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Seeing the Black Lives Matter Movement Through Computer Vision? An Automated Visual Analysis of News Media Images on Facebook

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Abstract

In this study, automated visual analysis was used to explore how the political leanings of news media are associated with their visual representation of the Black Lives Matter (BLM) movement. We analyzed more than 9,000 images posted on Facebook pages run by U.S. news media between August 2014 and October 2020 using commercially developed computer vision tools and a topic modeling algorithm. The results show that images used in BLM-related news coverage can be categorized into 10 distinctively themed groups that overlap with the main types of protest images uncovered by manual content analysis. Furthermore, news sources engaged in different visual representation practices depending on their partisan leanings. The patterns uncovered in this study imply that (de)legitimization of protests may take either active or passive forms. These findings contribute to theorization of the way news media might use social media platforms to (de)legitimize social protests, which may influence public opinion on social issues.

Keywords

social protests, Black Lives Matter movement, automated visual content analysis, topic modeling

Amid the COVID-19 pandemic, a witness video emerged on social media of a police officer kneeling on George Floyd during his arrest, which resulted in Floyd suffocating to death. The video went viral on social media platforms and spurred a series of protests across the United States as well as around the world. This is in line with research literature that highlights the critical role of media messages and news media in shaping public perceptions of social and political issues. Specifically, this incident showcases the potential of viral visual images to influence public opinion in the current image-based social media landscape (Bas & Grabe, 2016).

However, our understanding of how news media visually represent social protests on social media, which in general relies heavily on image-based content, is limited. This is not only because much of the research on media representation of social protests has focused on print and television broadcast news (Riddle et al., 2020) but also because there is a lack of systematic analysis of image components that circulate on social media platforms over an extended period. The dearth of research in this area is partially rooted in the Gutenberg Legacy, which undervalues the information potential of visual media compared with written text. Recently, calls have been made for a scholarly examination of images that carry important political information (Grabe & Bucy, 2009). We respond to this call by examining the Black Lives Matter (BLM)-related news images on social media by employing advanced automatized content analysis tools, which have fallen behind those used for textual content. Specifically, this study examines how news media curate visual images on social media to cover the BLM movement against racial injustice. We analyzed more than 9,000 images posted on Facebook by 61 news organizations between August 2014 and October 2020 using a procedure that combines commercially available computer vision tools and an unsupervised machine learning clustering technique (i.e., topic modeling).

Our findings show that visual representation of the BLM movement can be clustered into 10 image categories that share a common theme. Moreover, the major themes of these image clusters can be categorized according to their emotion

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and efficacy increasing potential that were identified in the literature by using manual content analysis of protest images (Esfandiari et al., 2021; Kharroub & Bas, 2016). Furthermore, our analysis also revealed subtle patterns that functioned to delegitimize protests that demand racial equality in the United States reflected in politicized visual representation practices news media utilizes on social media platforms. Specifically, pro-Democrats and neutral news sources highlighted positive aspects of the BLM movement. By contrast, pro-Republican news sources not only highlighted the confrontational aspect of the protests but also downplayed aspects of the BLM movement that potentially evokes hope and camaraderie. Our findings showcase the methodological advantages of commercially available computer vision tools in investigating a large visual data set.

Visual Representation of Social Protests on Social Media

Cultural studies scholarship emphasizes the discursive importance of visual representation of social groups, as media representation has the potential to reveal power inequalities in society. Media representations of marginalized groups not only reflect dominant ideologies such as racism but also reinforce racialized views toward the groups (Hall, 2011). For example, stereotypes persist in media representations of African Americans in the United States such that Black men are more likely to be depicted as unemployed or violent, whereas Black women are more likely to be hyper-sexualized (e.g., Brooks & Hebert, 2006). Visual representation of social movements, traditionally dominated by professional news media, also serves as an ideological force that reinforces stereotypical notions of marginalized groups by stressing the disorder and violence caused by social protests (DalCortivo & Oursler, 2021).

Despite the work of cultural studies scholarship and social movement studies on visual portrayals of social protests, the existing social scientific research on social protests falls behind on *systematic* investigations of how news media images visually portray social protests. The term *protest paradigm* suggests a predictable pattern—in usually textual—in the coverage of social protest news: protesters are portrayed in a way that frames them as marginals, undermines their viability, and sensationalizes their version of events (Chan & Lee, 1984). Professional journalistic conventions, such as reliance on certain news sources, lead to a one-sided perspective in covering social protests (McLeod & Hertog, 1992). Emphasis on the controversial or violent dimensions of social protests, while ignoring other aspects such as social issues or the social context from which the conflicts arose (Chan & Lee, 1984), affects audience attitudes and perceptions, delegitimizing them in the eyes of the audience (Shoemaker, 1984).

More recently, studies on traditional media coverage of the BLM movement found a similar pattern reported in the protest paradigm literature (e.g., Brown, 2021; Brown & Harlow, 2019). For example, Kilgo (2021) argued that news media coverage of the social protests in response to police brutality incidents contributed to the delegitimization of the BLM movement against police violence and racism. Certain media frames were used to cover anti-racism protests, such as the "spectacle frame" that highlights protesters' sensational, high drama, and unorthodox actions (Brown & Harlow, 2019; Brown & Mourão, 2021). In line with the protest paradigm, these studies found that negative frames reinforce the marginalization of Black people (Kilgo, 2021). Specifically, "legitimizing debates" in news coverage of the BLM movement lead to increased support for and identification with the protesters and criticism of the police, whereas exposure to "riot" and "confrontation" frames has the opposite effect (Brown & Mourão, 2021).

