



The COVID-19 vaccine on Facebook: A study of emotions expressed by the Brazilian public

Vacuna contra COVID-19 en Facebook: Un estudio sobre las emociones expresadas por el público brasileño

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ABSTRACT

Vaccines are an essential public health resource for disease containment and reduction of associated mortality rates. With the emergence of COVID-19, public debates on the themes of vaccines and vaccination processes became important topics on diverse media and social networking platforms. In this article, our objective was to identify and reflect on the emotions evoked in the Brazilian public with respect to the COVID-19 vaccine during 2020 and 2021 on Facebook. To achieve this, we used the Crowdtangle graphical interface to extract complete copies of posts made by public Facebook profiles during this timeframe, from which a random sample of 1,067 posts was selected for analysis. Identification of emotions was performed using the Human-Machine Interaction Network on Emotion (HUMAINE) descriptors as a baseline reference. Emotions were then grouped into categories following Core Affect Model guidelines. Data analysis and interpretation indicated a prevalence of positive emotions such as trust, interest, and hope directed toward vaccines in the Brazilian domestic scenario. Negative emotions such as worry and disapproval were also expressed, albeit in reference to contextual issues (for example, the spread of COVID-19, delays in vaccine access, and the emergence of new variants) and public figures, such as the President of Brazil.

RESUMEN

Las vacunas son un recurso de salud pública esencial para la contención de enfermedades y la reducción de las tasas de mortalidad asociadas. Con la aparición de la COVID-19, los debates públicos sobre los temas de las vacunas y los procesos de vacunación se convirtieron en temas importantes en diversos medios y plataformas de redes sociales. En este artículo, nuestro objetivo fue identificar y reflexionar sobre las emociones evocadas en el público brasileño con respecto a la vacuna COVID-19 durante 2020 y 2021 en Facebook. Para lograr esto, utilizamos la interfaz gráfica de Crowdtangle para extraer copias completas de las publicaciones realizadas por los perfiles públicos de Facebook durante este período de tiempo, de las cuales se seleccionó para el análisis una muestra aleatoria de 1.067 publicaciones. La identificación de las emociones se realizó utilizando los descriptores de Red de Interacción Hombre-Máquina en la Emoción (Human-Machine Interaction Network on Emotion, HUMAINE) como referencia. Luego, las emociones se agruparon en categorías siguiendo el Modelo de Afecto Central (Core Affect Model). El análisis y la interpretación de los datos indicaron una prevalencia de emociones positivas relacionadas a las vacunas, como confianza, interés y esperanza, en el escenario doméstico brasileño. También se expresaron emociones negativas como preocupación y desaprobación, aunque en referencia a cuestiones contextuales (por ejemplo, la propagación de COVID-19, retrasos en el acceso a la vacuna y la aparición de nuevas variantes) y figuras públicas, como el presidente de Brasil.

KEYWORDS | PALABRAS CLAVE

Vaccine, vaccination, emotions, social networks, Facebook, Brazil.
Vacuna, vacunación, emociones, redes sociales, Facebook, Brasil.

1. Introduction and state of the art

Vaccines were demonstrated to be an essential public health resource during the COVID-19 pandemic in terms of disease containment and mortality rate reduction. Developed rapidly and garnering high expectations from the public (Bok et al., 2021), the first COVID-19 vaccine – developed by Pfizer/BioNTec – was approved globally by the World Health Organization (WHO) in December 2020 for emergency use¹.

In Brazil, the National Health Regulatory Agency (“Agência Nacional de Vigilância Sanitária”) (Anvisa) first approved the Astrazeneca (as part of an accord between Oxford University and the Brazilian Oswaldo Cruz Foundation) and Coronavac (developed by Sinovac in collaboration with the Butantan Institute) vaccines for domestic use on January 17th, 2021². Shortly thereafter, nurse Mônica Calazans became the first Brazilian to be vaccinated with Coronavac, a moment that was widely covered by the media and generated copious amounts of content on social networks that revealed the public’s interests, perceptions, sentiments, and emotions regarding the vaccine’s approval and the beginning of the COVID-19 vaccination process in Brazil.

Based in this context, in this article we aim to identify and reflect on the feelings and emotions shared by the Brazilian public regarding vaccines during 2020 and 2021, a period in which the theme received extensive attention in the public sphere, which in turn generated expectations and interest. To achieve this aim, 1,067 posts made by public Facebook profiles were selected for analysis using the Crowdtangle graphical interface.

Though often left unexplored, emotions have been indicated by numerous studies as important to the understanding of historical and social events (Ahmed, 2014; Potkay, 2007), being described as constitutive elements of motivations, perceptions, and both collective and individual attitudes. As such, the study of the emotions evoked by the COVID-19 vaccine and related vaccination processes, specifically on Facebook, can be considered a productive strategy in the analysis of how this public health resource is seen and evaluated by the public.

