

# **Engagement as a Predictor: Regression Insights from Facebook Activity During the Sudanese Revolution**

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# Engagement as a Predictor: Regression Insights from Facebook Activity During the Sudanese Revolution

## Abstract

This study examines how the Sudanese Professionals Association (SPA) strategically used Facebook to mobilize offline protests during the 2018–2019 Sudanese revolution. Contrary to narratives of leaderless digital activism, the SPA an anonymous but organized actor effectively leveraged social media to coordinate mass action under authoritarian rule. Using a dataset combining SPA Facebook posts with verified protest events from the Armed Conflict Location & Event Data Project (ACLED), the study employs hierarchical multiple regression to analyze the impact of digital activity on protest frequency and size.

Key findings show that the number of posts and the day of the week significantly predicted protest incidents. In contrast, protest size was shaped by post-event engagement, specifically user responses to news posts following prior events. The analysis introduces new metrics, including a mobilization rate and a weighted response intensity score, to quantify online efforts and public sentiment.

The study also identifies a strategic engagement cycle: shares peak before events, reactions and comments rise during protests, and emotional engagement continues afterward. These patterns demonstrate how digital communication was timed and structured to support offline action. The findings contribute to social movement theory and offer new tools for understanding digital mobilization in authoritarian contexts.

**Keywords:** Facebook mobilization, offline protests, Sudanese revolution, social media engagement, collective action, hierarchical regression, online-offline dynamics

## Introduction and Background

According to Abdul Reda et al. (2021), social movement theories focus on three key areas of theoretical inquiry: the structure of political opportunity, cultural framing, and resource mobilization theory. The structure of political opportunity examines the constraints and challenges that social movements face, while cultural framing refers to the strategies and tools used to attract and recruit members. These approaches help explain how individuals are encouraged to join movements. While resource mobilization theory highlights the ability of movements to acquire and deploy both material and symbolic assets to sustain action.

With the rise of social media, particularly platforms like Facebook, these frameworks have evolved to account for digital forms of mobilization. Scholars have noted a shift toward

“connective action,” where loosely affiliated individuals coordinate via personalized social networks, often in the absence of traditional leadership (Bennett & Segerberg, 2013). In this model, digital platforms allow participants to share customized messages and mobilize around shared grievances without the need for centralized organizations or formal hierarchies. Unlike collective action, which typically relies on strong leadership, defined membership, and coordinated strategies, connective action is decentralized, fluid, and driven by individual expression. It emphasizes the role of digital media in enabling spontaneous and scalable forms of activism, often through hashtags, viral content, or peer-to-peer communication.

This theoretical shift has been supported by a growing body of empirical research showing that traditional leadership structures may in fact disrupt such decentralized dynamics. In many recent protest movements, the involvement of traditional or hierarchical organizations has been associated with reduced grassroots momentum. For instance, during the 2012 Occupy Nigeria protests, public enthusiasm declined after the Nigerian Labour Congress (NLC) entered negotiations with the government, which many saw as co-opting the movement (Adebanwi & Obadare, 2011). Similar patterns were observed in Egypt (Tufekci, 2017), the Hong Kong Umbrella Movement (Lee & Chan, 2016), and Occupy Wall Street (Gerbaudo, 2017), where formal leadership introduced tension or fragmentation. These cases accentuate (Bennett & Segerberg, 2013) argument that traditional leadership structures may clash with the personalized, horizontal nature of digital-era mobilization.

This study challenges that assumption by analyzing the role of the Sudanese Professionals Association (SPA) during a specific period within the 2018–2019 Sudanese revolution. Sudan became the focal point of global attention as the Sudanese people successfully overthrew a dictator after 30 years of rule. This victory followed waves of peaceful protests that rallied behind slogans

such as *Silmya* (peaceful) and #Just\_fall (Awad, 2022). These demonstrations were primarily organized and coordinated by a coalition of professionals—including doctors, teachers, lawyers, and university professors—operating under the umbrella of the SPA (Zunes, 2021).

Although founded in 2014 as a coalition of professional bodies, the SPA remained largely unknown until December 2018. Its members were anonymous, with no public names or faces, yet the organization quickly emerged as the most trusted voice coordinating protest actions through its verified Facebook page. Unlike the leaderless model emphasized in connective action theory, SPA's structured yet faceless leadership played a critical role in mobilizing mass offline participation.

By applying resource mobilization and cultural framing theories, this study investigates how SPA's strategic use of Facebook—particularly through calls to action, consistent messaging, and emotionally resonant content—correlated with protest size and frequency. It introduces novel measures, including a Facebook-specific mobilization rate and weighted response intensity score, to assess how online engagement predicted offline outcomes.

The findings offer a rare empirical case in which a relatively hierarchical actor operating through digital channels enhanced, rather than hindered, mass mobilization. This contradicts dominant narratives in the digital activism literature and offers new insights into the evolving role of organizational leadership in networked protest environments.

The SPA used their verified Facebook page as the primary channel to connect with the public. Through this platform, they provided protest schedules, directions, and strategic guidance to demonstrators from December 2018 until the onset of the war in 2023. Facebook's significance in

this context is underscored by data from Alexa.com<sup>1</sup>, which ranks Facebook as the third-most accessed website in Sudan, following Google and YouTube, while Twitter ranks sixteenth. **Error! Reference source not found.** depicts a map shared on the SPA Facebook page, used to guide protestors and organize their efforts.



Fig. 1 A Map from SPA Facebook Page giving direction for an arranged protest took place in March 28th, 2019

This study investigates the mass mobilization efforts carried out through the SPA Facebook page. It analyzes the framework used to communicate plans for various activities, or ‘calls for action,’ that took place between December 2018 and April 2019 (Fig. 2).



Fig. 2 Timeline highlighting the period of interest in this research

<sup>1</sup> [www.alexa.com](http://www.alexa.com) accessed June 2020.