Yet our understanding of how news media visually frame social protests is limited, as the previous literature has primarily focused on how news media *textually* frames social protests without accounting for their visual components. The visual aspect of social protest coverage warrants close scrutiny not only because social protests are important spectacles but also because visual and textual representations of social protests in news media do not always correspond to each other (Milman & Doerr, 2023) making the visual components of news coverage an integral part of interpretive packages (i.e., framing; Boscarino, 2022; Geise & Baden, 2015). These observations stress the importance of systematic visual analysis of social protests in understanding how news media frame social protests. For this reason, we identify two conceptual gaps in the literature in the following section to highlight the need to investigate how news media visually frame social protests on social media: the dearth of systematic investigation of (1) visual framing of social protests in general and (2) visual framing of social protests on social media, especially images created by professional journalists rather than user-generated content.

Social Media and Visual Framing of Social Protest

Images constitute an essential aspect of the news media coverage of protests. Citizens who monitor protests on social media platforms are exposed to a wide variety of both user-generated and professional journalistic pictures. Recently, the protests against police brutality in the United States have been heavily circulated on social media. Typically shared with the popular hashtag #BlackLivesMatter, images of protest events and the documentation of police injustices have been widely circulated (Pew Research Center, 2020). Indeed, a recent study that examines Twitter messages on the BLM movement found that visual images—especially those evoking certain emotions (i.e., enthusiasm and fear)—have a stronger potential to mobilize by drawing public attention to social protests (Casas & Webb Williams, 2019).

While images have the potential to influence public perceptions of protests (Arpan & Tüzünkan, 2011) and mobilize public participation (Casas & Webb Williams, 2019), systematic analysis of social protest images has received little attention. This is not only because the literary tradition undervalues visual information (Grabe & Bucy, 2009) but also because methodological difficulties arise from analyzing largely unstructured visual information. For example, developing a comprehensive coding scheme that accounts for complicated contextual information on visual images (e.g., Bock et al., 2011) can be challenging when conducting a comprehensive examination of visual content.

For this reason, only a handful of studies so far have conducted a manual content analysis of social protest images shared on social media (e.g., Esfandiari et al., 2021; Kharroub & Bas, 2016). For example, Kharroub and Bas (2016) identified the dominant visual themes in Twitter images shared during the 2011 Egyptian Revolution, where the overwhelming majority of images were shared by ordinary Twitter users (not by news professionals). The most prevalent images included collective efficacy, where groups were portrayed as protesting, engaging in protest activities, and displaying national and religious symbols. Kharroub and Bas (2016) argue that these types of images have efficacy-eliciting potential. Conversely, another important, yet less prevalent, image type was those with the potential to evoke anger. These images portrayed police acting against protesters, military vehicles, weaponry, injured persons, and blood.

Using a similar methodological approach, Esfandiari and colleagues (2021) investigated the visual content shared on Twitter during the 2011 protests in Iran. They found that efficacy-eliciting content was more prominent compared with emotion-arousing images. However, one rare study examined the visibility of Blockupy Frankfurt social protests against the opening of the European Central Bank in 2015 on Twitter and found that the images circulated reproduced existing power dynamics with violent imagery produced by the institutional authorities being the more prominent type (Neumayer & Rossi, 2018). A study that conducted a manual visual content analysis of select news coverage of social protests after the murder of Michael Brown by police showed a similar pattern; many news images visually highlight the lawlessness of the protests (Cowart et al., 2016), although such a tendency is more prominent in right-leaning news media (Phelps & Hamilton, 2022).

While these findings provide an important opportunity to examine the types of social protest visuals that social media users mostly share, it is unclear what types of images the public encounter on social media that shape their perceptions about social protests. In fact, social protest images created and shared by users are only a part of the visual information social media users encounter on these digital platforms. A large volume of visual information that potentially shapes public perceptions of social protests likely originates from news media and was carefully created by professional journalists. Yet, we have limited understanding of how news media visually curate social protests on social media, as previous research on this subject either focuses primarily on print and television broadcast news (e.g., Brown & Mourão, 2021; Riddle et al., 2020), conducts qualitative analysis on discrete case studies of iconic images (e.g., Doerr et al., 2013; Mattoni & Teune, 2014; Milman & Doerr, 2023), or focuses only on a short period immediately after an isolated incident (e.g., Cowart et al., 2016, 2022; Phelps & Hamilton, 2022). For these reasons, analyzing how news media visually frames social protests on social media for an extended period seems to be a first step to fully understanding how social protest visuals on social media potentially shape citizens' perceptions about the protests.

There are several reasons why visual components of news coverage about social protests on social media warrant scholarly attention. First, while visuals are one of the components that journalists use to construct an interpretative package to relay the most salient dimension of a story to a reader (i.e., news frame; Entman, 1993; Powell et al., 2015), visual images frame news stories differently than texts due to three unique qualities (Messaris & Abraham, 2001). Unlike the arbitrary association between words and their meaning, there is an analogical relationship between images and their meanings. Images are also processed automatically and quickly without much conscious thought. Therefore, images are believed to be authentic representations of reality. Finally, because an explicit propositional syntax that represents causality, generalization, or comparisons does not exist in visual communication, viewers are less likely to detect the implicit meanings in images, making stereotypes in visual images less likely to be noticed. Overall, these qualities render images better at capturing reality and eliciting emotions and are more persuasive than verbal text (Grabe & Bucy, 2009; Messaris & Abraham, 2001).