According to a study by Avaaz (a network focused on global social mobilization) and the Brazilian Immunization Society (“Sociedade Brasileira de Imunizações”) (SBIIm) (2019), networks such as Facebook play important roles as spaces for debate and sources of information on vaccines. Orr et al. (2016) and Oliveira et al. (2020) corroborate this assertion, demonstrating that Facebook has indeed been used as a tool for the search for and sharing of health-related content.

In Brazil, this usage and the potential it represents are accentuated, as the Brazilian population, 77% of which has internet access, represents the sixth most intense user of social networks worldwide according to a report by We Are Social (2022). Searches for information are highlighted as one of the most important use cases for Facebook, which is one of the most popular social networks in the country, in this same report.

Understanding discussions about the COVID-19 vaccine and related vaccination processes on Facebook, from the perspective of the analysis of and reflections on the emotions they evoke, can, in turn, be considered paramount to the understanding of how the public perceives one of global society’s key tools for the containment and eradication of diseases, especially in a context of growing reluctance to vaccinate on a global level (Kennedy, 2020) and the circulation of anti-vaccine discourse (Costa & Silva, 2022).

1.1. Vaccines, emotions, and social networks

Vaccine development and mass vaccination processes are society’s principal means of prevention, control, and, in some cases, eradication of diseases, thereby reducing their morbidity and mortality (Kennedy, 2020).

In recent years, however, there has been a reduction in the number of vaccinations administered worldwide. This has provoked a resurgence of outbreaks of diseases that were previously considered to have been eradicated, sounding an alarm that must be answered by public policy (Dubé et al., 2015). Brazil, which makes WHO-recommended vaccines available free of charge to the public, has historically enjoyed high vaccination rates, though rates have recently been dropping. According to DataSus, Brazil’s

2021 overall vaccination rate was 59.8%, lower than in 2020 (67.2%) and 2019 (73.4%)³. There are numerous potential explanations for this reduction, including lack of access to vaccinations or even the pandemic itself, which destabilized numerous public services⁴. Aside from these factors, researchers have also indicated vaccine reluctance as a contributing phenomenon (Nobre & Guerra, 2021; Milani & Busato, 2021). The global scenario was also already concerning before the pandemic, with the WHO naming vaccine reluctance as one of the top ten threats to global health in 2019 (World Health Organization, 2019).

Investigation of the public's attitudes toward, and perceptions of, vaccines on social networks allows for an impactful understanding to be built regarding certain groups' approaches and stances on the issue, as well as extant focal points of disinformation and anti-vaccine narratives (Massarani et al., 2021). Such investigation also allows for an understanding of the emotions evoked by public Facebook pages on the subject of vaccines to be built, taking into consideration the fact that social networking sites are interactive spaces that incentivize and galvanize the expression of sentiments and emotions (Serrano-Puche, 2016; Papacharissi, 2014). Despite recognition of this fact, the study of emotions as a technical discipline remains underdeveloped in some aspects, be it due to difficulties in defining and measuring emotions or to conflicting theoretical approaches.

In general terms, there are three principal standpoints in the study of emotions (Clarke et al., 2006; Rezende & Coelho, 2010). The first of these considers emotions as biological elements innate to their subjects, which therefore possess universal expression. The second strand, in contrast, understands emotions as historical, social, and cultural constructions, derived from social relations rather than "human nature", with the ability to vary according to time and place. The third perspective, adopted in this study, promotes the integration of the previous two, understanding emotions as being derived as much from natural elements as they are from social, cultural, and historical ones.

Calhoun (2008) aligns with this perspective, stating that emotions mustn't be viewed as irrational reactions, but rather as categories that can shed light on certain events. Ahmed (2014) reinforces this argument by stating that emotions can reveal motivations, customs, and predispositions, as well as power relations, going so far as to characterize them as a reflection of zeitgeist.

Some studies have adopted this position in their investigation of the issue of emotion on social networks, with the aim of understanding the behavior and opinions of certain groups. One of the strategies employed in such endeavors is sentiment and emotion analysis (Benevenuto et al., 2015; Gonçalves et al., 2013), which integrates language processing and analysis in order to determine the emotional content present in a specific excerpt of text with the objective of identifying its polarity or valence (positive or negative), excitation (level of activation or deactivation), and the emotions it represents through standardized descriptions.

Some studies performed specifically on social media content produced on the subject of vaccines and vaccination processes have demonstrated the importance of analyzing feelings and emotions. When analyzing discourse related to COVID-19 vaccines on Twitter during the rollout of vaccinations in the USA, for example, Monselise et al. (2021) demonstrated the utility of evaluating public sentiment on vaccines through the way in which they are represented on social networks, applying their results in the formulation of public health policy. Chou and Budenz (2020) in turn suggest that, once identified, negative emotions such as fear and anger may come to provide explanations for vaccine reluctance, creating opportunities for the implementation of communication strategies with the potential to neutralize negative emotions and promote other, positive emotions to counteract them.