### *Study Context*

In the early weeks of the revolution, protests emerged spontaneously without prior planning. These demonstrations often occurred in markets or immediately after school dismissals. By mid-December, the SPA began playing a more prominent role in coordinating actions through their Facebook page. Initially, the SPA supported calls for action suggested by other Facebook users by sharing their content. Over time, they assumed a leadership role, proposing dates and specific actions for the public to follow.

The SPA page organized a wide range of activities, including protests, marches, civil disobedience campaigns, cleaning initiatives, brief sit-ins, and other forms of resistance against the authorities (Guta, 2023). These actions were strategically suggested across various locations, targeting the capital city of Khartoum as well as other cities across Sudan. There was no fixed schedule; calls for action could be made on weekdays or weekends. Once the SPA issued a call on their page, people on the ground would respond and carry out the described action. However, the number of participants varied. For instance, a single call for protests often resulted in multiple demonstrations, differing in size and location. Therefore, analyzing the response to SPA calls involves not only determining whether people participated but also assessing the overall number of participants.

In addition to issuing calls for action, the SPA page provided real-time coverage during events by posting pictures and videos. They also shared news updates and highlighted reactions from various stakeholders, such as political parties, labor and student unions, and religious groups. In some instances, the SPA did not initiate specific actions but supported and amplified calls from other groups by posting them on their page.

The SPA page also generated significant engagement within the online community. Posts received a variety of reactions, including likes, shares, comments, and other interactions enabled by Facebook's tools. While the SPA actively sought to encourage participation through their posts, the online responses also served as indicators of broader support. This support often came from individuals unable to participate directly, mainly Sudanese people living abroad, who used the platform to express solidarity and encouragement.

The centrality of the SPA in the uprising was not only evident from its online activity but also widely acknowledged by observers, activists, and international organizations. As protests intensified, the SPA emerged as the most trusted and organized body coordinating resistance efforts across the country. According to the International Crisis Group (2019), the SPA played a decisive role in sustaining public momentum, maintaining protest discipline, and articulating unified demands, particularly during the general strikes and mass actions that challenged the regime's authority. Its transparent communication and credibility among the public positioned it not just as a mobilizer, but as a *de facto* leadership body of the revolution.

In that context, Sudan erupted in nationwide protests that would come to define a critical turning point in the country's modern political history. Initially ignited by the government's decision to cut subsidies on basic goods such as bread and fuel, the demonstrations quickly transformed into a broader movement demanding political reform and an end to President Omar al-Bashir's 30-year authoritarian rule (Gallopín, 2020).

While demonstrations in Sudan had occurred in previous years, the 2018–2019 protests were unprecedented in both scale and persistence. What distinguished this wave was the strategic use of digital technologies to coordinate action, spread information, and foster solidarity. Social media

platforms, particularly Facebook and Twitter, played a vital role in circumventing state censorship and creating a shared national discourse (Guta, 2023). Despite severe internet restrictions and violent crackdowns, the movement sustained momentum for several months through a combination of online coordination and offline mobilization.

Unlike traditional opposition parties, which were often viewed as fragmented or compromised, the SPA garnered public trust through its organizational discipline and clear communication. Its posts frequently included details about protest times, locations, and strategies for peaceful resistance. These calls were not just instructional, they served as rallying points, enabling decentralized groups to act simultaneously across the country. At times, a single SPA post led to dozens of spontaneous demonstrations, particularly in Khartoum, Omdurman, and Port Sudan (The Guardian, 2019).

Ultimately, sustained pressure led to the military overthrow of President al-Bashir on April 11, 2019. Though the post-revolution transition has faced many setbacks, the events of 2018–2019 underscored the transformative potential of grassroots mobilization and the pivotal role digital platforms can play in shaping political outcomes in authoritarian contexts.

This study investigates how the SPA utilized Facebook not only as a platform for coordination and communication but also as a structured tool for mobilizing offline collective action during the Sudanese revolution. Contrary to dominant accounts suggesting that centralized leadership dampens decentralized protest energy, this case provides an empirical counterexample in which a relatively hierarchical and anonymous organization successfully facilitated mass mobilization through consistent and emotionally resonant messaging.



Grounded in resource mobilization theory and cultural framing, this study explores the extent to which SPA's Facebook activity translated into on-the-ground action. By analyzing patterns of user engagement (reactions, shares, and comments) and linking them to verified offline protest events, the study examines the predictive relationship between digital signals and physical participation.

This study introduces a novel event-level method for quantifying mobilization efforts on Facebook by analyzing engagement with protest-specific hashtags. It also proposes a weighted response intensity measure based on engagement types, offering a more meaningful interpretation of online reactions. These metrics are then tested for their predictive power in relation to verified offline protests, providing both methodological and empirical contributions to the literature on online-offline activism.

This work is organized as follows: first, a review of relevant literature on social media, offline protests, Facebook mobilization, and Facebook reactions. Next, the methodology and analytical framework are outlined. This is followed by an analysis of the dataset and presentation of the results. Finally, the Discussion, limitations, and conclusions, and suggestions for future research are discussed.

## **Literature Review**

Measuring mobilization efforts through social media is an active area of research. Several studies have explored how online activity can be quantified to understand efforts aimed at mobilizing people, resources, or support for various causes, ranging from political elections (Kligler-Vilenchik et al., 2020) to health campaigns (Gupta & Gupta, 2020) to social movements (Norambuena et al., 2022). In particular, the focus has shifted toward understanding how social media platforms act as both tools for coordination and signals of mobilization intensity.

Research studies have investigated the relationship between social media activity and offline protest behavior. For example, Wu & Gerber (2018) found a strong correlation between tweet volume and protest onset during the Egyptian revolution, though no significant link was found between tweets and actual activist networks. Abdul Reda et al. (2021) introduced the Resource Mobilization Score (RMS), measuring the ratio of event-relevant tweets to overall activity in the Black Lives Matter movement. Other studies have refined this approach with predictive models using machine learning (Chen et al., 2021) and temporal network modeling (Park & Jung, 2023), which take into account interaction dynamics over time. These studies were focused on the value of social media metrics in forecasting or interpreting protest intensity. However, others such as Soler i Martí et al. (2020) show that digital engagement alone is not always sufficient, pointing to the disconnect between persistent online activity and actual mobilization during the COVID-19 lockdown.