Second, Americans increasingly receive their news from social media, with approximately one-third regularly receiving their news on Facebook (Pew Research Center, 2021a). This means that social protest images encountered by the public on social media may substantially influence their perceptions of social protests. Indeed, a handful of studies that have systematically investigated the effects of how visuals are used in professional reporting on social protests show that the way social protest visuals are portrayed in the media potentially shapes public perceptions of those social protests. For example, Arpan and Tüzünkan (2011) found that, when protesters are portrayed as deviant (e.g., in conflict) as opposed to peaceful, viewers reported more negative perceptions of the protestors—providing empirical evidence supporting cultural studies scholarship on how visual media representations reinforce certain ideologies. Finally, with the proliferation of online news, news organizations have redesigned their interfaces to be eligible for mobile devices (Guo & Sun, 2020). Studies on audience news consumption on online platforms and social media suggest that news images

and headlines are prominent components (Meijer & Kormelink, 2015) that attract attention (Powell et al., 2021; Sargent, 2007). These observations imply that platform specificities may impact the particularities of images news media organizations share on social media compared with those images that news media publish on traditional platforms.

From this perspective, this study employs automated visual content analysis to explore how news media visually curate social protests on social media using the BLM movement as a case study. We argue that understanding the impact of news coverage about the BLM movement (spanning more than 6 years since 2014) necessitates innovative techniques that allow for a large-scale visual content analysis. Automated visual image analysis of social media posts is warranted as a first step to uncovering the BLM coverage consumed by audiences in the current media landscape.[1] Among the social media platforms, we focused on Facebook, as it is a major news source for a substantial portion of the American population (Pew Research Center, 2021a). In this study, we paid particular attention to thumbnail images accompanying news stories on Facebook shared by news media organizations. This was not only because these images draw greater attention from social media users than those without an image (Keib et al., 2018) but also because they have the potential to shape public opinions about social protests, even for people who only look at the image components and short headlines included on the Facebook posts of the stories. To shed light on the images that accompany traditional news media outlets' Facebook posts, this exploratory study examines images of news outlets' BLM coverage. The following research question is posed to guide this investigation:

> Research Question 1: What are the visual themes of images that accompany Facebook posts of news media coverage of the BLM movement?

Partisan Bias of News Outlets and the Representation of the BLM Images

The role of media representations in shaping the opinions and attitudes of the audience is established in the political communication literature. For example, it has been found that affective polarization is heightened by the polarized reports in the news media (Levendusky & Malhotra, 2016). Given the contentious nature of the issues raised by the BLM movement, it is reasonable to suspect that media coverage of the movement has a role in Americans' current polarized views of the movement. Indeed, the political charge of the BLM movement is clear in counter-protests (e.g., Blue Lives Matter, All Lives Matter, and anti-mask "Let Us Breathe" marches), political campaigning that criminalized the movement ("when the looting starts the shooting starts"), and legislative initiatives to restrict voting (West et al., 2021). Survey data also show partisan divides in attitudes about the BLM movement. In September 2021, 85% of Democrats, 3% of Republicans, and 38% of Independents had reported support for the BLM movement in a Civiqs survey.[2]

These differences in public views of the BLM movement depending on one's political orientation may be caused by differences in how news media with different political stances represent the movement. Previous studies have found that news media present different political realities in accordance with their ideological leanings (e.g., Aday et al., 2005; McDonald & Morgaine, 2016). For example, the political leanings of news media were associated with how news media represent racial injustice and racism (el-Nawawy & Elmasry, 2021). Indeed, a study that analyzes select U.S. news media coverage of the murder of Michael Brown and subsequent protests in 2014 shows a stark partisan difference in visual representations of the BLM movement (Phelps & Hamilton, 2022). Specifically, conservative news media visually frames the protests as dangerous threats, delegitimizing the movement, whereas liberal news media highlight more peaceful scenes during the protests. A similar pattern was found in the visual analysis of Danish news media coverage of a local BLM movement in 2020 (Milman & Doerr, 2022, 2023). These observations suggest that the way certain news media visually represent the BLM movement likely depends on their partisan stance.

However, at least one study suggests that U.S. media, irrespective of partisan stances, primarily focus on the violent and disruptive elements of the BLM movement covering the movement as merely riots (Brown & Harlow, 2019). Such tendencies—focusing on the "violent side" of the movement—continued when George Floyd's death rekindled the movement in 2020, even though the media paid relatively more attention to police violence (Kilgo, 2021). A recent visual analysis of select news images immediately after the killing of George Floyd found that, although news media usually highlighted peaceful moments during the protests, violent images that showed a physical confrontation between protesters and police were most likely to appear when news images captured both protesters and law enforcement officers in a single image (Cowart et al., 2022). These findings suggest that the ideological leaning of news media may not be directly associated with how news media visually cover the BLM movement. To address these conflicting observations on the partisan stance of news media and visual representation of the BLM movement, we propose the following research question:

> Research Question 2: Are there differences in the visual representations of BLM images based on the partisan slant of news media?

Method

We implemented a procedure described in a previous study (Araujo et al., 2020), which combines commercial computer vision tools (Microsoft Face API and Google Computer

Vision) and unsupervised textual analysis (i.e., topic modeling) to automatically categorize visual images based on shared themes. Specifically, each image in the data set was fed to the two computer vision tools, which automatically detect the existence of a set of objects in visual data and produce relevant features of the image (i.e., tags). The structural topic modeling (STM) algorithm (Roberts et al., 2019) was used to automatically categorize these processed images into a set number of clusters by analyzing co-occurrence patterns of the contextual information (i.e., tags) produced by the computer vision tools.[3] The underlying logic behind this procedure is that a similar set of objects would likely appear in images with the same underlying theme. For example, a set of tags generated for images that show a confrontation between protesters and the police force would be different from a set of tags generated for images that show peacefully marching protesters, because the tags that are associated with law enforcement officers (e.g., police officers, police equipment, etc.) would be more likely to appear in the former than the latter.