Greyling and Rossouw (2022), analyzing data concerning information about vaccines posted on Twitter in 10 different countries, observed that posts containing positive information regarding their safety and efficacy tended to amplify other positive attitudes and sentiments on the subject, demonstrating the degree to which sentiments and emotions can be important factors in the influencing of decision-making processes. Hu et al. (2021) present similar results, though they also indicate the complexity and diversity of emotions that can be associated with vaccines and vaccination, including how critical events can impact and shape public opinion on vaccines. In Brazil, despite wide circulation of vaccine-related content on social networks, studies about the emotions evoked by this content are still incipient, especially with

regard to Facebook. Among the studies carried out in the Brazilian context, the following themes can be observed: analysis of emotions and sentiments evoked during the COVID-19 pandemic using Twitter posts (Gonçalves et al., 2022), and investigations into the sentiments and emotions around vaccines, also on Twitter, in distinct temporal slices, such as during the vaccine approval process in Brazil (Penteado et al., 2021), the first few months of vaccinations in the country (Rodas et al., 2022), and specific months of 2022 (Obeica & Martins, 2022). It is noteworthy that, overall, there is a scarcity of analysis of platforms other than Twitter and longitudinal studies; the use of a wider temporal scope and an increase in the number of networks included in data sets would allow for research done on the relationship between vaccines and emotions to contribute more effectively to knowledge of how the Brazilian public processes information relevant to this theme.

2. Materials and methods

2.1. Data collection

Data for this study was extracted using the Crowdtangle graphical interface system on January 3rd, 2022, using the search terms “vaccine”, “vaccines”, “vaccinate”, “vaccinated”, “vaccinates”, “vaccination”, “coronavac”, “pfizer”, “janssen” and “astrazeneca” for posts on public Facebook pages made between January 1st, 2020, and December 31st, 2021, returning a total of 2,965,376 results.

In order to identify the emotions expressed by the Brazilian public on Facebook in such a large quantity of collected publications in light of the challenges inherent in their analysis, a simple random sample was chosen with a 95% confidence interval and 3% margin of error using the sample n () function, an element of the dplyr package in the programming and statistical analysis language R. As a result, the final data set for this study was composed of 1,067 posts, an adequate sample size for a simultaneously representative and qualitative analysis.

The choice to randomly select posts for analysis was made due to the size and diversity of the dataset, as well as to avoid limiting analysis to the most liked, commented, and shared posts, as would have been the case if selection by order of engagement were employed, and which could potentially be biased towards highly emotionally charged text according to algorithmic criteria for content circulation on the platform (Berger & Milkman, 2012).

2.2. Identification and classification of emotions

After data collection and processing, the posts were interpreted and categorized in order to determine their emotional content. Those void of emotional content were classified as “no emotions expressed”, a category corresponding to informational content and other types of content without explicit emotional affect (Penteado et al., 2021). Posts that did contain explicit emotions were classified as one of two forms: “emotion expressed and identified”, to which the emotional descriptors, which will be described shortly, were applied, or “emotion expressed but not identified” in cases that, despite having detectable emotional content, did not demonstrate enough clarity for classification as any specific emotion.

Of the 1,067 posts, 523 (49%) were classified as “no emotions expressed”, 22 (2%) as “emotion expressed but not identified”, and 523 (49%) as “emotion expressed and identified”. Due to our interest in investigating posts with identifiable emotional content, those classified as “no emotion expressed” or “emotion expressed but not identified” were not analyzed further. As such, the data set for this study consisted of 523 posts.

Numerous systems for the recording and classification of emotions exist in the field of sentiment and emotion analysis, including automated (with the use of tailored software); semi-automated (employing software and manual resources) and manual (performed by researchers without the assistance of automated processes) alternatives (Aman & Szpakowicz, 2007; Siegert et al., 2014; Devillers et al., 2005). Automated and semi-automated systems, though higher in throughput, entail some negative aspects, such as difficulties in identifying emotions in text with grammatical inconsistencies or messages with ambiguous meanings (such as irony or sarcasm), as well as difficulties in recognizing cultural characteristics of some emotions. For this study, we employed a manual recording and classification process, which is recommended for smaller data sets as it reduces the potential for error in interpreting emotions and

promotes an understanding of their meanings based on specific contexts and communication dynamics (Martin et al., 2009).

