenge conventional norms when it comes to cat-related content. The organization prides itself on being at the forefront of digital media and utilizing cutting-edge technologies to deliver engaging and entertaining cat-centric experiences. Through the use of immersive storytelling techniques, original videos, captivating photos, and interactive digital platforms, CoolCats seeks to captivate audiences and provide a fresh perspective on the feline world.\n\nSince its inception, CoolCats has been recognized as a pioneering force in the cat media landscape. The organization has successfully collaborated with renowned photographers, filmmakers, and artists to produce visually stunning content that showcases the beauty, agility, and playfulness of cats. CoolCats has also established strong relationships with cat-related brands, shelters, and organizations, serving as a bridge between the various stakeholders in the cat community.\n\nCoolCats' commitment to creativity and passion is evident in its diverse range of projects. The organization has launched successful online campaigns in support of animal welfare causes, education initiatives, and adoption programs. Additionally, CoolCats has ventured into publishing, producing high-quality magazines and books that explore the allure and mysteries of the feline world. These publications showcase captivating stories, share valuable knowledge, and celebrate the unique bond between humans and cats.\n\nAs a forward-thinking organization, CoolCats understands the power of social media and actively leverages platforms such as Instagram, YouTube, and Facebook to reach and engage with a global audience. Through captivating posts, interactive features, and community-building efforts, CoolCats continues to cultivate a strong online presence, fostering connections among cat lovers and enthusiasts worldwide.\n\nIn summary, CoolCats is an innovative and creative media company that has been dedicated to driving the cat narrative forward since its inception. With a passion for cats and a commitment to pushing boundaries, CoolCats produces captivating content, hosts engaging experiences, and supports various initiatives that celebrate the feline world. Through its unique storytelling techniques and cutting-edge digital platforms, CoolCats seeks to captivate audiences, connect cat lovers, and advocate for the welfare and well-being of cats everywhere.",
    "image_prompt": "",
    "ai_image": "no_image.png",
    "description": "CoolCats is a media company that is only interested in driving the cat narrative forward.",
    "day_zero": false,
    "ATM": {},
    "legal": "All material contained is confidential and proprietary to Netanomics and the CASOS center at CMU."
}
```

X/TWITTER ACCOUNT EXAMPLE


```
{
    "owner_aesop_id": "3362094714",
    "twitter_id": "3036913001664145858",
    "screen_name": "CoolCats",
    "day_zero": false,
    "user_active_start_date": "2024-05-24",
    "user_active_end_date": "2024-05-26",
    "features": [
        false,
        false
    ],
    "bend_maneuvers": [
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0",
        "0"
    ],
    "maneuvering_upon": "",
    "tweet_distribution": "Day 1(10%), Day 2(10%), Day 3(10%), Day 4(40%), Day 5(30%)",
    "account_bio": "",
    "account_location": "",
    "account_url": "",
    "account_creation_date": "2024-12-05",
    "number_of_followers": "10000",
    "number_following": "100",
    "number_of_languages_user_tweets_in": "1",
    "percent_tweets_in_language": "en:100.00%",
    "num_original_tweets_per_day": [
        2,
        5
    ],
    "top_topics": "",
    "num_mentions_per_tweet": [
        0,
        4
    ],
    "accounts_to_mention": "",
    "mention_others": "Yes",
    "num_retweets_per_day": [
        4,
        10
    ],
    "num_replies_per_day": [
        4,
        10
    ],
    "num_quotes_per_day": [
        4,
        10
    ],
    "retweet_quote_valence": "Mostly Positive",
    "retweet_quote_categories": "News (60%); Gov (30%); Health (7%); Other(3%)",
    "accounts_to_retweet_quote": "",
    "other_accounts_retweet_quote": "Yes",
    "num_hashtags_per_post": [
        0,
```

```
        4
    ],
    "top_hashtags": "",
    "other_hashtags": "Yes",
    "top_words": "",
    "other_words_used": "Yes",
    "when_does_account_tweet_gmt": [
        7,
        20
    ],
    "percent_tweets_pos_neg_neut": "Positive (50%), Negative (25%), Neutral (25%)",
    "text_ratio": "1",
    "image_ratio": "0",
    "video_ratio": "0",
    "identity_markers": "None",
    "stylistic_markers": "None",
    "legal": "All material contained is confidential and proprietary to Netanomics and the CASOS center at CMU."
}
```

EVENT EXAMPLE