Data Collection

This study used CrowdTangle (https://www.crowdtangle.com/), a Facebook monitoring tool developed and maintained by Meta (formerly known as Facebook), to identify and collect news images posted on the Facebook platform. First, a list of news media operating in the United States was created. This list includes 61 news organizations across the political spectrum. Two keywords (BLM and "Black Lives Matter") were used to search any news stories related to the movement posted by these news media between August 2014 (when the movement was nationally recognized because of the street demonstrations in Ferguson, Missouri) and October 2020 (about 5 months after the death of George Floyd).[4] This 6-year time frame allows us to examine how news media visually represent the BLM movement together with any changes that may have occurred within this period.

A total of 15,446 news postings from 61 news media organizations were obtained. A Python code specifically written for this project was used to collect a visual image (i.e., thumbnail) appearing on each news media posting. This was done because those images appearing on each post are what Facebook users see before they engage with the posting and are directed to the original web page (Carcamo Ulloa et al., 2015; Powell et al., 2021). Of note, some news postings were excluded from the analyses because no images were associated with news postings, leaving us with 12,692 images to analyze (82.1% of the original list).

Data Preprocessing

Two commercially available computer vision tools (Google Computer Vision and Microsoft Face API) were used in the preprocessing stage. These tools use object detection algorithms to identify the presence of known objects in an image and create a set of tags accordingly for an affordable cost.

The following procedure was implemented to preprocess the images in the data set. We first *n*-gramized tags with multiple words such as "police equipment" and "public event" to make them an independent word unit. Of note, Microsoft Face API was also trained to recognize public figures, including politicians, athletes, and celebrities. Instead of using the names of individual figures as an independent tag, we replaced the name of each figure with the term "celebrities" to indicate that the image includes a person identified by the computer vision tool. We combined the tags generated by the two computer vision tools to maximize the chance of identifying objects in the images, as some images were only analyzable in either one of the two tools. At this point, some images were excluded as neither computer vision tools could analyze them ($n = 175$, 1.1%). Furthermore, duplicate images posted by the same news media were excluded from the data set ($n = 2{,}250$, 14.6%). This preprocessing procedure left us with 10,267 images (66.5% of the original list) for the data analysis.

Partisan Leaning of News Sources

We coded the partisan leanings of 61 news sources that were used to collect the data for this study using the AllSides bias ratings (https://www.allsides.com/media-bias). The AllSides bias rating data set was created by a crowd-sourcing evaluation technique.[5] The data set includes partisan leanings of news sources that range from −2 (left) to +2 (right). To simplify the statistical comparison, we first coded 32 news sources in our data set that are perceived to hold a left and lean-left stance as pro-Democrat news sources (−1). Next, nine news sources categorized as holding a right and lean-right stance were coded as pro-Republican news sources (+1). Then, 12 news sources perceived to have a neutral stance by the AllSide were coded as neutral news sources (0).

Because the main objective of this study was to compare the visual representation of the BLM movement across different partisan leanings of news sources, nine news sources that were not rated by the AllSides bias ratings were excluded from the analysis (see Supplemental Table A1 for the list of news sources included in the analysis). This decision was made as the STM algorithm accounts for metadata of documents (i.e., date and the partisan leaning of news sources in the case of this study) to find a topic solution for the data (Roberts et al., 2019). This procedure resulted in a total of 9,156 images (59.3% of the original sample). Supplemental Figure A1 in Online Appendix A presents the distribution of news coverage of the BLM movement.

Clustering "Black Lives Matter" Images

All tags produced by the computer vision tools for each image were fed to the STM algorithm, which uses co-occurrence patterns of the tags to automatically cluster images. The SearchK function of the STM package was used to find an optimal topic solution for the BLM image data set (Roberts

et al., 2019). We estimated candidate models with a varying combination of topic number K (3–20) and used diagnostic values generated by the SearchK function to determine the topic solution for the data set (see Supplemental Figure B1 in Online Appendix B for the diagnostic values).[6] Based on the estimates of each model, we first selected a few candidate models and conducted a closer examination of each candidate model.

The diagnostic values and our readings of candidate models were found to favor the model, with 10 topics as the topic solution for the BLM image data set. For each image in the data set, the fitted model generated a topic probability for each of 10 topics. For easier interpretation of image clusters, we assigned each image to a topic with the highest probability.

Results

Research Question 1 sought to identify the visual themes of images accompanying Facebook posts of news media coverage of the BLM movement. Table 1 presents 10 automatically generated image topics and the 10 most frequent tags for each topic. We labeled each topic based on its most frequent tags and our reading of a random subset of images clustered under each topic. Figure 1 illustrates the correlations between the topics based on the co-occurrence of topic probabilities. As the plot suggests, the image topics can be largely grouped into two image clusters, with one topic existing independently.