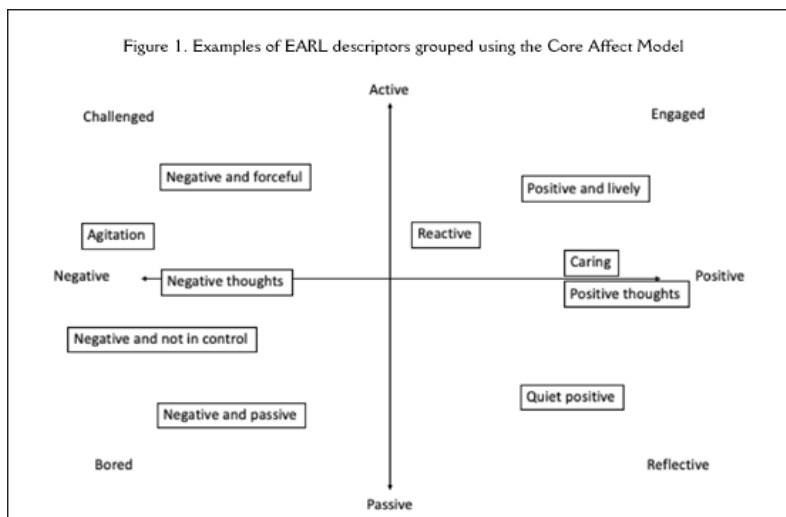
In order to establish a reliable structure for categorizing the observed emotions, we used the Emotion Annotation and Representation Language (EARL) framework, a list of 48 emotions compiled by the Human-Machine Interaction Network on Emotion (HUMAINE) described in Schröder et al. (2006) and Douglas-Cowie et al. (2007), as a basis. In some cases, affective or emotional expressions other than those included in EARL were encountered during the classification process and were added to the list of descriptors. Following these steps, we listed 56 emotions in total (Table 1).

Table 1. List of emotional descriptors adapted from HUMAINE/EARL protocols

| | | |
|------------------------------------|-----------------------------|--------------------------|
| Negative and strong | 20 - Shame | 38 - Happiness |
| 1 - Anger | Negative and passive | 39 - Joy |
| 2 - Annoyance | 21 - Boredom | 40 - Pleasure |
| 3 - Contempt | 22 - Despair | Caring |
| 4 - Disgust | 23 - Disappointment | 41 - Affection |
| 5 - Irritation | 24 - Hurt | 42 - Empathy |
| 6 - Impatience | 25 - Sadness | 43 - Friendliness |
| 7 - Disapproval | Agitation | 44 - Love |
| Negative and not in control | 26 - Stress | Positive thoughts |
| 8 - Anxiety | 27 - Shock | 45 - Confidence |
| 9 - Embarrassment | 28 - Tension | 46 - Courage |
| 10 - Fear | Quiet positive | 47 - Hope |
| 11 - Helplessness | 29 - Calmness | 48 - Humanity |
| 12 - Powerlessness | 30 - Contentment | 49 - Satisfaction |
| 13 - Worry | 31 - Relaxation | 50 - Pride |
| Negative thoughts | 32 - Relief | 51 - Trust |
| 14 - Doubt | 33 - Serenity | Reactive |
| 15 - Perplexity | Positive and lively | 52 - Interest |
| 16 - Envy | 34 - Amusement | 53 - Curiosity |
| 17 - Frustration | 35 - Delight/Enchantment | 54 - Politeness |
| 18 - Guilt | 36 - Elation | 55 - Surprise |
| 19 - Defensiveness | 37 - Excitement | 56 - Enthusiasm |

Note. Rowe et al. (2023) adapted from HUMAINE and EARL.

Emotional descriptors were then grouped into larger categories adapted from Russell (2003)'s Core Affect Model, as described in Rowe et al. (2023). This model classifies emotions based on excitation and valence: two bipolar, independent dimensions.



Note. Adapted from Rowe et al. (2023).

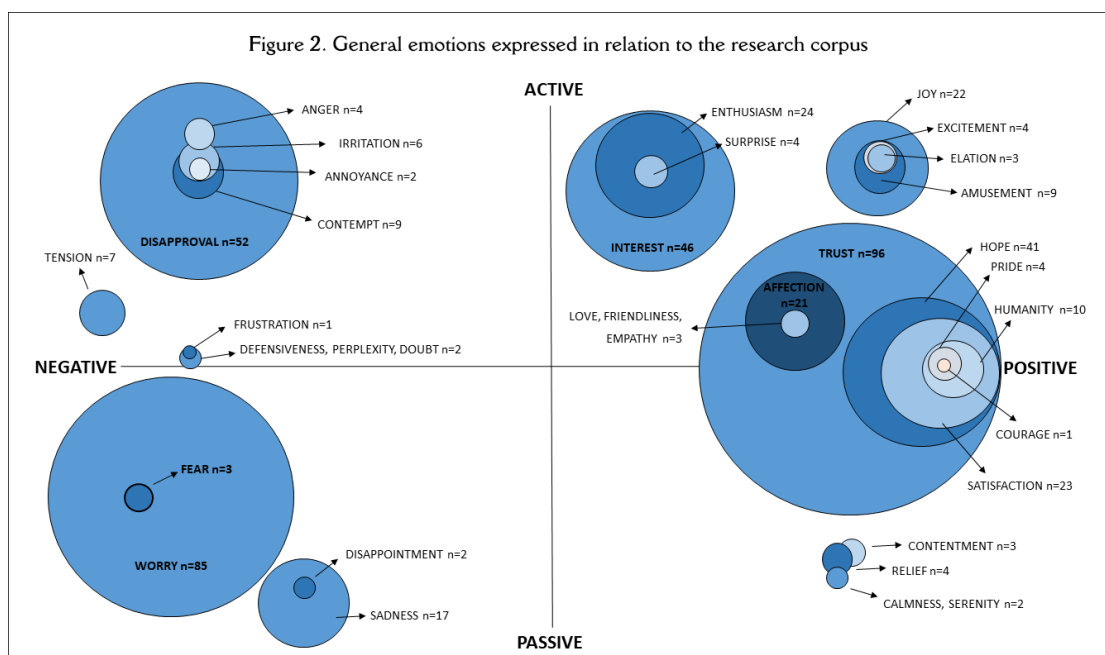
The analysis of valence includes positive (agreeable) or negative (disagreeable) sensations experienced and excitation refers to the level of emotional activation, varying from excited (active) to calm (passive) (Russell, 2003, 2009). After categorization, we observed that emotions were frequently directed towards aspects only tangentially related to the vaccine or vaccination, such as relevant decisions taken (or not

