Covid-19 on Twitter: an analysis of risk communication with visuals

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Abstract

Background: In a pandemic, when timely and clear communication is important, visuals on social media can help citizens quickly find and understand health risk information. In recognition of visuality and social media's value during a crisis, we investigated popular Covid-19 risk communication with visuals posted on the platform Twitter. Looking at tweet authors, their use of graphics, the preventative messages, and risk framing, our objective was to determine how visual communication on Twitter promoted WHO Covid-19 health recommendations.

Methods: We sourced Twitter's 500 most retweeted Covid-19 messages for each month from January - October 2020 using Crowdbreaks. Included tweets had to have visuals, be in English, come from verified accounts, and contain at least one of the keywords 'covid19', 'coronavirus', 'corona', or 'covid'. Following a retrospective approach, we then performed a qualitative content analysis of the tweets' text and visuals.

Results: Most of the tweets analysed came from influencers - individuals with many followers (51%), followed by media companies (30%), and health and government institutions (15%). At the start of the pandemic, the latter two were most prevalent. Analysis of visual formats showed that photographs were most common, and the majority of tweets combined them with other graphic types (55%). 68% of tweets had text in their visual, 42% of all visuals were animated, and 26% included a URL. 'Stay home' and 'wear a mask' were the most frequently communicated Covid-19 preventative measures. 70% of tweets used risk framing (emphasising health gains or loss), and 32% had tones of critique.

Conclusion: This study found that the most retweeted Covid-19 preventative measures with visuals mostly came from individuals, showing that health and government organisations were not alone in promoting preventative measures on Twitter. This stresses the important role individuals play in the dissemination of information using social media during a health crisis. The finding that more tweets used health loss framing, often combined with the emotive medium of photographs, raises concerns about persuasive tactics feeding on fear. Future research is needed to better understand this approach's consequences and its impact on public perceptions and behaviours.

Background

The coronavirus pandemic has offered public health professionals a real-world case study on visual risk communication through social media. In the wake of the pandemic, amid toilet-paper buying frenzies, government-ordered city shutdowns, and requests from mayors that citizens stay home, visual health risk messages have proliferated online. From health officials and pop-stars co-producing YouTube videos (1, 2) to animals explaining health measures on TikTok (3), health risk communication has become fully submerged in the image-driven, de-centralised, peer-to-peer, cross-cultural melting pot of social media. Among the array of social media platforms, Twitter has played a prominent role.

Visuality, the quality of being visual, increases the impact of health and risk messages in online environments. Graphics (when accurate and truthful) can improve public understanding of qualitative

and quantitative health risk information (4). In doing so, they then foster autonomy by enabling viewers to make their own health decisions or facilitating shared-medical decisions and behaviour change (5, 6). Visuals can also help to engage 'hard to reach' audiences, such as those with low literacy levels, thereby promoting social equity as an ethical imperative of public health (7). Moreover, visuals can prompt action by their persuasive and emotional impact (8-10), with colour hues affecting an individual's psychological reactance to health recommendations (11). Ultimately, their ability to affect viewers renders them powerful tools to foster public adoption of health officials' recommendations (12). When new infectious diseases break out, visuals can help risk-reducing messages reach and be understood by a majority of the population, promoting solidarity and reducing stigmatisation of risk groups (13).

As a social media platform, Twitter holds great potential for strategic visual health risk communication. It allows public health authorities and government agencies to reach millions of people. However, like all social media channels, along with this vast potential, Twitter faces corresponding challenges and ethical concerns (14). With this platform, the lay public join journalists and topic experts as mass media and content producers, and with few filtering mechanisms, content goes viral at accelerated speeds (15, 16). This can result in the nearly instantaneous spread of unverifiable health information, as occurred during the Ebola and Zika outbreaks (12), and now during the Covid-19 pandemic (17). Detecting health misinformation and acting to stop its spread is a critical challenge for public health authorities, as hazardous or misleading recommendations (like drinking bleach) place individual health at risk. Content may also misrepresent statistics, thereby failing in truthfulness, sincerity, and correctness, which can lead to misunderstanding and erode trust (18, 19). Moreover, such content saturation may promote dubious moral communication strategies, such as using shock tactics to attract attention, or the sacrifice of privacy through the graphic portrayal of an individual's story (20).

This study acknowledges the importance of visual communication and social media in a global health crisis, and so investigates the characteristics of popular Covid-19 risk communication visuals posted on the platform Twitter between January and October 2020. Focusing on the tweets with the most retweets for each month, we follow a retrospective approach to the study of tweets with images that contain Covid-19 prevention messages. This study's overall objective was to determine how visual communication was used on Twitter to promote the World Health Organisations (WHO) recommended preventative behaviours and how this communication changed over time. To this end, we use qualitative content analysis (21) to identify:

1. To what extent were health and government organisations present amongst the most popular tweets;
2. What were the predominant graphic types and visual properties used (22);
3. Which Covid-19 preventative measures featured the most (23);
4. How health gain or loss framing was present and whether tone changed over time (24).