First, images in a cluster that are grouped together (i.e., Topics 1, 2, 3, 5, 9, and 10) relate to individuals and groups of people that appeared in the BLM movement-related news coverage. For example, Topic 10, the most prevalent image category in the data set ($n = 1{,}716$, 18.7%), was labeled as *Close-up Images of Face* because the images in this topic tend to be a close-up image of a person or group of people. As face(s) comprise a large proportion of the images in this topic, the computer vision tools detected many facial features such as nose, skin, and eyewear (see Table 1). Images in this topic span a wide range of domains that focus mainly on the face, including mugshots, selfies, portraits, and screenshots of interviews. Topic 3 ($n = 934$, 10.2%) and Topic 2 ($n = 805$, 8.8%) are, respectively, labeled as *Images of known figures (celebrities and political elites)* and *Images of a (known) individual making statements*. Images that fall into these two topics present a medium shot of an individual or a group of people. The major difference between these two topics is that people appearing in the image of Topic 2 tend to use audio equipment to directly (or indirectly) to address a large group of people, whereas images in Topic 3 focus on renowned figures that are detected by the computer vision tools.

Finally, a small number of images were classified as Topic 9 ($n = 164$, 1.8%), labeled as *Medium shots of people*. Images in this topic portray a small group of people engaging in various activities such as hugging, sitting, and handshaking. Images in Topic 9 differ from those in Topics 2 and 3 because the former tends to include more people than the latter. As images in Topic 9 tend to present a small group of people, Topic 9 was found to correlate with Topics 1 and 5 in the cluster, which often featured a large group of people engaging in a collective activity such as protesting and marching (see Figure 1).

Topic 5 ($n = 1{,}105$, 12.1%) focuses on a large group of individuals gathered on the streets to protest against racial injustice. BLM banners are usually identifiable in these group images. Therefore, we labeled Topic 5 as *Protest activities*. Protesters appearing in Topic 5 are portrayed as participating collectively in peaceful demonstrations, one of the typical shots of social protest coverages. By contrast, images classified as Topic 1 ($n = 1{,}163$, 12.7%), labeled as *Confrontation between protesters and police officers*, typically depict heightened tensions between protesters and law enforcement. This cluster includes images representing a group of law enforcement officers on the street, often equipped with riot gear.

Another image cluster with three topics (Topics 4, 7, and 8) predominantly includes images that portray non-human objects. However, each of these topics represents a distinctive theme. For example, Topic 7 ($n = 1{,}005$), which we labeled as *BLM mural paint on the street*, includes street images in which slogans of the BLM movement are written in yellow paint, such as "Black Lives Matter" or "End Racism." Other images in Topic 7 also focus on the written expression on banners or placards.[7] However, Topic 8 ($n = 775$, 8.5%), labeled as *Vandalism/symbol of oppression* is in direct contrast to Topic 7. Many images in this topic present vandalized objects related to the BLM movement. For instance, many images in this topic feature Confederate statues with "BLM" written on them with yellow paint. Some other images capture a burning building and silhouettes of people looking at it. Finally, images in Topic 4 ($n = 886$, 9.7%), labeled as *Logos/Graphics*, include graphics and illustrations related to the BLM movement. While many images in this topic are not related to the BLM movement (e.g., news media logos), other images in this topic are related to the BLM movement, such as screenshots of tweets or web pages and images that portray BLM-related symbols.

Images grouped in Topic 6 ($n = 612$, 6.7%) mainly portray two types of images: athletes and motor vehicles. Considering professional athletes' involvement in the BLM movement in recent years, it is not surprising to see images depicting professional athletes constituted an independent topic in our data set. However, many images that portray motor vehicles on the street were also classified in Topic 6. While this is slightly confusing, as these two seemingly different themes of images were clustered together, one possible explanation is that a few images that belong to this topic present people in a sports jersey standing in front of a motor vehicle (e.g., an image of a professional racer). Because these images are associated with tags related to both sports and motor

Table 1. Top 10 Frequent Words and Example Images for Each Topic.

Topic 1 (1,163, 12.7%): Confrontation between protesters and police officers
Photograph, social group, community, event, interaction, standing, product, fun, white, law enforcement





Topic 2 (805, 8.8%): Images of a (known) individual making statements
Finger, microphone, audio equipment, electronic device, hand, public speaking, technology, thumb, wrist, spokesperson





Topic 3 (934, 10.2%): Images of known figures (celebrities/political elites)
Clothing, celebrities, dress shirt, coat, formalwear, outerwear, style, dressed, standing, necktie






Topic 4 (886, 9.7%): Logos/graphics
Font, blue, electric blue, black, yellow, red, line, world, logo, graphical user interface

(Continued)

Table 1. (Continued)

Topic 5 (1,105, 12.1%): Protesting activities
Group, cap, street-fashion, flag, hat, mammal, headgear, human, protest, cool




Topic 6 (612, 6.7%): Images of athletes and motor vehicles
Sport, motor vehicle, jersey, player, car, mode of transport, sportswear, sports uniform, transport, grass





Topic 7 (1,005, 11.0%): BLM mural paint on the street
Street, banner, road, building, city, protest, rebellion, urban_area, public event, sky






(Continued)

Table 1. (Continued)

Topic 8 (776, 8.5%): Vandalism/symbol of oppression
Sign, handwriting, advertising, sky, nature, signage, tree, poster, fire, sculpture



Topic 9 (164, 1.8%): Medium shots of people
Sleeve, gesture, temple, blazer, tie, sitting, white-collar worker, active shirt, costume accessory, newspaper






Topic 10 (1,716, 18.7%): Close-up images of face(s)
Nose, skin, posing, eyewear, glasses, vision_care, head, mouth, ear, face





Note. BLM = Black Lives Matter.