taken) by public officials. Consequently, we identified and listed the objects of each expressed emotion in order to understand which topics were most associated with the broader theme of vaccines.

3. Analysis and findings

Thirty-five distinct emotions were identified in this study's dataset, demonstrating the wide range of emotions with distinct triggers, perspectives, and expressions that vaccines and vaccination evoke. Grouping these emotions based on the Core Affect Model (Russell, 2003, 2009), we registered 142 occurrences of high excitation, positive valence emotions. High excitation, negative valence descriptors were assigned 87 times.

Among passive descriptors, 107 were negative valence and 187 were positive valence. The most frequently identified emotion was trust (18.4%), followed by worry (16.3%), disapproval (10%), interest (8.8%), hope (7.9%), enthusiasm (4.6%), satisfaction (4.4%), joy (4.2%), affection (4%) and sadness (3.3%). Other emotions were identified at lower levels of prevalence.



Note. Authors' compilation. Circle size corresponds to the total number of appearances of the corresponding emotion in the dataset.

Among the positive valence emotions identified in the posts, trust ($n=96$) was associated with messages in which the vaccine and the vaccination process were well-received, demonstrating an association with information regarding safety and efficacy of vaccines as their principal characteristic. Interest ($n=46$), hope ($n=41$), enthusiasm ($n=24$), satisfaction ($n=23$), joy ($n=22$) and affection ($n=21$) were also expressed in reference to the vaccine, seen as an important step towards the end of the pandemic.

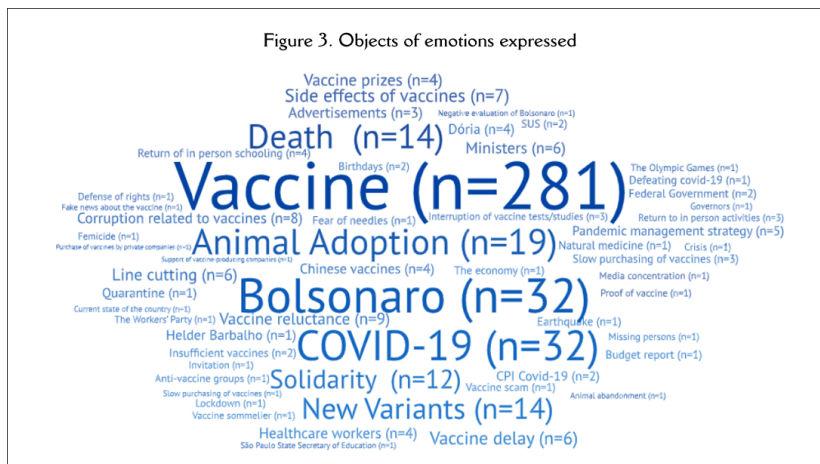
Among negative valence emotions, worry ($n=85$), disapproval ($n=52$) and sadness ($n=17$) were most prevalent. It is noteworthy that posts containing these emotions, in general, did not refer to the vaccine itself. Worry, for example, was commonly directed towards the spread of COVID-19 ($n=32$), new variants ($n=14$), delays in vaccine purchasing and administration ($n=10$), and insufficient amounts of vaccine ($n=2$).

Disapproval, in turn, was directed towards the actions and speech of public figures, such as President Jair Bolsonaro ($n=32$), cases of corruption related to the vaccination process ($n=8$) and the actions of several ministers ($n=6$).

Other negative emotions were also directed towards the president and/or his actions, such as irritation ($n=6$), anger ($n=4$), and annoyance ($n=2$). Sadness was identified in posts citing deaths ($n=14$) caused by the absence of vaccines as a form of COVID-19 prevention.