Much of the literature focuses either on spontaneous, individual-level activism, where users independently express dissent or mobilize peers, or on coordinated, organization-level efforts, where formal actors structure messaging and timing. While Twitter-based studies often emphasize the former, Facebook studies (e.g. McKeon & Gitomer, 2019) more frequently capture the latter. This study aligns with the second stream, examining how a formal actor (SPA) strategically engaged users via structured messaging campaigns.

While Twitter has been the dominant platform in these studies, Facebook presents a unique environment due to its diversity of interaction spaces (e.g., pages, groups, profiles). McKeon & Gitomer, (2019), for instance, analyzed how a Facebook page was used to organize resistance to high-stakes testing, demonstrating how it functioned as both a mobilization space and a source of tactical knowledge. Similarly, Auter & Fine (2018) explored how political candidates used

Facebook to raise funds and spread campaign messaging. Despite Facebook's dominance in many regions, especially in the Global South, its role in structured mobilization efforts remains underexplored. In particular, few studies have developed event-level measures that quantify mobilization efforts through Facebook pages using consistent, traceable hashtags or post typologies.

A growing subfield has focused on Facebook reactions as indicators of public sentiment and engagement. Early research primarily examined “likes,” shares, and comments. However, with the platform’s introduction of more nuanced reactions (Love, Haha, Wow, Sad, Angry), scholars have sought to interpret emotional responses to content. For instance, ‘Love’ and ‘Angry’ are often viewed as clear indicators of positive and negative sentiment respectively, while ‘Like’ remains ambiguous—frequently excluded due to its overuse and unclear intent (Freeman et al., 2020; Kaur et al., 2019; Kim & Yang, 2017). Gerbaudo et al. (2023) found that Angry reactions were significantly correlated with higher shares, especially on posts related to politically charged issues such as immigration and security.

To analyze these reactions, researchers have applied diverse techniques, including sentiment analysis (JOST et al., 2020), regression modeling (Eberl et al., 2020), and clustering (Giuntini et al., 2019). Some studies, such as Freeman et al. (2020), have introduced reaction intensity measures, combining engagement types into weighted indicators. For instance, shares are often considered stronger indicators of support than comments, which may reflect either agreement or dissent. Other researchers have proposed logarithmic or proportional adjustments to account for skewed distributions of reactions.

Despite these efforts, scholars caution against over-interpreting reaction data. (Paolillo, 2023)

emphasizes that Facebook reactions are context-dependent and “semantically unstable,” as platform design and post content shape how users react. Nonetheless, when aggregated and interpreted carefully, engagement metrics can offer valuable insights into patterns of attention, emotional resonance, and potential mobilization.

Together, these studies provide the foundation for this paper’s approach: to develop a structured, event-level mobilization metric tailored to Facebook, and to assess how user responses measured by intensity and polarity relate to offline protest activity. By applying and adapting these insights in the context of the Sudanese revolution, this study contributes to the growing literature on digital activism, while highlighting the unique dynamics of mobilization through Facebook.

Building on these prior studies, this research focuses on three main categories of independent variables, each tailored to Facebook’s interaction model and SPA’s structured outreach. The first group captures SPA’s mobilization efforts, including the total number of posts per event, the number of explicit calls for action, the day of the week selected for protest, and the duration of each mobilization. The second group reflects public engagement, operationalized through a mobilization rate derived from event-specific hashtags, and a response intensity measure that combines reactions, comments, and shares to assess the volume and depth of user engagement. The third group considers emotional polarity, particularly from news-style posts referencing earlier events, by examining the distribution of Facebook reactions which offer insight into users’ responses.

These variables are tested against two dependent variables: (1) the number of offline protest incidents following each SPA mobilization effort and (2) the size of physical protests as reported in independent media. Together, these variables support the testing of two null hypotheses: (H0a)

that there is no relationship between the independent variables and protest incidents, and (H0b) that there is no relationship between the independent variables and protest size. This framework enables the analysis of whether and how SPA's digital communication influenced offline mobilization outcomes during the specified period of the Sudanese revolution.

## **Methodology and Analytical Framework**

This section details the methods employed to achieve the research objectives, including data collection, ethics review, and data preprocessing. The study utilized two datasets: the first was sourced from the SPA's public Facebook page (<https://www.facebook.com/SdnProAssociation>), while the second comprised third-party data on offline protests in Sudan, obtained from the Armed Conflict Location & Event Data Project (ACLED) <sup>2</sup>.

### ***Data Sources and Context***

The first dataset comprises Facebook posts from the SPA. Data were accessed via the Social Media Archive (SOMAR) at the University of Michigan's ICPSR through Meta's Content Library API. SOMAR provides ethical, systematic access to public social media data for scholarly research. Ethics approval for data use was obtained (Approval #103851). A total of 4,510 posts were collected as of July 9, 2021, including text content, reactions, comments, and shares.

The analysis focused on posts published between December 2018 and April 2019, when SPA's role in mobilization was most prominent and broadly supported. During this time, SPA's influence was at its peak before shifting in mid-2019 due to disagreements over military

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<sup>2</sup> For more information on ACLED, visit <https://acleddata.com/>

negotiations. The final sample included 543 posts, of which 152 were direct calls for action, linked to 71 unique events identified through SPA's official hashtags.

A content analysis of the SPA's Facebook activity revealed three main types of posts:

- Calling posts: Explicit instructions for collective action (e.g., protests, strikes).
- News posts: Updates on incidents or casualties from the ground.
- Statements: Announcements from third parties shared by SPA (e.g., political or religious entities).

The author of the post distinguishes the first two types since they are SPA authored Calling and News posts, while Statements originated from external bodies. Fig. 3 illustrates their distribution.