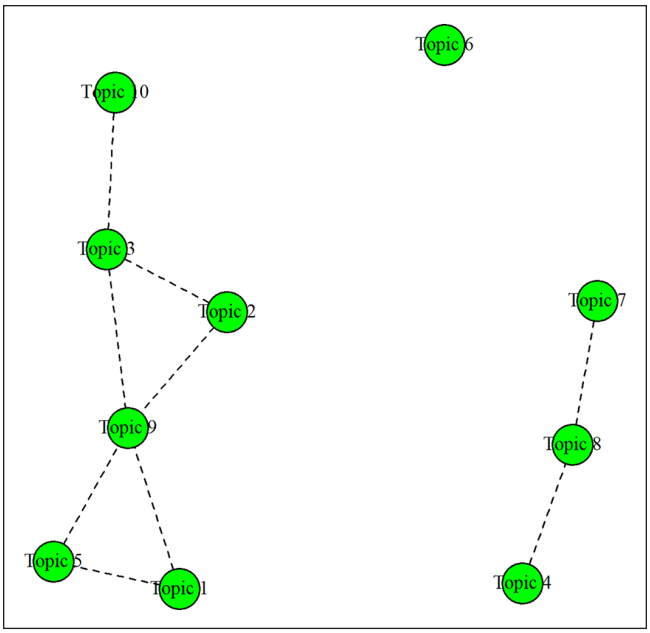

Figure 1. Correlation between topics.

vehicles, the STM algorithm may have grouped the images that depict athletes (wearing sports gear) together with the images that include motor vehicles. Overall, images in Topic 6 are labeled as *Images of athletes and motor vehicles*.

Partisan Leanings of News Sources and Visual Representation of the BLM Movement

Research Question 2 sought to determine whether the partisan leanings of news sources are related to the way news media visually represent the BLM movement. To answer this question, we estimated the differences in the topic prevalence of each topic as a function of the partisan leanings of news sources. Figure 2 illustrates the estimated differences in topic prevalence. Supplemental Table C1 in Online Appendix C shows the estimated topic prevalence for each topic across the partisan spectrum. In this section, a few notable points are highlighted in the interest of brevity.

First, there seems to be discernible differences in how pro-Republican and pro-Democrat news sources visually represent the BLM movement. For example, compared with pro-Democrat sources, pro-Republican news sources were approximately 2.2% (95% CI = [1.2%, 3.1%]) more likely to use images that stress the tensions between protesters and law enforcement officers (Topic 1). By contrast, pro-Republican news sources were less likely to use images that portray a large group of peaceful protests (Topic 5; point estimate of the difference: −1.8%, 95% CI = [−1.1%, −2.5%]) and images that depict BLM slogans (e.g., BLM) written on the street (Topic 7: point estimate of the difference: 1.8%, 95% CI = [1%, 2.7%]) than pro-Democrat news sources. These observations suggest that pro-Republican news sources were more likely to use images that might delegitimize the movement, whereas pro-Democrat news sources were more likely to stress the camaraderie existing in the protest to report the BLM movement than their pro-Republican counterparts.

Second, while neutral news sources also covered the tensions and unrest of the movements (i.e., Topics 1 and 8), they were more likely to report the BLM movement using images that shed a positive light on the movement compared with partisan news media. For example, images that portrayed the movement as peaceful protests (i.e., Topics 5 and 7) were more frequently used in neutral news sources than their partisan counterparts. Specifically, neutral news sources were approximately 2.7% (95% CI = [1.6%, 4.2%]) and 2.5% (95% CI = [0.9%, 4.2%]) more likely to use Topics 5 and 7, respectively, than pro-Democrat news sources. Neutral news sources, compared with pro-Republican news sources, were more likely to use Topic 5 (point estimate of the difference: 4.2%, 95% CI = [3.4%, 6.0%]) and Topic 7 (point estimate of the difference: 4.2%, 95% CI = [2.3%, 6.3%]).

Finally, pro-Republican news sources (15.3%, 95% CI = [14.1%, 16.6%]) were far more likely to use images in Topic 10, *Close-up Images of Face*, than pro-Democrat news sources (12.4% 95% CI = [11.3%, 13.5%]) and neutral news sources (9.3%, 95% CI = [7.4%, 11.1%]). This implies that pro-Republican news sources may have used images that focus on a single or a few individuals at the expense of images that may emphasize the collective efficacy of the protesters fighting against systematic racism and violence against Black people (i.e., Topics 5 and 7). These findings suggest that the delegitimization of the movement may occur not only by associating more negative images with the movement (i.e., Topics 1 and 8) but also by tuning out some positive attributes of the movement in news reports (i.e., Topics 5 and 7).

Discussion

From the automated visual content analysis of more than 9,000 images collected from Facebook news pages over a 6-year time frame, our findings suggest that images posted on news media Facebook pages can be clustered into 10 different thematic groups (i.e., topics). We also discovered politicized visual representation practices in the coverage of the BLM movement.