```
{
    "aesop_id": "5840946919",
    "name": "Accidental death of a cat",
    "type": "Collision/Accident",
    "which_objects_involved": "",
    "who_owns_objects": "",
    "name_of_objects": "",
    "excite_number": 3,
    "active_date_range": [
        "2024-05-25 11:00",
        "2024-05-25 13:00"
    ],
    "other_countries_involved": [],
    "cities": "",
    "other_areas": "",
    "event_leader": "",
    "leader_job_title": "",
    "leader_home_country": [],
    "positive_hashtags": "",
    "negative_hashtags": "",
    "summary": "A cat was accidentally run over by a car in Ramses Park.",
    "prompt": "Here is some information about Accidental death of a cat, a(n) Collision/Accident:\nThis accident involves a cat and a car. It takes place from 2024-05-25 to 2024-05-25. The purpose/summary of the event is as follows: \nA cat was accidentally run over by a car in Ramses Park.\nGenerate several paragraphs describing the event in detail.",
    "ai_description": "On May 25, 2024, a tragic accident occurred in Ramses Park involving a cat and a car. It was an ordinary day, with people enjoying the park's serene atmosphere, unaware of the heartbreaking events that were about to unfold. The unsuspecting cat, going about its day, crossed paths with an unfortunate vehicle.\n\nAs fate would have it, the car, driven by an unaware and unsuspecting driver, approached the unsuspecting feline. In a split second, the cat found itself in the wrong place at the wrong time, unable to escape the impending danger. The collision was sudden and unavoidable, causing a wave of panic and distress amongst onlookers who witnessed the heartbreaking scene.\n\nThe impact of the car against the innocent creature resulted in immediate tragedy. The force was enough to cause serious injuries that led to the untimely demise of the cat. An overwhelming sense of sorrow overcame those who witnessed the unfortunate event, as they realized there was nothing that could have been done to prevent it.\n\nMembers of the community, park-goers, and animal lovers came together, heartbroken by the unfortunate accident. Some attempted to console and provide support to the distraught driver, understanding that this was an unintentional incident. Others grieved for the loss of an innocent life, reflecting on the fragility and unpredictability of existence.\n\nOfficials were promptly contacted, and an investigation was initiated to determine the exact details and circumstances surrounding the collision. Statements from witnesses were obtained, reconstructing the event to understand the sequence of events leading to the tragic accident. The incident served as a stark reminder of the importance of attentiveness and cautious driving, even in seemingly safe environments.\n\nIn the aftermath of the accident, the community rallied together to create awareness about road safety, emphasizing the need for drivers to be ever watchful for animals that may unexpectedly cross their path. This unfortunate event served as a crucial reminder to drivers to exercise heightened caution, particularly in areas where animals are known to roam freely.\n\nAlthough the accidental death of a cat may appear inconsequential to some, its impact resonates deeply within the hearts of those who value all forms of life. The incident highlights the importance of fostering a community that not only cares for its human members but also extends this compassion to the welfare and safety of animals. It serves as a reminder to us all to be mindful of our surroundings, acknowledging that our actions have consequences that extend beyond our own lives.",
    "number_of_injects": 0,
    "injects": [],
    "ai_image": "no_image.png",
    "legal": "All material contained is confidential and proprietary to Netanomics and the CASOS center at CMU."
}
```

GROUP EXAMPLE


```
{
    "aesop_id": "3969792916",
    "name": "Dogs_Good",
    "group_ratio": "1",
    "leaders": [
        "4002506303"
    ],
    "people": [
        "3916147220",
        "7879212436"
    ],
    "people_src": [],
    "orgs": [
        "4002506303"
    ],
    "orgs_src": [],
    "bots": [
        "8590922004"
    ],
    "bots_src": [],
    "chatters": [],
    "chatters_src": [],
    "groups": [],
    "groups_src": [
        "7704052942"
    ],
    "GTM": {},
    "GTT": {},
    "legal": "All material contained is confidential and proprietary to Netanomics and the CASOS center at CMU."
}
```

TOPIC EXAMPLE


```
{
    "aesop_id": "6262843952",
    "topic_name": "Cats",
    "topic_hashtags": [],
    "topic_description": "Cats rule",
    "number_of_narratives": 4,
    "narratives": [
        {
            "aesop_id": "8350793621",
            "narrative_name": "Cat allergens",
            "narrative_date_start": "2024-05-07 00:00",
            "narrative_date_end": "2024-05-28 00:00",
            "narrative_stance": "Anti",
            "narrative_ratio": "1",
            "narrative_description": "Cats do not make the best pets because many people are allergic to them.",
            "narrative_example": "",
            "narrative_group": [
                "3969792916"
            ],
            "narrative_event": [],
            "narrative_hashtags": [
                "nocats",
                "allergies"
            ],
            "bend_maneuvers": [
                "100",
                "20",
                "20",
                "10",
                "10",
                "10",
                "10",
                "10",
                "5",
                "5",
                "5",
                "5",
                "5",
                "5",
                "5",
                "5"
            ]
        },
        {
            "aesop_id": "7946016526",
            "narrative_name": "Cats are the best pets",
            "narrative_date_start": "2024-05-14 00:00",
            "narrative_date_end": "2024-05-26 00:00",
            "narrative_stance": "Pro",
            "narrative_ratio": "1",
            "narrative_description": "Cats make the best pets",
            "narrative_example": "",
            "narrative_group": [
                "8984124093"
            ],
            "narrative_event": [],
            "narrative_hashtags": [
                "cats",
                "pets"
            ],
            "bend_maneuvers": [
                "100",
                "20",
                "20",
                "10",
                "10",
                "10",
```

```
        "10",
        "10",
        "5",
        "5",
        "5",
        "5",
        "5",
        "5",
        "5",
        "5"
    ]
},
{
    "aesop_id": "4076237060",
    "narrative_name": "Death of a cat",
    "narrative_date_start": "2024-05-25 00:00",
    "narrative_date_end": "2024-05-25 03:00",
    "narrative_stance": "Neutral",
    "narrative_ratio": "1",
    "narrative_description": "A cat was accidentally killed today.",
    "narrative_example": "",
    "narrative_group": [
        "7704052942",
        "8984124093"
    ],
    "narrative_event": [
        "5840946919"
    ],
    "narrative_hashtags": [
        "petnews"
    ],
    "bend_maneuvers": [
        "100",
        "20",
        "20",
        "10",
        "10",
        "10",
        "10",
        "10",
        "5",
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