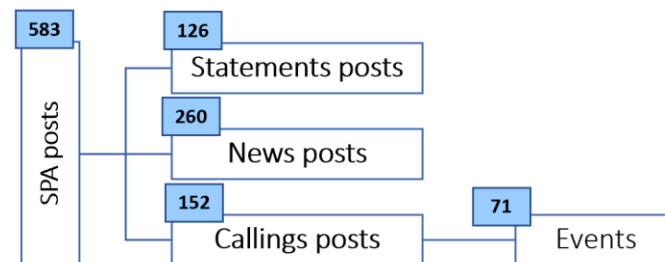


Fig. 3 Distribution of SPA Posts by Type.

SPA's Facebook communication heavily relied on hashtagging. A general movement hashtag, #مدن\_السودان\_تنتفض ("The Sudan Cities Revolt"), appeared consistently. From January 2019 onward, SPA implemented an event-specific hashtag policy, using formats like #موكب\_30\_مارس ("Procession of March 30") to coordinate specific mobilization efforts. These hashtags were used in both pre-event mobilization and post-event reporting. Fig. 4 shows an example for a calling post.



Fig. 4 A post featuring the message ‘Print, distribute, disseminate’ alongside the #موكب30مارس (Procession of March 30) and #مدن\_السودان\_تنتفض (The Sudan Cities Revolt) hashtags. The post calls on neighborhood committees to organize campaigns and sit-ins.

The second dataset was sourced from the ACLED, a widely referenced initiative that provides verified data on protest and political violence worldwide. For Sudan, ACLED compiles information from local and international news sources (e.g., Sudan Tribune, Radio Dabanga, Al Rakoba, UNSCO), covering incident type, participation size (e.g., Dozens, Hundreds, Thousands), and protest location. Events are cross-verified with at least two sources to ensure reliability.

This dataset was filtered to include events between December 2018 and April 2019, aligning with the Facebook data period. It served as the basis for the study’s dependent variables: the number of incidents and the size of protests across Sudan.

To prepare the SPA dataset for analysis, posts containing the same event-specific hashtag were grouped under a single event. For example, all posts tagged with #موكب28مارس (“Procession of March 28”) were consolidated into one event entry. Posts were categorized into three types: Calling, News, and Statement. However, Statement posts were few (only 21) and often inconsistently tagged. These posts were not authored by SPA and generated minimal user interaction. For these reasons, they were excluded from further analysis.

News posts, in contrast, were more consistent in hashtag usage and more frequent, totaling 251. They generated higher user engagement and were often published on or shortly after the protest day, serving as reflections on protest outcomes. These posts were analyzed to assess their influence on post-event mobilization sentiment and following events. For each event, various attributes were extracted and aggregated. Table 1 summarizes these attributes.

Table 1 Event-Level Attributes Extracted from SPA Data

Attribute Name	Description
Event	The date of the protest event
Shares, Comments, Likes, Loves, Hahas, Wows, Sads, Angrys (8 variables)	Aggregated total for each interaction across all posts tagged with the event hashtag
#posts	Total number of SPA-authored posts related to the event
#calling	Number of direct calls for action by SPA
Day of the week	Day on which the event took place
Size	Estimated protest size (see Table 2 for encoding)
#incidents	Number of protest-related incidents reported (from ACLED via Rydzak et al., 2020)
#days	Number of days the event was promoted in advance

For instance, the March 28 event (a Friday) included 8 SPA posts, of which 5 were calling posts. That day, 15 protest incidents were reported across multiple cities, with participation estimated in the hundreds. User engagement was computed by summing all interactions (reactions, shares, and comments) across all SPA-authored calling posts for each event. To enable quantitative analysis, categorical variables such as protest size and day of the week were encoded into numerical values, as shown in Table 2

Table 2 Encoding of Categorical Variables

Variable	Values Encoded
Day of Week	Saturday = 1, Sunday = 2, ..., Friday = 7
Protest Size	None = 0, Unidentified = 1, Dozens = 2, Hundreds = 3, Thousands = 4

### ***Measures of Effort and Engagement***

To assess the SPA's digital mobilization efforts and public engagement, this study introduces two key measures: mobilization rate and online response intensity. These were selected to capture both the organizational effort of the SPA and the public's behavioral reaction to these efforts. The



mobilization rate builds on the framework by Abdul Reda et al. (2021), who used a time-based ratio of tweets calling for action to total tweets to track mobilization efforts on Twitter. In Facebook's more centralized structure, this was adapted to reflect the SPA's effort on a per-event basis, calculated as the number of SPA "calling" posts containing an event hashtag divided by the total number of SPA posts referencing that event. This offers a normalized indicator of the SPA's intention to mobilize, adjusting for the varying volume of posts per event. Formally:

$$m\_rate_e = \frac{N\_callings}{N\_posts}$$

For example, to calculate the effort leading up to the April 11 event, there were 10 calling posts and a total of 28 posts containing the event hashtag  $m\_rate_{April\_6} = 10/28 = 0.35$ . In comparison, the effort for the March 28 event was calculated as follows:  $m\_rate_{March\_28} = 6/10 = 0.6$ .

To complement this measure of organizational input, the study includes a second measure: response intensity, which evaluates how strongly the public engaged with these posts. This reflects not only the volume of interaction but also the emotional weight and behavioral investment of the audience. Prior studies have employed various approaches to interpret Facebook reactions. For example, Eberl et al. (2020) used multilevel negative binomial regression, while Giuntini et al., (2019) applied clustering to group reactions by type, and Jost et al., (2020) and Kim & Yang, (2017) used sentiment analysis to infer post sentiment from reaction patterns. However, these methods often focused on post-level sentiment classification or relied on aggregate patterns without incorporating interaction weight. Moreover, some reactions such as 'Haha' and 'Wow' are semantically ambiguous, which can introduce noise when used uncritically (Paolillo, 2023).