By providing empirical data on these four aspects of visual health communication in the age of social media, this study's results contribute to communications and public health research. Specifically, the study’s results will enhance our understanding of whose Covid-19 health risk messages had the most

reach, and what form this took. Furthermore, by discussing the messages' and format's potential ethical issues, this paper will help guide future crisis and health risk communication and policy professionals in using strategic and ethically derived approaches to using visuals on Twitter.

Methods

Data Collection

Data extraction

Using the platform Crowdbreaks[1], we sourced the most retweeted (based on retweet counts at the time of request) tweets with visuals that contained at least one of the keywords 'covid19', 'coronavirus', 'corona', and 'covid' (25). The tweet objects (such as tweet text, publishing date, media URLs) were then received using the tweet IDs from the Twitter-API. We selected the 500 most retweeted tweets per month to see trends over time and ensure uniform distribution. Where no tweet location was available, we added it manually when possible. The total dataset consisted of 5031 tweets.

Inclusion and exclusion criteria

To be included in our analysis, tweets needed to a) include a visual (i.e. image or video), b) be in English (both image and tweet text), and c) promote a WHO-recommended Covid-19 health preventative measure (as grouped in Table 1). By limiting our scope to the WHO's publicised recommendations, as an internationally recognised authoritative source of Covid-19 risk communication, we sought to focus on the main preventative measures relevant to all countries. We excluded tweets that did not primarily focus on preventative Covid-19 measures, or that promoted alternative, non-WHO recommended preventative measures; for example, drinking bleach. Ambiguous cases were discussed within the research team to determine inclusion within the final sample. Upon applying these criteria, we included 616 tweets in our analysis.

Qualitative Content Analysis

We performed a qualitative content analysis following an iterative process (21). Starting from a preliminary codebook informed by prior research and typologies (22, 24) and WHO guidelines (23), two researchers (JS, JA) coded a random sample of 40 tweets not pertaining to the study sample to test and refine the codebook. The revised codebook was then applied to a subset of 60 tweets by two researchers (JS, JA) independently to establish intercoder reliability (26, 27). The second round of coding resulted in minor revisions to the codebook using review and discussion. One researcher (JS) then applied the final version of the codebook (Table 1) to the 616 tweets that met our inclusion criteria using a custom interface shown in Figure 1. This interface allowed us to see the original tweet directly in the coding interface through the Twitter Embed API. A second researcher (JA) performed an intermittent reliability check on 10% of the tweets (n=62) halfway through coding. Group discussions among three researchers (JS, JA, MS) resolved intermittent coding disputes.

[1] Crowdbreaks.org

Table 1. Codebook

Top-level	Detail	Example
Source (Identified inductively)	Health or governmental organisation	The WHO, of Victoria Government
	Private sector	Pharma Company.
	Media	CNN, ABC News
	Individual person	Citizen, politician, academic, or artist
	Other	University
Graphic Type (Saunders, 1994)	Symbols	A pictographic or logo
	Graphs	Used to show quantitative relationships
	Diagrams	Parts, a process, a general scheme, and/or the flow of results
	Illustrations or rendered pictures	Drawn pictures, realistic or abstract, including background illustrations.
	Photographs	Still (i.e. photograph) or moving (such as gif or video)
	Models	Such as 3d renderings or computer models
	Composite Graphics	Multiple images
Other Visual Attributes	Colour	Anything with more than white and black.
	Animated	Video, Gif or animation.
Link	Link / URL	A URL is in the tweet text or in the visual
Content Focus (Identified inductively)	Raises Criticism	E.g. Government or political criticism, or criticism of someone's behaviour
	Provides entertainment	E.g. Shows something funny, or emotive
	Thankful / gratitude	E.g. Thanks doctors for saving patients
Covid-19 Focus (Identified inductively)	Detection	Relates measures to detection of cases or how it impacts the body
	Treatment	Mentions people recovering
	Impact	Discusses impacts to behaviour, the economy, or society
	Other	How it spreads
Type of Action (WHO guidelines)	Social distance	Keeping distance with people and avoiding crowded places
	Wear a mask	Protecting yourself and other by wearing a mask
	Stay home	Working, studying or remaining at home if feeling unwell / quarantine
	Wash hands	Regularly and thoroughly washing hands with soap and water
	Cover mouth & nose when sneezing	Or using a tissue and disposing it immediately
	Avoid touching mouth and eyes	Particularly with unwashed hands
	Get medical help w. Symptoms	(but call - don't go in)
	Other	cooking meat or eggs / basic hygiene / know the symptoms / get tested

Framing (Tversky & Kahneman, 1992)	Health Gain	We need to *protect* ourselves and others to protect / *save* society.
	Health Loss	we need to follow measures to avoid sickness, suffering and death
	Non-applicable	We just need to do this.