Overall, the automatically clustered image topics uncovered in this study can be mapped on to two main themes identified in previous studies: anger-evoking and efficacy-eliciting images (Esfandiari et al., 2021; Kharroub & Bas, 2016; Neumayer & Rossi, 2018). These two themes tap into the two main motivators of collective action (van Zomeren et al., 2008). Our image Topics 1 and 8 align with images with anger-evoking potential. The images in these topics, in line with the protest paradigm, tend to emphasize the violent aspects of protests (confrontations between law enforcement officers and protestors, protests where vandalism and fires

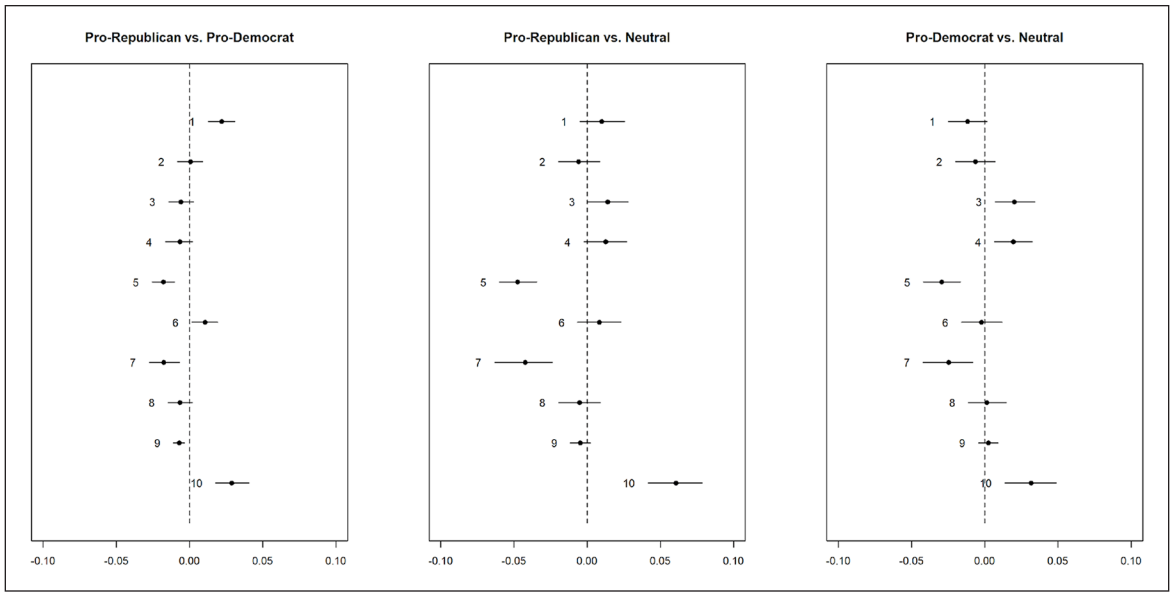

Figure 2. Estimated differences in topic prevalence due to partisan leanings of news sources.

were involved) similar to the images typically covered by the traditional media outlets (Brown & Harlow, 2019). Conversely, Topics 5 and 7 include images of protestors engaged in various protest activities, such as peaceful demonstrations or smaller groups raising fists. These types of images tap into the efficacy-eliciting images and arguably increase the audience's belief that collective action can change the status quo and result in a meaningful change in the desired direction (Bas et al., 2022; Esfandiari et al., 2021; Kharroub & Bas, 2016).

Despite conflicting observations in previous studies concerning partisan differences in news media representation of the BLM movement in the United States, our findings show that partisan leanings of news media are associated with how the BLM movement is visually represented. Specifically, pro-Republican news sources were more likely to use images that stress the conflict between protesters and law enforcement officers, while news media that are pro-Democrat and those categorized as neutral were more likely to use images that legitimize the movement by highlighting peaceful collective action against racial injustice. Interestingly, our analysis also identified a subtle difference in visual representations of the movement at the expense of positive attributes of the movement. Specifically, pro-Republican news sources were far more likely to use news images that highlight a few individual(s) (i.e., Topic 10) instead of peaceful protest scenes (Topics 5 and 7).

These subtle patterns imply that delegitimization of protests may take two forms (i.e., active and passive). First, pro-Republican news sources were more likely to use images that associate the movement with riots. Second, the fact that pro-Republican news sources are more likely to use images that feature individual figures also leads to de facto delegitimization of the movement. Such passive forms of delegitimization downplay positive aspects of the movement (e.g., scenes which evoke the collective nature of the movement) that have the potential to shape positive public opinions toward the causes of the movement. Indeed, considering the tendency to selectively consume attitude-consistent news sources (e.g., Stroud, 2011), the observed differences in the visual framing of the BLM movement might have influenced the existing partisan divides on attitudes about the movement (Pew Research Center, 2021b).

Using visual representations of the BLM movement as a case study, our study makes an important methodological contribution to the literature by demonstrating the possibility of applying automated content analysis techniques to analyze a large volume of social protest images. Of note, there are a few exceptions in communications and other related fields that have already employed computer vision tools to automatically analyze visual images of social protests (Steinert-Threlkeld et al., 2022; Zhang & Peng, 2022). However, these studies rely on state-of-the-art computer vision techniques, which require intensive coding skills and a powerful machine that handles computationally intensive tasks. Using commercially available computer vision tools is an accessible alternative that overcomes such methodological barriers and enables rapid exploration of a large visual data set.

Furthermore, our findings also show the importance of probing the (in)visibility of certain categories of images in news media to understand how news media visually frame social protests (Cowart et al., 2016, 2022; Milman & Doerr, 2022). The development in visual technologies and mobile

phone cameras has given marginalized citizens the ability to engage in what Milman and Doerr (2022) call "visibility acts of citizenship." With social media, citizens are able to amplify their voices, circumventing traditional media. Social movement literature emphasizes the framing contest between movement organizers and authorities as well as news media (DalCortivo & Oursler, 2021). Social media, in this sense, allows social movement organizers to visually frame their movements and preemptively create a narrative against racialized media portrayals of social protests. At the same time, news media still exert substantial influence on how the public understand social protests by gatekeeping what and how user-generated visual images are brought to public awareness. In other words, how news media visually represent social protests may function as a strong social force, potentially forming the dominant narrative about a certain movement (cf., Arpan & Tüzünkan, 2011; Brown & Mourão, 2021). The existing tension between news media and activists attests to the importance of analyzing both citizen- and news media-generated visual content to understand how visual images mobilize political participation. For this reason, future work could employ automated visual analysis tools to examine which and how citizen-generated images are covered by traditional news media, taking advantage of the method's ability to rapidly explore a large visual data set.