This study instead adopts the approach of Kaur et al., (2019), who proposed an empirically validated weighting model that assigns different importance levels to reactions, shares, and

comments. Their model, which achieved 94% accuracy in aligning Facebook metrics with sentiment-labeled text, was designed to reflect the affective, cognitive, and behavioral dimensions of user engagement. In their scheme, emotional reactions (‘Love’, ‘Angry’, ‘Sad’) receive a weight of 0.5, sharing—which indicates strong alignment and behavioral intent—is weighted at 0.2, and commenting receives a weight of 0.05 for cognitive investment. This method is particularly well-suited for the current study, which aims to quantify public alignment with protest messages. A log transformation was applied to address skewness in engagement volumes and enhance comparability across events. The formula is:

$$\text{Response Intensity} = \sum (\log(\text{count}) + 1) \times \text{weight}$$

For example, with 13,218 Love reactions, 70 Sad, 6 Angry, 16,312 shares, and 5,687 comments, the score is approximately 6.15. This intensity value reflects the degree of user engagement with SPA calls to action, with higher values suggesting broader or more enthusiastic support.

### ***Analytical Framework***

To examine the relationship between SPA’s online mobilization efforts and subsequent offline protest activity, this study employs hierarchical multiple regression analysis. This method is suitable for evaluating the incremental predictive power of conceptually distinct groups of independent variables, entered in theoretical and temporal blocks. Specifically, hierarchical regression enables the assessment of how much additional variance in protest size and the number of incidents can be explained by online engagement and news post responses, beyond the foundational mobilization activities carried out by SPA.

The regression analysis is conducted in three blocks:

- **Block 1 (early stage):** includes features such as number of posts, number of calls to action, day of the week, and campaign duration.
- **Block 2 (use engagement):** includes the mobilization rate and response intensity to SPA's posts.
- **Block 3 (post-event):** News Post Responses: includes the intensity of public interaction with posts reporting on earlier events.

This stepwise, theory-driven structure not only reflects the chronological flow of mobilization and feedback but also aligns with literature on social media protest dynamics. The analysis models each dependent variable—protest size and number of incidents—as an outcome, with the following regression equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon$$

Where Y represents the dependent variable,  $\beta_0$  is the intercept,  $\beta_1, \beta_2, \dots, \beta_n$  are the regression coefficients for each predictor  $X_n$ , and  $\varepsilon$  is the error term.

The incremental contribution of each block is evaluated using changes in the coefficient of determination  $\Delta R^2$ , which indicates how much additional variance is explained by each successive block of variables.

Before conducting the analysis, standard assumptions were checked to ensure validity. Multicollinearity was assessed using VIF scores, confirming that no predictors were excessively correlated. Residual plots were examined to verify linearity, homoscedasticity, and the normality of residuals. Continuous variables (e.g., shares, reactions) were log-transformed as needed to address skewness.

## Analysis and Results

This section examines the relationship between SPA's Facebook mobilization efforts and offline protests. It begins with descriptive statistics of SPA posts and user engagement, followed by hierarchical regression analyses to evaluate key predictors including post frequency, mobilization rate, and response intensity on protest size and frequency.

### *Descriptive Statistics and Temporal Engagement Trends*

The SPA's posting pattern typically involved promoting a major event (protest) with smaller events in between. Although protests began on December 13th, SPA posts did not start until December 25th. Periods of inactivity, particularly in January, were observed. Starting in February, events became more frequent and consistent (see Fig. 5). The SPA published an average of 2.6 calls per event, with mobilization efforts typically lasting 1.1 days. Notably, high-impact events like December 25th and April 11th had longer campaigns, lasting up to four days (Zunes, 2021).

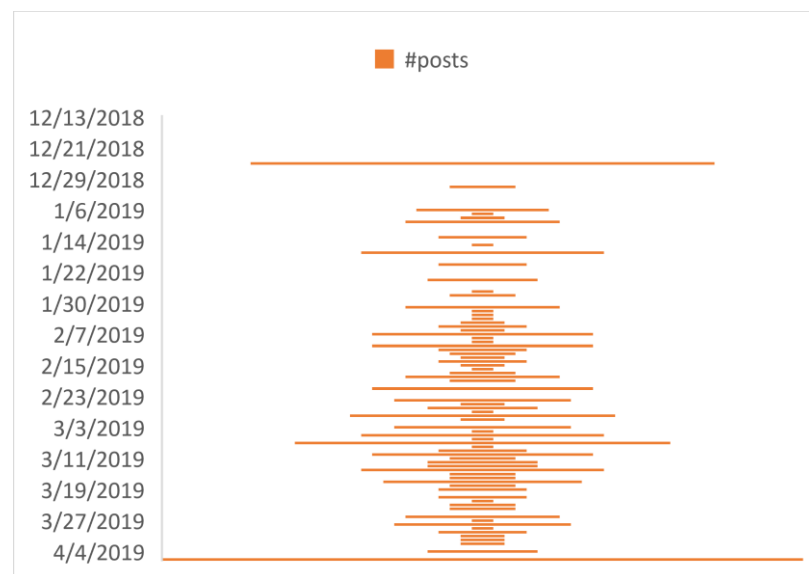


Fig. 5 Distribution of SPA posts from December to April, highlighting small and large events.

SPA's Facebook page total nearly 1 million likes and followers as of September 2021. Engagement peaked around 'calling' posts, which were shared over 140,000 times—more than the combined shares of news and statement posts. Emotions expressed were predominantly positive. Pearson's correlation analysis (Carbonell & Brand, 2018) confirmed a strong association between shares/comments and positive reactions ('Like', 'Love'). Negative reactions ('Sad', 'Angry') showed weak correlation with user engagement.

Online response values ranged from 2.97 to 6.85, averaging 4.86 with a median of 4.71, indicating a symmetric distribution. According to ACLED data, offline incidents were recorded on 66 of the 71 days analyzed. However, only 34 days involved injuries or fatalities. Protest size was poorly documented before mid-February, with many entries marked as 'unidentified'. Nevertheless, 13 major events were documented, each involving hundreds of thousands of participants.