Results

Stakeholders / Tweeters

The 616 tweets analysed came from 351 verified Twitter accounts. The majority of these users (75%) accounted for just one tweet in the sample, while a small group of 21 accounts (6%) had multiple tweets included in the sample (from 5-28 tweets per user). Overall, the accounts had an average 3,972,526 user following, and themselves followed an average of 4394 users. The users were thus 'influencers' with more followers than people they followed. Tweets also had an overall retweet average of 5468 and were on average favourited 16837 times. As Table 2 shows, the primary stakeholder group was 'individuals' (51%), meaning influencers such as pop stars, activists, politicians, and journalists. Official media companies accounted for 31% of the tweets, followed by health or government organisations (15%), others (5%), and the private sector (1%).

Figure 2 depicts the demographics, as the tweets came from 35 different countries. The majority of these from the USA (n=267, ~43%) and India (n=108, ~17.5%). Following were the UK (n=108, ~10%), Switzerland (n=32, ~5%), Philippines (n=27, ~4%), and China (n=21, ~3%). 11 tweets had unknown locations.

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Table 2. Stakeholder statistics

Stakeholder	Total Followers	Total Following	Total Retweets	Total Favourites	Total Tweets	% of Sample
Health or Gov	347222414	95452	287390	468975	93	15.1%
Individuals	413203578	2316248	2165539	7371062	315	51.1%
Media	1601570945	263561	707959	1806942	188	30.5%
Other	30497591	21745	70441	198460	14	2.3%
Private Sector	54581286	674	137184	525973	6	1%
Total	2447075814	2697680	3368513	10371412	616	100%

Graphic types and visual properties

Identified using Saunders typology (22), most tweets (55%) used a combination of two to five graphic types. 42% (n=261) of all tweets were animated as either videos or gifs. As Figure 3 shows, photographs (either still or moving) were most frequently combined with symbols (like company logos). Symbols were also used often in combination with other graphic types. In tweets with only one graphic type, photographs predominated, while diagrams, graphs and models were least used. In 2.6% of tweets, no graphic type was recorded as these tweets used screenshots or text saved in a jpg or png format, which did fit the coding categories (22). In terms of other characteristics, 97% used colour (n=596), 68% (n=418) included text within the image, and 26% (n=159) included a URL.

Table 3. Other Tweet Characteristics

What	Total	Percentage
Used colour	597	97%
Was animated	261	42%
Included text in the visual	418	68%
Included a URL	159	26%

Covid-19 content

The Covid-19 themes of 'detection', 'treatment', 'impact' and 'other' complemented the topic of prevention. Most frequently combined was 'impact' (with tweets communicating how the pandemic was impacting society), and 'detection' (referring to the numbers of Covid-19 infections and how to detect the virus from symptoms). Regarding preventative messages, 'stay home' (44%), and 'wear a mask' (33%) frequented most when tweets only had one message. When combined, as was the case with 45% of the tweets, the preventative measures 'social distancing' and 'wash hands' frequented more. Figure 4 presents these results in more detail

Risk framing & tone over time

Of the 616 tweets analysed from January 1 to October 15, 2020, 69.9% used risk framing to communicate preventative measures. Meaning, they framed messages according to health loss, where the emphasis was on sickness and suffering, or they used health gain framing that emphasised protecting and retaining good health. 5% of tweets used a combination of both. Figure 5 shows that most (57.5%) used health loss framing, particularly around the spikes at the end of January and again in August. Then in terms of tone, 48.9% of tweets were coded showing critique, entertainment or gratitude. Critical tweets, most common from June onwards, were often expressions of disagreement with the lack of preventive measures. For example, critiques of other citizens not wearing masks. Another example was Indian students protesting against exams as preventative measures could not be followed and infection could harm families. In contrast, many tweets around the first half of the year, as shown in Figure 5, had entertaining tones. These tweets showed, for example, humorous instances of quarantine, like a couple pretending to holiday by fishing on their television screen. Lastly, there were also thankful tweets which communicated gratitude for fellow citizens following preventive measures.