At the same time, some methodological limitations that are inherent in a machine-centric approach warrant close attention. For example, because the topic modeling algorithm, which was used to automatically cluster the machine-generated tags, relies on term co-occurrence patterns to create a latent semantic structure, they sometimes produce non-interpretable image clusters from the perspective of human interpreters. While most of the topics that emerged in our analysis had an interpretable and coherent theme, Topic 6 was problematic as it was an amalgam of two seemingly distinct themes: athletes (especially those who protest for racial equality) and scenes of motor vehicles on the streets. This may be attributable to the fact that some images include some objects (e.g., athletic gear and motor vehicles) that may bridge the two distinctive image clusters into one topic. Nonetheless, the existence of this topic suggests that careful examination is crucial to make sense of computer-generated image clusters.

It should also be noted that the two computer vision tools used in this study that were not specifically designed for researching media representations of social protests and thus may leave room for error. Specifically, computer vision tools automatically detect objects without taking contextual information into consideration. That is, images that show police confrontation and protesters shaking hands with police officers are likely grouped into the same category, as the computer vision algorithms would have generated a similar set of tags for each image. As computer vision tools are currently evolving to comprehend complex contextual information, analyzing image data sets with more advanced computer vision tools may increase the accuracy of the clustering process. However, one should be aware that there are concerns about biases inherent in computer vision APIs (Application programming interface) due to the lack of diversity in the data set used to develop the tools. For example, a study found that commercially developed software tends to be more inaccurate when classifying darker skin tones (Buolamwini & Gebru, 2018). While such bias may be less of an issue if the tools were primarily used to detect objects in images, it could be potentially problematic if the main objective of the study requires the accurate detection, for example, of human facial features (e.g., skin pigment) or biological sex. In such a case, relying solely on automated visual analysis without taking a close look at its results may lead to an inaccurate conclusion. In other words, researchers who plan to use this methodological approach should be aware that the validity of their work heavily depends upon the accuracy of the computer vision tools of choice; it is thus important to closely inspect the results before drawing any conclusions.

Finally, our findings should be read with caution, as this study only collected and analyzed the news images that were posted on the Facebook pages of news media outlets. Although the images analyzed in this study were what news audiences would have responded to on Facebook, it should be noted that these images capture only part of the wide range of visuals that journalists have used to cover the BLM movement. For this reason, future research could analyze the entirety of visual images used in news coverage of social protests to provide a deeper understanding of how news media visually represent protests against social inequalities. Similarly, examining the image components of news stories without considering the textual components may miss an important aspect of how news media cover social protests. Therefore, future studies could use more advanced methodological tools to holistically analyze textual and visual information of news stories shared on social media and integrate insights derived from the critical and cultural studies tradition to fully understand how ideology is associated with racialized representation in media content (Hall, 2011).

Despite these limitations, automated visual content analysis was found to be useful to systematically analyze a large volume of visual information. Our results also reveal that there are multiple angles through which the news media portrays the BLM movement, which may substantially shape how the public views both the protest and racial injustice in the United States. Drawing on the protest paradigm as a theoretical framework, we were able to interpret the results of computerized visual analysis. We also uncovered subtle differences in journalistic practices used to visualize social protests across news sources based on partisan leanings. These findings contribute to the theorization of how partisan and neutral news media use social media platforms to (de)legitimize social protests and influence public opinion.

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Supplemental Material

Supplemental material for this article is available online.

Notes

1. Of note, there exists notable scholarly efforts to conduct an automated visual analysis of social protest images (e.g., Steinert-Threlkeld et al., 2022). However, these studies were designed with a specific goal in mind (e.g., quantifying violence in a visual image). Examining the thematic structure of visual representation of social protests (i.e., what and how media represent social media) requires a more explorative work with a bottom-up approach.
2. https://civiqs.com/results/black_lives_matter
3. The topic modeling algorithm identifies the main theme of a document (a term referring to the unit of analysis—in this study, the unit of analysis is an image) by analyzing co-occurrence patterns of words (e.g., nouns, verbs, in the case of this study, tags). Topic modeling assumes that (a) a set of documents contains a number of topics (themes) and (b) a certain set of words tend to appear together in each topic (Guo et al., 2016).
4. Of note, there were some news media postings on Facebook from July 2013 following the first tweet that initiated the BLM movement ($n = 29$). However, these news postings were not included in the data set, as they were news coverage about the U.S. Bureau of Land Management (BLM), not the movement for the racial justice.
5. See https://www.allsides.com/media-bias/media-bias-rating-methods for a more detailed description of their methodological approach. News bias ratings assessed by AllSides were highly correlated with another news bias measure created by AdFontes ($r = .88$, $p < .01$).
6. Of note, several tags commonly appearing in all images were excluded from the data set, as prevalent terms make little contribution in differentiating one image cluster from another. Also excluded were 589 tags that appeared only once in the data set. The final data set included a total of 9,154 images with 1,715 tags and 87,050 tokens.
7. Some images in Topic 7 also present some protesters. However, in contrast to Topic 5, protesters appearing in these images are singled out as engaged in activities such as painting on the streets.

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