User reactions displayed a clear dominance of the 'Like' reaction across all months, reflecting consistently high baseline approval of SPA's content. 'Love' reactions followed as the second most frequent, suggesting strong emotional connection. Less prevalent reactions like 'Angry' and 'Sad' remained marginal throughout, indicating minimal digital dissent. A closer look at the inset chart in Fig. 6—which excludes the overwhelming 'Like' reaction—uncovers a richer emotional profile during February and March, where 'Love', 'Wow', and 'Haha' reactions increased. These shifts coincided with intensified mobilization and heightened online engagement.



Fig. 6 Distribution of Facebook reactions to SPA posts from December to April. The inset excludes 'Like' to highlight variations in other emotional reactions.

No consistent correlation was found between online engagement and protest incidents overall. However, moderate correlations were observed after mid-February, suggesting growing alignment between digital and offline mobilization efforts. The average number of protests per day was 3.8 (range: 0–19). In 57% of cases, protests spanned multiple cities; 18% occurred solely in the capital, while 8% took place in non-capital cities. Thursday was the most common protest day, likely due to its position before the Friday-Saturday weekend (see Fig. 7).

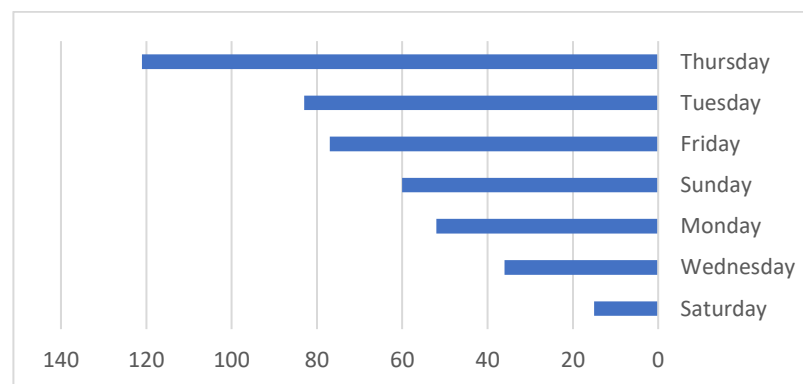


Fig. 7 Distribution of protests per day

To further explore digital engagement trends, user interactions (shares, comments, reactions) were analyzed in a 3-day window around key protest events:

- December 25, 2018: The first major mobilization effort saw moderate increases in engagement, led by widespread sharing.
- January 17, 2019: Engagement rose slightly as awareness grew.
- February 5 & 20, 2019: Coordinated efforts boosted shares and reactions. Comments surged during events.
- March 28, 2019: Sharp spikes in shares and reactions reflected strong support.
- April 6, 2019: Peak engagement across all metrics. Shares dominated pre-event, reactions peaked during, and post-event activity sustained momentum.

While SPA posting activity generally preceded or aligned with spikes in protest numbers, the overall temporal pattern shows a more consistent rhythm in protest occurrence than in Facebook activity. Fig. 8 highlights a few key alignment moments, such as the peaks around January 13 and April 11, where posting and protest numbers surged simultaneously. However, many days saw protests occur with relatively few SPA posts, underscoring the importance of other organizing forces or prior mobilization momentum. This suggests that although SPA played a key role in setting protest dates and amplifying calls to action, it was not the sole driver of protest occurrence. The data also revealed that although some protests occurred without SPA-associated hashtags, every hashtag used by the SPA corresponded to an offline protest. In other words, when the SPA issued a hashtag, it was always followed by real-world action.

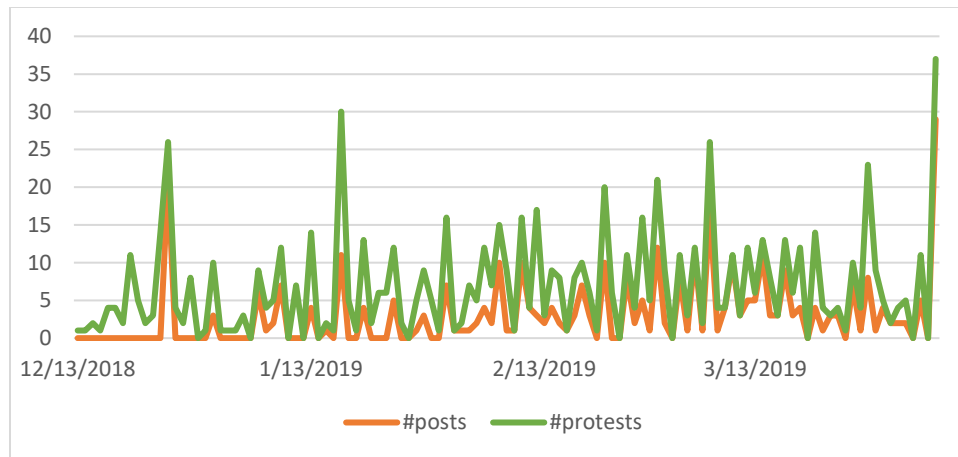


Fig. 8 SPA Facebook posts and protest activity reported in mainstream media.

### ***Hypothesis Testing***

Hierarchical regression was used to test the impact of SPA's Facebook activity on protest outcomes by entering variables in three theory-driven blocks: (1) Mobilization Basics, (2) Online Engagement, and (3) News Post Response. Two hypotheses were tested: one predicting the number of protest incidents, the other the size of protests.

#### **Hypothesis A – Number of Incidents**

The first model included SPA mobilization basics: number of posts, number of calls, duration, and day of the week. These core planning variables explained 30.9% of the variance in protest incidents ( $R^2 = 0.309$ ,  $p < 0.001$ ). Within this block, #posts ( $p = 0.008$ ) and day\_of\_week ( $p < 0.001$ ) emerged as significant predictors.

Adding the online engagement block (mobilization rate and response intensity) in Model2 yielded a small, statistically non-significant improvement ( $\Delta R^2 = 0.032$ ,  $p = 0.182$ ). Neither mobilization rate nor online response was a significant contributor to the number of incidents.