Discussion

With 340 million registered users, 166 million daily active users, and 500 million tweets per day (28), Twitter constitutes one of the world’s most widespread communication platforms, especially in a public health crisis. Although social media can help with rapid knowledge dissemination in a pandemic (29), no media is a passive vehicle for communication. Like on other social media platforms, where concise, emotive and immersive content spreads like fire, we have seen Twitter become a "fertile ground for the

spread of false information, particularly regarding the ongoing coronavirus disease" (30). Recognising its role in misinformation propagation, in March 2020, Twitter introduced warning labels for tweets containing potentially harmful or misleading information relating to Covid-19, and linked verified information (31).

Nonetheless, Twitter has played a pivotal part in health risk communication during the Covid-19 health crisis (32, 33). Various world leaders have utilised the platform to inform, boost morale and prompt political discussion (34). Given such uptake, it is not surprising that health measures trended in the Twittersphere (35-37). This study documents several health risk measures communicated, often in combination. Most frequently were the measures ‘stay home’ and ‘wear a mask’ — messages focused on actions at the individual level.

Messages targeting individual agency and responsibility for controlling health, raise the ethical issue of culpability (38, 39). As Guttman & Salmon explain (7), messages that appeal to personal responsibility have pervaded public health communications for decades and can have unintended adverse effects. For example, the tweets shaming citizens for not complying by staying home or wearing a mask could have prompted feelings in non-abiders of guilt, shame or frustration. However, these individuals may not have had a choice, needing to go work to support their family, or not being able to wear a mask for health reasons.

Ethical consideration must also be given to the message framing, specifically regarding the potential for persuasive and paternalistic communication styles, which can create a barrier and lead to erosion of trust. On the other hand, more educational approaches provide only information to enhance rational decision-making, but research shows they are not always effective (40). In this study, most tweets used health loss or gain framing to persuade adherence to public health measures. Meaning, they presented Covid-19 preventative measures by emphasising their health-protective capacities, or the negative consequences resulting from non-adherence. Out of these two, ‘health loss’ was the most frequent. Appeals to fear using vivid images or describing damages to health echoes earlier public health campaigns, such as smoking or HIV. This approach came under ethical critique for causing unnecessary fear and stigmatisation (7).

However, a public health crisis may justify negative emotional appeals or paternalistic communication strategies to ensure maximal adherence and societal safety (40, 41). Indeed, prospect theory proposes that loss-framed messages have more success when outcomes are riskier and more uncertain (like in a pandemic with high infectious rates and unclear solutions), while gain-framed messages are more persuasive when outcomes are more clear and apparent (24, 42-44). In the Twittersphere, "fear for the unknown nature of the coronavirus" underscored most Covid-19 conversations (35). This ethical crossroads should be approached with great discretion.

The study results also show that the most retweeted Covid-19 risk communication with visuals took the format of photographs, often with logos and text. One possible reason for this predominance of photos is that they have evidential power by documenting reality. Studies on the role of photographic images in late

capitalistic societies also emphasise their multiple roles, including dramatizing experience to increase communicative impact (45). In other words, they have emotive and rhetorical power and provide easy and quick content for viewers to digest (46-48). In the context of health communication, research shows visual aids and animated graphics positively influence attention, comprehension, recall and behavioural adherence (49, 50).

Interestingly, tweets that combined visual formats mostly used photographs with symbols (such as company logos). One explanation could be that logos indicate a source, and thereby fortify the message's trustworthiness and credibility: essential in the context of mounting online misinformation, and recommendations to trust only verified sources. The logo usage could also result from content cross-pollination (for example, the media reposted from TickTock).

Despite the potential of photographs in health communication, some question using their vividness and strong emotional appeal (as common coercive marketing tactics) to attract attention and convey information about risk (20). An overtly aesthetic or dramatic approach can force the audience's attention to particular messages or content to persuade them. However, this may have unintended impacts. For instance, one of the analysed tweets included a video of a conventionally attractive young woman wearing tight clothing and handing out masks to men. Although this video tailored to male viewers successfully drew attention to mask-wearing, it also reinforced negative stereotypes and societal gender/power imbalances.

Still, images transcend literacy and language requirements and so can help promote understanding, accessibility and fairness (7). Notably, the use of images alongside text is most effective, as was the case in most tweets (68%) in this study. Indeed, combining visual and linguistic signification increases health communication effectiveness (51). Ultimately, when sensitive to ethical concerns, visual aids can be "among the most highly effective, transparent, fast, memorable, and ethically desirable means of risk communication" (52).