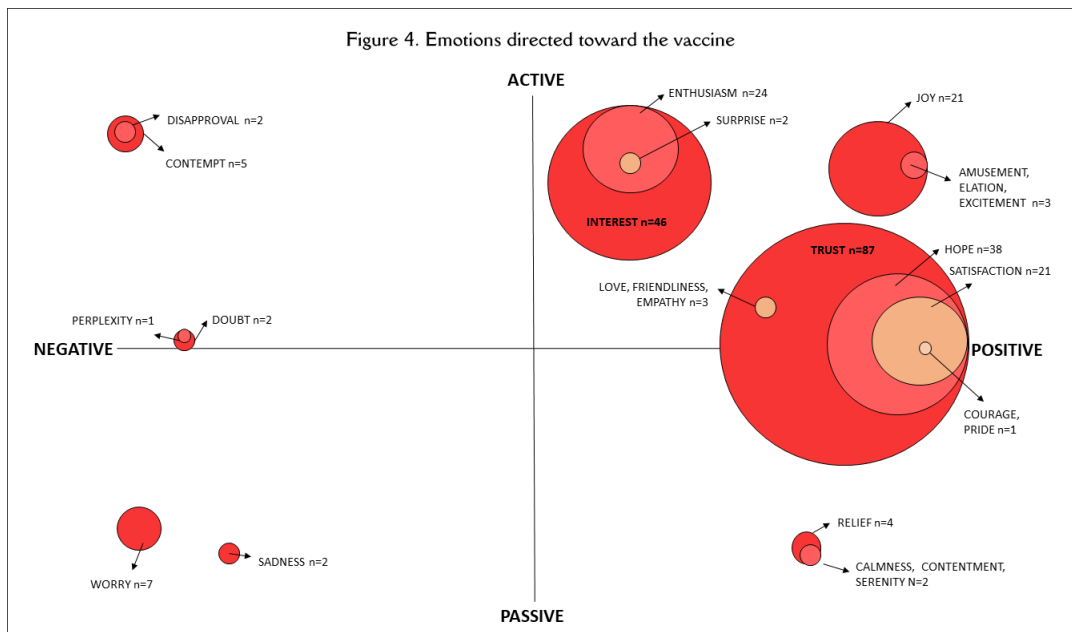
| Table 2. Representative posts of prevalent emotions (our bolding) | |
|---|--|
| Trust | Vaccines are, without a shadow of a doubt , a step forward for medicine and for humanity. Through vaccines, there is control and prevention of epidemics. Immunization is fundamental to quality of life, so protect yourself always. Vaccines are safe , get vaccinated! ⁹ . For three centuries, vaccines have saved lives! Throughout history, immunizations have contributed to the eradication and control of epidemics. Be an ethical professional and incentivize vaccination. Please run from the fake news. |
| Interest | Drivers demand covid-19 vaccines and salary adjustments. Vaccinate now , especially if you haven't stopped working during the pandemic. #vaccinate now #sus ⁹ #maskup #pandemic #health |
| Hope | Through August 10th, 6,631 people have taken one dose of the vaccine, 2,772 people have taken two and 300 people have received the single dose vaccine #arautjournalism #arautonline #immunization a breath and expectation of better days . It is what is to be expected with the expansion of vaccination in Sun Valley. During the week that marked the beginning of vaccinations for those 18 and over, another important moment was celebrated in the town: the slowing down of the pandemic in Sun Valley. Happy 2021 to all! I hope that it will be the year of the vaccine , of agglomerations and the fall of a certain president!! |
| Worry | Scientists are not totally confident that the covid-19 vaccines will work against the variant of the virus found in South Africa. Matt Hancock, Minister of Health in the United Kingdom, says that the mutation identified in South Africa is a " very, very significant problem ". Brazil continues in last place! While the world advances its efforts to exterminate the Coronavirus, Brazil doesn't even appear on the vaccine map. We are the caboose , literally. And this "game" cannot be lost, lives are at stake! #coronavirus #vaccine #Brazil. |
| Disapproval | #thepeople the anchor is indignant with the country's current situation, and laments that the ex-husband and father of Sasha Meneghel wasn't afforded the opportunity to take the Covid-19 vaccine. Xuxa blames the government for their refusal to purchase doses when offered them. While Brazilians suffer due to the lack of vaccines , due to the economic crisis that has increased the numbers of the unemployed and the hungry, Bolsonaro has decided to decree himself a Carnaval holiday . |
| Irritation | In the worst moment of a pandemic, what does a genocidal president do? Just this! Criticize the only thing that can save lives in a country that hasn't even vaccinated 2% of its population. |
| Sadness | "The dreamed of vaccine that my friend wasn't able to take . But I carry him in my heart," said the comedian. #news106. |