The final model included response to news posts from previous incidents (Model 3). This contextual layer added only a marginal improvement ( $\Delta R^2 = 0.010$ ,  $p = 0.557$ ), indicating that news post engagement following earlier protests had limited predictive value.

To conclude, the hierarchical regression analysis which focused on SPA's basic mobilization efforts explained the largest share of variance in protest frequency. Variables such as the number of posts and the timing of calls for action emerged as significant predictors, highlighting the central role of SPA's planning activities. Adding online engagement and contextual factors provided only marginal improvements in explanatory power.

### Hypothesis B – Size of Protests

For protest size, SPA Mobilization Basics (Model 1) explained 25% of the variance ( $R^2 = 0.250$ ,  $p < 0.001$ ), with both #posts ( $p = 0.020$ ) and day\_of\_week ( $p = 0.046$ ) showing significant effects.

Adding Online Engagement (Model 2) increased the explained variance to 28.5% ( $\Delta R^2 = 0.035$ ,  $p = 0.072$ ). In this block, mobilization rate ( $p < .01$ ) and online response ( $p < .01$ ) emerged as statistically significant individual predictors, further enhancing the model's explanatory power.

The News Post Variable (Model 3) improved the model further ( $R^2 = 0.328$ ;  $\Delta R^2 = 0.043$ ,  $p = 0.027$ ), with response to previous incidents becoming a significant predictor ( $p = 0.027$ ). This indicates that engagement with news posts following prior protests influenced turnout size in subsequent events.

As a result, the second hierarchical regression model which focused on predicting protest size showed that while SPA's mobilization efforts accounted for much of the variance, incorporating online engagement and contextual feedback from prior protest news significantly improved the model. User responses to earlier events, including both the mobilization rate and

online response, emerged as key predictors, suggesting that protest size was influenced not only by planning but also by how previous events were perceived and shared. Table 3 summarizes the hierarchical regression results, showing how each block contributes to the overall model.

Table 3 Hierarchical Regression Results for Protest Incidents and Protest Size Coefficients and p-values are shown for each model block: SPA mobilization (Block 1), online engagement (Block 2), and news post response (Block 3). \*Note: \*p < .05, \*\*p < .01, \*\*\*p < .001

Predictor	Model 1 (Incidents)	Model 2 (Incidents)	Model 3 (Incidents)	Model 1 (Size)	Model 2 (Size)	Model 3 (Size)
Intercept	1.632***	1.714***	1.779***	1.234***	1.543***	1.678***
#posts	0.144**	0.129**	0.125**	0.115*	0.110*	0.105*
#callings	0.223*	0.202*	0.190*	0.212*	0.198*	0.187*
Day of week	-0.218**	-0.201**	-0.191*	-0.15*	-0.13*	-0.115*
#days	0.031	0.028	0.026	0.08	0.075	0.07
Mobilization rate		0.127	0.12		0.300	0.280*
Online response		0.112	0.105		0.220	0.210*
News response			0.092			0.210*

## Discussion and Limitations

This study investigated how SPA's Facebook mobilization influenced the frequency and size of offline protests during the Sudanese uprising. While many accounts of digital activism emphasize decentralization and spontaneity, our findings suggest that structured and centralized messaging, when executed strategically, can significantly contribute to offline mobilization. Contrary to critiques that see hierarchical coordination as incompatible with digital movements (Bennett & Segerberg, 2013), the SPA demonstrated that deliberate timing, message clarity, and contextual awareness can amplify digital-to-offline impact.

Hierarchical regression modeling, structured around three theory-driven blocks: planning variables, online engagement, and contextual feedback allowed for isolation of different layers of influence on protest outcomes. In the first model predicting protest frequency, only SPA's post timing and volume consistently predicted offline action, while online engagement and reactions to prior news had minimal added explanatory power. This suggests that the SPA's consistent and

timely communication of calls to action played a direct role in the frequency of protests. The significance of the “day of the week” variable, with Thursday being the most common protest day, underscores the strategic alignment of online calls with offline routines and cultural contexts, likely capitalizing on the pre-weekend timing for maximum turnout. This finding aligns with resource mobilization theory, which posits that successful movements effectively acquire and deploy resources (in this case, information and coordination) to sustain action (McCarthy & Zald, 1977).

Interestingly, while online engagement (mobilization rate and response intensity) showed a small, statistically non-significant improvement in predicting protest incidents, it significantly contributed to explaining the variance in protest size. This distinction is crucial: while basic communication (number of posts) might trigger an event, the depth of online engagement, particularly user responses to news posts, appears to be a stronger indicator of the scale of participation. This suggests a nuanced relationship where initial mobilization is driven by direct calls, but sustained and larger-scale participation is influenced by the collective emotional and cognitive investment of the audience, as reflected in their reactions, shares, and comments. The weighted response intensity measure, which assigns higher value to emotional reactions and shares, effectively captured this deeper engagement, indicating that emotionally resonant content and widespread dissemination are vital for amplifying protest size.

The finding that every hashtag used by the SPA corresponded to an offline protest further reinforces the direct and impactful link between the SPA’s online strategy and real-world outcomes. This contrasts with studies that highlight a disconnect between persistent online activity and actual mobilization (Soler i Martí et al., 2020) , and instead supports the notion that when a credible and organized entity like the SPA issues clear calls to action, digital signals translate

reliably into physical participation.

Another interesting finding emerged is the strategic engagement cycle observed in this study where shares dominate before events to raise awareness, reactions and comments peak during events to reflect real-time engagement, and reactions continue after events to sustain sentiment. It illustrates how digital activity is timed and structured to support offline outcomes. This supports (Tufekci, 2017) assertion that digital movements are most effective when they integrate symbolic communication with logistical coordination, using platforms like Facebook not just for visibility, but for sustained mobilization.

This temporal pattern reveals that Facebook was not merely a broadcast tool but part of an evolving engagement rhythm. However, not all forms of online activity translated into offline participation. For example, neither the mobilization rate nor the intensity of online response significantly predicted protest outcomes. This aligns with prior studies (Bode, 2017; Margetts et al., 2015) that caution against interpreting digital engagement metrics as proxies for real-world action. Fig. 9 demonstrates the engagement cycle.