Our results also reflect the changing role of governments in sharing health risk communication on Twitter. Research has shown that a higher intensity of government communication via social media positively influences citizens’ adherence to preventive measures (53). Previous crisis-related research indicates that health organisations rely more often on traditional media than social media when framing a health crisis (54, 55). Our study results reveal that although dominated by individual voices ('influencers' with many followers), both health/government institutions and the media also had a significant presence. As Figure 5 illustrates, at the start of the year (the onset of the pandemic) the majority of tweets came from the media (indicated by blue) and health and government organisations (indicated by pink). These stakeholders' tweets then tapered out into an even distribution. This pattern could reflect citizens’ desire for official guidance at the outset of the pandemic when everything was in a state of uncertainty. The shift towards individual voices from March onwards aligns with the stay-at-home mandates when individual social media use generally increased (37). The prominence of individual voices also highlights

the importance of citizens sharing health messages among their networks, enabling health messages to reach broader segments of the population and promoting solidarity and inclusiveness.

Finally, the high number of tweets with tones of critique shows how Twitter, even in the context of health-risk communication, gets used as a platform for communicating protest. In August and October, the spikes in tweets came mostly from Indian students protesting against exams for fear of getting infected (56). Note, India was the second leading source of tweets in this study, and the tone during this time was increasingly critical, as shown in Figure 5. Since the Arab Spring and Occupy Wall Street movements, Twitter has developed a reputation as a platform for protests because it amplifies individual voices, and the mass of critical tweets in this study reflects this. That most tweets used photographs also fits as photos can help build social movements and networks (57, 58), visual fortify propaganda during conflicts (59) and images can foster advocacy, as we have also seen with climate change movements (60, 61). Ultimately, this highlights how critical tones ignite activity on Twitter and that citizens play a crucial role in information distribution.

Limitations

This study has some limitations. To start, we recognise that filtering for only the top 500 Covid-19 tweets in English per month means the exclusion of other potentially relevant tweets. Nonetheless, this approach's strength was that it revealed the extent to which preventative measures appeared amongst the tweets with the most reach. However, by only including English language tweets, this study's results may not reflect global trends as they are biased towards the West. As well, duplicate images were not documented. Another limitation lies in the fact that we limited our analysis to tweets promoting WHO preventative behaviours; this may have led us to miss other types of preventive messages. However, we deemed this a reasonable strategy for verifying the legitimacy and effectiveness of preventive behaviours being promoted on Twitter, as was the study's focus. Further, although all tweets analysed in this study came from verified accounts, it was beyond this study's scope to identify the potential presence of bots.

Conclusion

To our knowledge, this study is the first to analyse the characteristics and trends of Covid-19 risk communication with visuals on Twitter. This study’s results show that individuals accounted for the majority of WHO recommended Covid-19 health measures with visuals most retweeted during the January to October months. This outcome highlights the importance of engaging citizens as distributors of information, for they enable health messages to reach broader segments of the population, promoting solidarity and inclusiveness. Further, most of the tweets communicated one to two preventive measures, used the visual format of photographs, and employed either a health loss or gain framing. The predominance of health loss framing combined with photographs as an emotive form raises concerns about coercion tactics being used to exploit public uncertainty in the midst of a pandemic. However, a public health emergency may justify health and government authorities using such tactics, due to the need for rapid knowledge dissemination and widespread adherence to measures. Future research is

needed to evaluate the behaviour changing efficacy of loss-framed versus gain-framed messages with visuals in the context of the Covid-19 pandemic and across different social media platforms.

Abbreviations

WHO: the World Heath Organisation

JPEG: Joint Photographic Experts Group

PNG: Portable Network Graphics

Declarations

Ethics approval

This study was approved by the ETH Zürich Ethics Commission.

Consent for publication

Not applicable.

Availability of data and materials

The full data that support the findings of this study are available from Twitter but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Twitter. The authors declare that all other data supporting the findings of this study, including the identifiers of the analysed tweets, are available within the article and its supplementary information files.

Competing Interests

The authors declare that they have no competing interests.

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Authors' contribution

JS, JA, MS, and EV participated in the conception and design of the study. JS and JA carried out the qualitative coding, MS built the coding interface and data processing pipeline. JS drafted the manuscript with substantial revisions by JA, MS and EV.