Among the expressed and identified emotions (Figure 2), 62.1% (n=325) had positive valence, while 37.9% (n=198) showed negative valence. The most frequent objects of these emotions demonstrate the vaccine's role as a central theme (n=281, 53.7%). The vaccine was associated with positive emotions such as trust, interest, and hope. Topics related to Bolsonaro and COVID-19 (both at n=32 or 6.1% each) appeared next most prevalently, the first being related to emotions such as disapproval, irritation, and anger, and the second to worry. Animal adoption⁷ was the next most prevalent object of emotional expression (n=19 or 3.6%), and was associated with affection. Aside from these themes, deaths and new variants (n=14 or 2.7% each) appear as objects associated with sadness and worry, respectively. Other objects identified in smaller quantities of posts are expressed in Figure 3.



Note. Authors' compilation. The size of each word corresponds to its total number of appearances in the data set⁸.

In cases of emotion directed toward the vaccine, positive emotions were displayed in 93.1% ($n=256$) of posts and negative emotions in 6.9% ($n=19$). The most commonly expressed emotions in these cases, aside from trust ($n=87$; 30.9%), interest ($n=46$; 16.3%) and hope ($n=38$; 13.5%) as previously mentioned, were joy ($n=21$; 7.4%) and enthusiasm ($n=21$; 7.4%).



In the negative quadrants, worry ($n=7$; 2.5%), disdain ($n=5$; 1.8%) and disapproval ($n=2$; 0.7%), followed by doubt ($n=2$; 0.7%), sadness ($n=2$; 0.7%) and perplexity ($n=1$; 0.4%) can be observed. These emotions correspond to a smaller proportion of the results than the positive emotions.

4. Discussion and conclusions

Social networks have emerged as important spaces for the expression of ideas, stances, and attitudes by different groups on the most diverse subjects (Santos & Cypriano, 2014). They are also seen as channels through which a large variety of emotions transit (Serrano-Puche, 2016; Papacharissi, 2014). Our analysis of Facebook posts discussing the vaccine during 2020 and 2021 and their associated emotions revealed trust to be the most prevalent emotion. Despite worry being the second most frequently observed emotion by a small percentage difference, and disapproval holding third place, trust was directed specifically towards the vaccine and vaccination, whereas the negative emotions were directed towards contextual situations in the country, including difficulties in accessing the vaccine.

This result indicates broad acceptance of the vaccine among Facebook users in Brazil, considering the sample of this study, corroborating studies on perceptions of vaccines performed prior to the pandemic (Gallup, 2019). The presence of such elements as the safety, efficacy, and positive effects of vaccines have been noted as factors that may have contributed to the production of trust in public communications, seeing as they reinforce the positive bias surrounding vaccines. These points support an understanding of the vaccine as a strategy for overcoming the pandemic, as well as a form of avoiding spreading the disease and unnecessary deaths, in light of the recurrence of trust in posts that considered the vaccine as positive while simultaneously distancing themselves from possible doubts (Figure 2). Messages addressing the vaccine with a positive bias tend to engender positive public perceptions and discussions of the vaccine (Kwok et al., 2021), while messages that question its efficacy may contribute to anti-vaccine stances (Greyling & Rossouw, 2022).

Hu et al. (2021) also found trust to be the predominant emotion in their study of Twitter posts made before and after the approval of the vaccine in the USA. According to the authors, trust and other positive

emotions gained visibility during the onset of vaccination, outcompeting negative emotions such as sadness, anger, and disgust. This same dynamic was observed by Rahmanti et al. (2022) in their observation that positive emotions such as trust outweighed negative ones during the beginning of vaccinations in Indonesia, understood by the authors as a consequence of effective public communication strategies enacted by the government regarding the vaccine's safety. Similarly, trust was the most frequently observed emotion in a study performed on discussions of the vaccine on social networks in Australia (Kwok et al., 2021). These results can be used as references for the understanding of debates on vaccines as well as public responses to vaccines on social networks.

Positive bias, articulated through emotions such as hope, joy, interest, satisfaction, and enthusiasm, was the most frequently observed stance (62.1%) for posts addressing the vaccine and vaccination processes in this study. We reiterate that the majority of negative valence emotions identified (37.9%) were not directed principally toward the vaccine. Worry, for example, was mainly directed toward the spread of COVID-19, disputes regarding vaccine approval, purchases of vaccines and implementation of the vaccination process, and the emergence of new variants.

The emergence of new variants, in particular, was viewed as a risk to efforts to control the pandemic and a threat to the vaccination process. Negative emotions associated with this theme were also identified in other studies (Greyling & Rossouw, 2022; Mahyoob et al., 2022). Questions regarding eventual side effects of the vaccines, in turn, was one of the only topics directly related to the vaccine that was identified among instances of worry, though it represented a small proportion of the data set (only 1.3% in total).