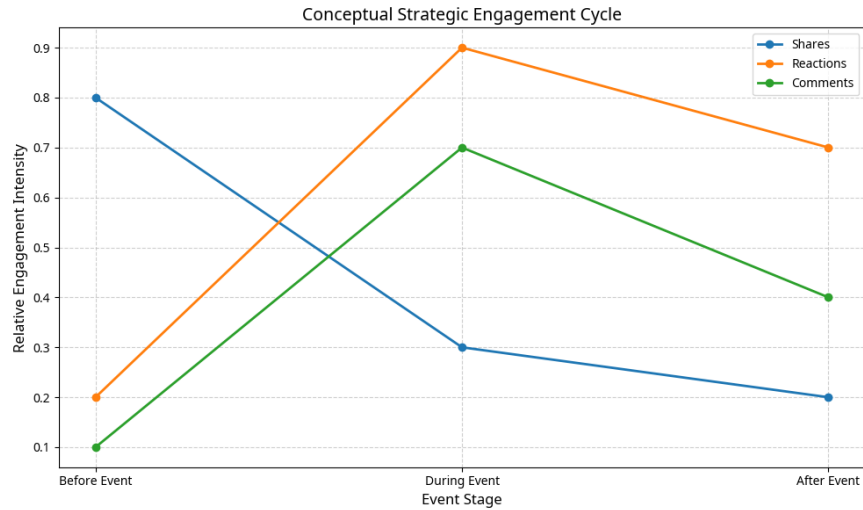


Fig. 9 Engagement cycle showing peaks in shares before events, reactions and comments during, and sustained activity post-event—highlighting how digital activity supports offline mobilization.

### *Limitations*

Several limitations temper these findings. First, the dataset includes only posts from SPA’s official Facebook page, potentially overlooking decentralized or parallel mobilization efforts. Additionally, protest data from ACLED relies on media reports, which may underrepresent rural or heavily censored regions. Manual classification of post types, while systematic, introduces possible subjectivity. Moreover, algorithmic amplification, user location, and platform-specific norms may influence engagement metrics in ways that do not reflect mobilization intent.

Reactions such as “Love” or “Angry” are also context-dependent. Their meaning is shaped by platform design and social norms, not always by sentiment alone (Paolillo, 2023). This complicates attempts to use emotional reactions as clean indicators of public mood or support. While SPA’s follower base was large, many users were likely located outside Sudan and thus unable to protest, further complicating the interpretation of engagement signals.

Importantly, causality cannot be established. While correlations were significant in some cases,

they do not imply direct influence. External factors, such as repression levels, media coverage, or local networks, were not modeled but likely played a role. Future research could apply time-series methods, causal inference designs, or mixed-method approaches to explore these dynamics more deeply.

Finally, the absence of significant effects for some variables such as the mobilization rate, number of calling posts, or campaign duration suggests that strategic quality and contextual fit may matter more than volume. These findings reinforce the idea that digital mobilization is less about noise and more about tone, timing, and trust in the source.

## **Conclusion and Future Work**

This study examined the SPA's strategic use of Facebook during the 2018–2019 Sudanese revolution, revealing how digital communication supported offline protest. Engagement followed a clear cycle: shares before events to build awareness, reactions and comments during for real-time support, and continued reactions after to sustain momentum. Hierarchical regression showed that post frequency and timing significantly predicted protest incidents, while post-event responses to news influenced protest size. These findings highlight how coordinated online strategies can shape real-world collective action.

This research contributes significantly to the social movement literature by challenging prevailing digital protest theories that often emphasize leaderless movements. The study demonstrates that a centralized, albeit anonymous, actor operating can effectively mobilize through social media. This adds a new dimension to ongoing debates about leadership, strategy, and the evolving logic of connective action, suggesting that organized entities can leverage digital platforms to achieve substantial real-world impact. Methodologically, the study's development of a context-specific

mobilization rate, adapted from prior Twitter-based scores, and its linkage of targeted online campaigns to verified offline events using ACLED data, provide a more granular and contextually grounded understanding of how digital signals translate into physical participation.

To build upon these findings and address current limitations, several avenues for future research are proposed. Firstly, further investigation into the ambiguous role of Facebook's 'Like' button is warranted, as its unclear meaning led to its exclusion from this study. Understanding the nuances of such seemingly simple interactions could provide deeper insights into user engagement. Secondly, expanding the analysis to include periods of less consensus within the SPA's mobilization efforts could offer valuable comparative insights into the dynamics of online-offline mobilization under varying conditions of internal cohesion.

Moreover, future research should aim to incorporate multimodal data sources beyond Facebook, such as WhatsApp communication, protest flyers, graffiti, and oral testimonies. This would help capture a more comprehensive picture of mobilization efforts that occur outside the Facebook platform, providing a more holistic understanding of the ecosystem of digital and analog communication in social movements. Adopting mixed-methods approaches that combine digital trace data with qualitative insights, such as interviews with activists, could further explore causal pathways and contextual nuances. Additionally, the application of advanced analytical techniques, including time-series and network analysis methods, may offer stronger tools for examining causal relationships and uncovering the real-time dynamics of protest coordination, thereby enhancing the predictive power and theoretical depth of future studies in this critical area.

## **DECLARATIONS**

### **Ethical approvals**

This study received ethical approval under Approval Number 103851. All data were publicly accessible and collected via the Social Media Archive (SOMAR) using the Meta Content Library and API, adhering to privacy and ethical standards. No personally identifiable information was used, ensuring compliance with ethical research practices.

### **Competing interests**

The author has no competing interests to declare that are relevant to the content of this article.

### **Availability of data and materials**

The Facebook dataset used in this study was subject to strict ethical review and cannot be shared publicly. Protest incident data from the Armed Conflict Location & Event Data Project (ACLED) is publicly available at <https://acleddata.com>.

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