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Figures

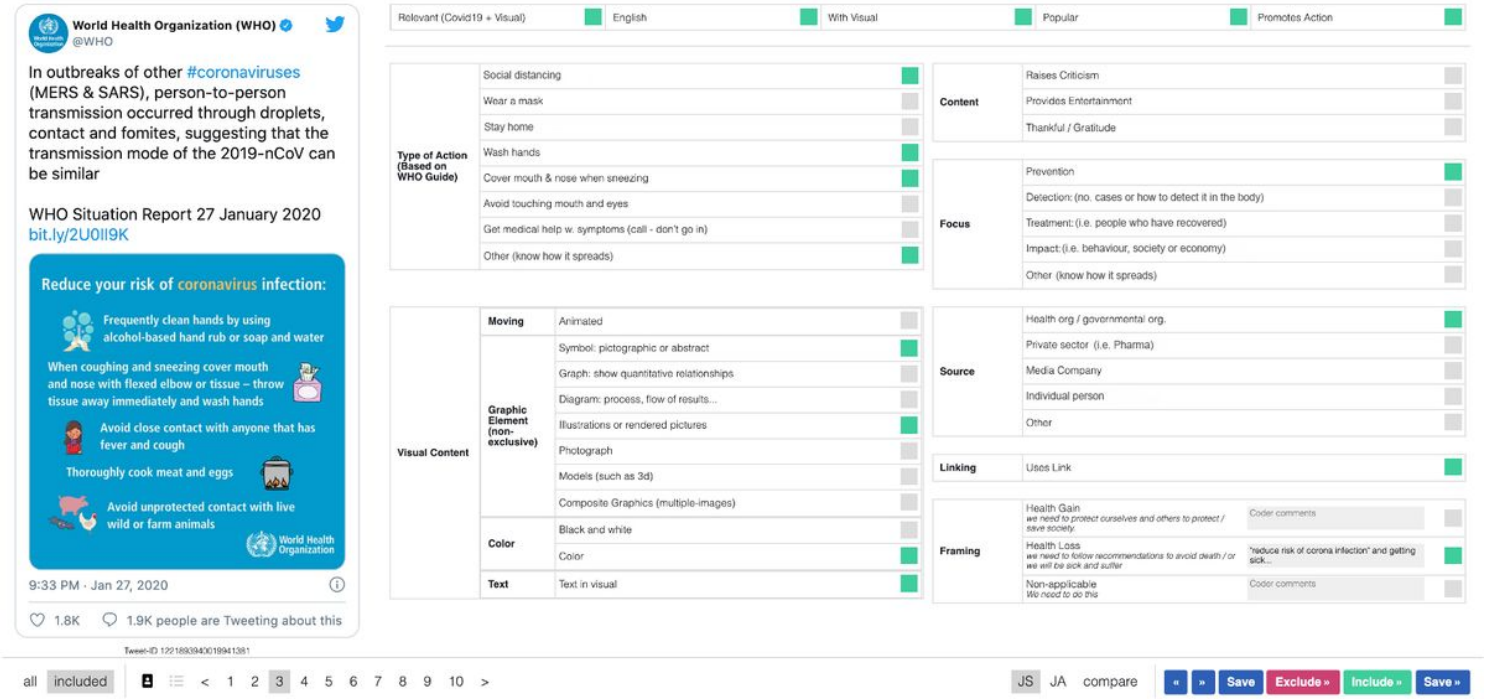

Figure 1

Custom Interface used for qualitative coding

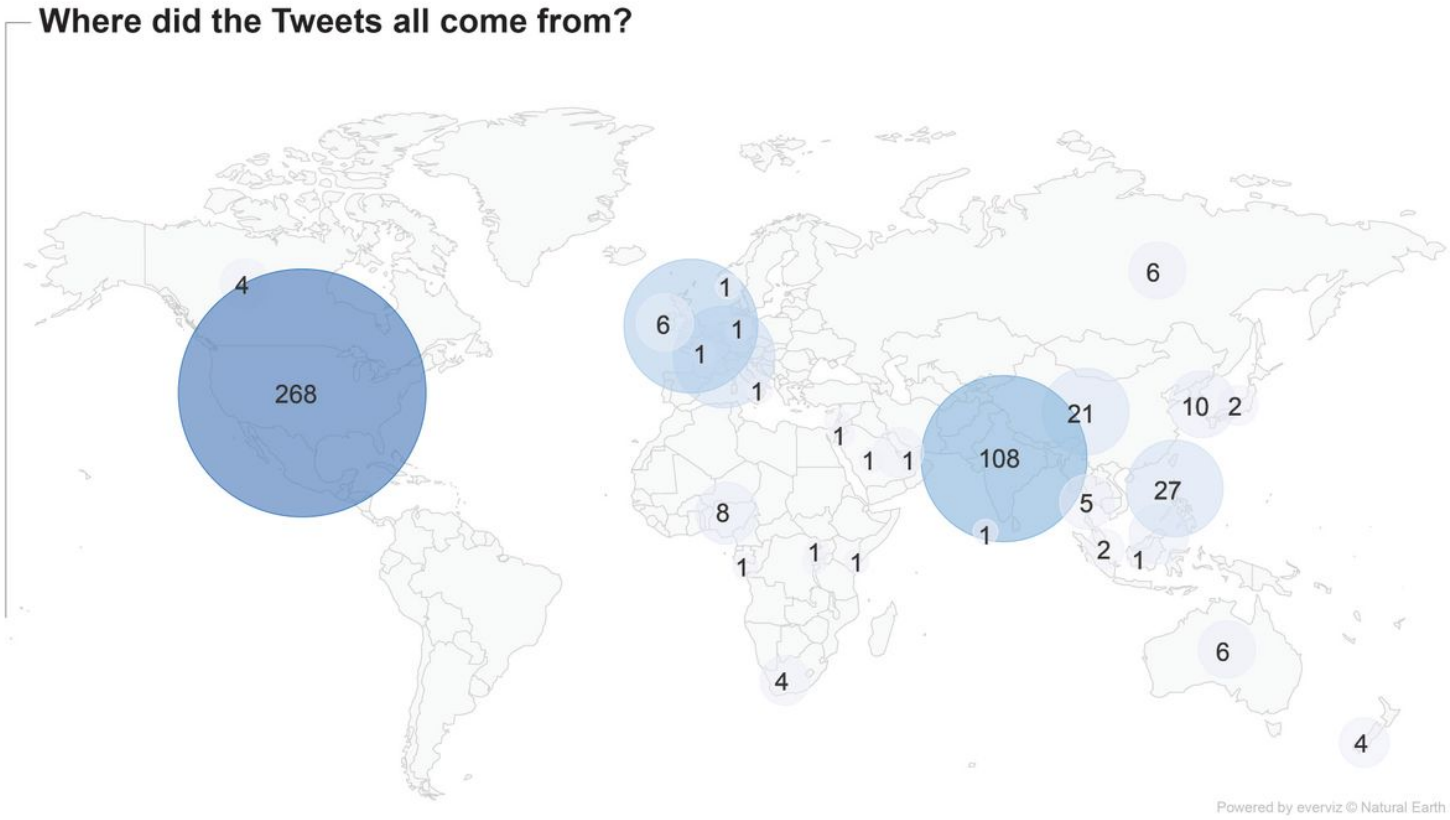

Figure 2

Tweet Locations. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

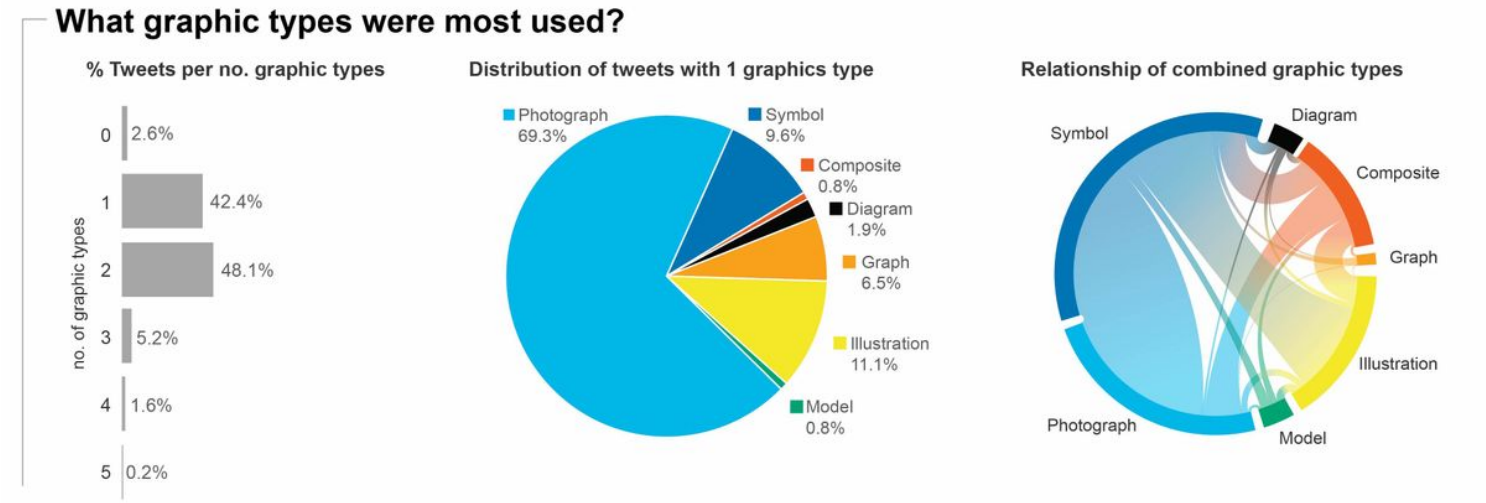

Figure 3

Graphic types and combinations