Disapproval was also not typically directed towards the vaccine; it was most commonly directed toward the speech and actions of public figures such as President Jair Bolsonaro, who repeatedly vocalized his anti-vaccine stance⁹. Events such as these, in which public officials placed themselves in opposition to the development and administration of public health resources such as the vaccine, have the potential to impact discussion on vaccines, as well as the emotions evoked by the public in their evaluation of and decisions based on such information (Hu et al., 2021). Other emotions that were expressed and identified in this study were also directed toward the Brazilian president, his ministers, and their actions, specifically anger, irritation, and annoyance. This demonstrates that, while the vaccine was described positively in the majority of posts, the president, his team, and their actions were seen as hindrances to the success of the vaccination process in Brazil.

The results indicate that the vaccine evoked a wide array of emotions with different valences and levels of excitation, demonstrating what a sensitive and recurring theme it was in public debate. Among the emotions identified, those of positive valence, such as trust, interest, and hope, occurred most frequently, especially when directed specifically towards the vaccine. Negative valence emotions, such as worry and disapproval, were focused on contextual themes and issues, such as the spread of COVID-19, difficulty in accessing the vaccine, new variants, and President Bolsonaro himself.

Though fewer in number, these negative emotions should be interpreted as challenges to the recognition of the vaccine as an effective strategy for combatting the pandemic, especially in a scenario in which public figures propound anti-vaccine stances (Duarte, 2020). In this sense, the identification of distinct themes in discourse on the COVID-19 vaccine and vaccination process, as well as the emotions evoked in these instances, is shown to be an important tool for the development of tactics and strategies that aim to reinforce public trust in vaccines and increase vaccination rates.

The results obtained in this study regarding the identification of emotions related to the vaccine expand on the findings of previous studies performed in other contexts and social networks (Monselise et al., 2021; Greyling & Rossouw, 2022; Hu et al., 2021; Penteado et al., 2021), contributing to reflections on the theme, especially in the Brazilian context. It is important to highlight that this study's results, however, refer to a bounded data set which possesses both limitations and potentialities. Its limitations include the fact that the data set is representative of a specific social network, as well as the fact that it does not address the entire data set on vaccines or groups that do not have internet access. Its potentialities include the ability to shed light on an issue that, as of yet, has been little explored in Brazil, contributing as such to interpretations regarding the perceptions of a subset of the Brazilian public on Facebook regarding the COVID-19 vaccine, identifying emotions evoked, their valences, and their principal objects.

Given these aspects, taking into consideration the cut applied, as well as the diversity of publications and extant platforms, it is evident that further investigations into other time periods, post types, and social networks are necessary in order to elucidate the relevant dynamics involved, identify similarities and differences between them, and, in summary, understand the perceptions and emotions of different groups regarding the COVID-19 vaccine and vaccination processes in Brazil.

Notes

¹WHO issues its first emergency use validation for a COVID-19 vaccine and emphasizes need for equitable global access (<https://bit.ly/3Sp3iLS>).

²Anvisa approves emergency use of first coronavirus vaccines in Brazil (<https://bit.ly/3EjToap>).

³Data from the Unified Health System Informatics Department (DataSus), an Agency of the Secretary of Strategic and Participative Management at the Ministry of Health. (<https://bit.ly/3BFuJu7>).

⁴Essential health services confront constant disruptions during the COVID-19 pandemic (<https://bit.ly/3LBW9FM>).

⁵Despite the fact that the posts in question were posted publicly, we have chosen not to identify their authors as an ethical consideration.

⁶Translator's note: SUS is an acronym for the "Sistema Único de Saúde" (Unified Health System), Brazil's public health system.

⁷As the search terms did not exclusively define the vaccine as a human health resource, some selected posts in the study's data set were on the topic of animal vaccination and adoption. In these cases, vaccines were seen as a signal of responsibility, care, and affection towards the animals.

⁸Translator's note: João Dória (n=4) was the governor of São Paulo at the time of the posts. The COVID-19 Parliamentary Commission of Inquiry (Comissão Parlamentar de Inquérito) (CPI, n=2), in turn, was convened by the Brazilian Federal Senate from April 27th to October 26th, 2021, for the purpose of investigating alleged omissions and irregularities in the activities of Jair Bolsonaro's federal government during the COVID-19 pandemic in Brazil.

⁹<http://glo.bo/3C2iN79>.

Authors' Contribution

Idea, L.M.; Literature review (state of the art), G.F.O., L.M., G.S., T.O.; Methodology, L.M., G.S.; Data analysis, G.F.O., L.M., T.O., G.S., M.A.S.J.; Results, G.F.O.; Discussion and conclusions, G.F.O., L.M., T.O., G.S., M.A.S.J.; Writing (original draft), G.F.O., L.M.; Final revisions, G.F.O., L.M., T.O., G.S., M.A.S.J.; Project design and sponsorship, L.M.

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