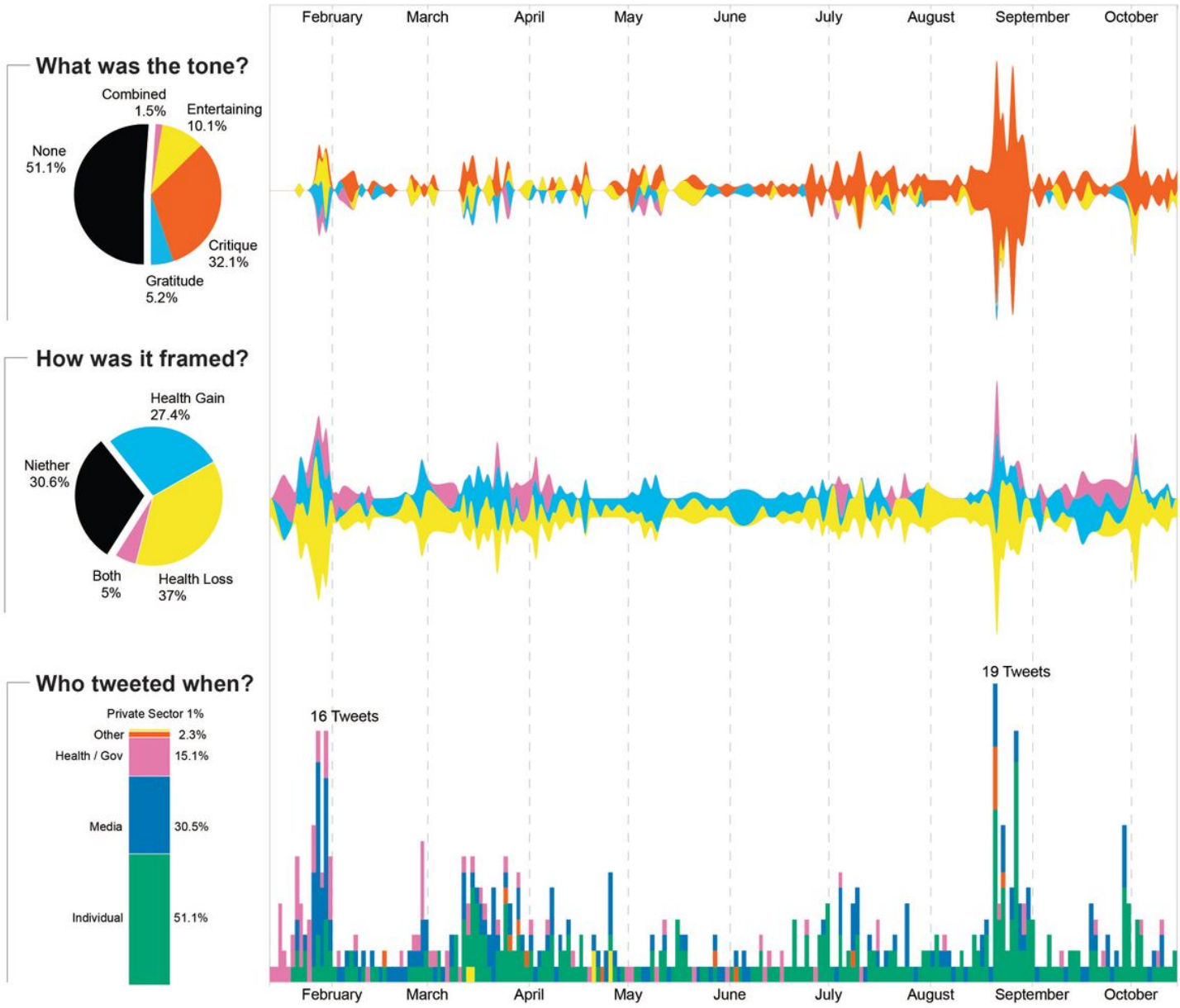

Figure 5

Tones, framing and tweets over time

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- 1.DataTweetLocations.csv
- 2.DataGraphicTypes.csv
- 3.DataGraphicTypesCombinedNormedEdges.csv
- 4.DataGraphicTypesCommunicatedIndividually.csv
- 5.DataCovidTopics.csv

- 6.DataTopicsMentionedAlongsidePrevention.csv
- 7.DataCovid19MeasuresCommunicatedIndividually.csv
- 8.DataCovid19MeasuresInCombination.csv
- 9.DataCovid19MeasuresInCombinationNormedEdges.csv
- 10.DataCovid19MeasuresOverallFrequency.csv
- 11.DataFraming.csv
- 12.DataFramingOverTime.csv
- 13.DataToneofTweets.csv
- 14.DataToneofTweetsOverTime.csv
- 15.DataStakeholderTweetsOverTime.csv
- 16.AllQualitativeCodingData.csv