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The vaccine on Instagram: study of emotions expressed in the Brazilian context

A vacina no Instagram: estudo das emoções expressas no contexto brasileiro

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Abstract

With the emergence of Covid-19, discussions on vaccines caused greater repercussions around the world. In social networks, spaces where different publics produce content and express their perceptions and interests, publications about immunizers have become major topics of public debate. In this article, we aim to identify and analyze the feelings and emotions expressed about the vaccine and vaccination processes in the Brazilian context in 2020 and 2021. To this end, we take as an empirical cut-out a random sample built from public posts on the topic on Instagram, collected through the Crowdtangle graphical interface. The process of classification and identification of emotions is performed from the standardized descriptors of the Human-Machine Interaction Network on Emotion (HUMAINE), followed by adoption of the circumplex model (Core Affect Model) of Russell (2003). As a result, data analyses point to the prevalence of positive emotions such as hope and trust regarding the vaccine in the Brazilian scenario, while negative emotions such as disapproval and concern are identified in the corpus relating to contextual factors (the figure of then-president Jair Bolsonaro, his speeches and actions, as well as the advancement of Covid-19 and emergence of new variants).

Keywords

Vaccine; emotion; Instagram; Brazil.

Resumo

Com a emergência da Covid-19, as discussões sobre vacinas passaram a ter maior repercussão em todo o mundo. Nas redes sociais, espaços em que diferentes públicos produzem conteúdos e expressam suas percepções e interesses, publicações sobre os imunizantes se tornaram um dos principais tópicos do debate público. Neste artigo, temos como objetivo identificar e analisar os sentimentos e emoções expressos em torno da vacina e dos processos de vacinação no contexto brasileiro durante os anos de 2020 e 2021. Para tanto, tomamos como recorte empírico uma amostra aleatória construída a partir de postagens públicas sobre o tema no Instagram, coletadas por meio da interface gráfica do Crowdtangle. O processo de classificação e identificação das emoções é realizado a partir dos descritores padronizados da Human-Machine Interaction Network on Emotion (HUMAINE), seguido pela adoção do modelo circunplexo (Core Affect Model) de Russell (2003). Como resultado, as análises dos dados apontam para a prevalência de emoções positivas como esperança e confiança em relação à vacina no cenário brasileiro, enquanto emoções negativas, como desaprovação e preocupação são identificadas no corpus no que se refere a fatores contextuais (a figura do então presidente Jair Bolsonaro, seus discursos e ações, assim como o avanço da Covid-19 e surgimento de novas variantes).

Palavras chave

Vacina; emoções; Instagram; Brasil.

1. Introduction

Vaccines and vaccination processes are regarded by health agencies and the scientific community as fundamental public health resources due to their importance in the eradication, control, and prevention of a wide array of diseases. With the emergence of Covid-19, the relevance of vaccine administration and development was reemphasized, especially given the high numbers of infections and deaths due to the disease.

Developed at great speed (Bok et al., 2021) and in a context of high public expectations, the first Covid-19 vaccines were approved by the World Health Organization (WHO) in December of 2020^[1]. In Brazil, the approval and subsequent administration of the first emergency-use vaccines occurred in January of 2021^[2], in the midst of a scenario marked by dispute and denialism, promoted in large part by Jair Bolsonaro, who was president of the country at the time and repeatedly expounded his anti-vaccine, pro-scientifically unproven medication stance on Covid-19 treatment (Paes, Brasil & Massarani, 2022; Recuero & Soares, 2021; Duarte, 2020; Monari, Santos & Sacramento, 2020).

All of these events were accompanied by ample debate, in such a way that the debates themselves became topics of primary public importance and reverberated through internet social networks (see Amanatidis et al., 2021, Monselise et al., 2021, and Penteado et al., 2021, among others). In this context, some studies have indicated an upward trend in publications about the Covid-19 pandemic and vaccines on social networks (Almars et al., 2022), especially regarding social isolation measures adopted by some countries as containment strategies to combat the new coronavirus. Simultaneously, social networking platforms have recently been indicated by several studies as primary sources of health information (Zulfiker et al., 2022; Orr, Baram-Tsabari & Landsman, 2016; Oliveira, Quinan & Thot, 2020; Benetoli, Chen & Aslani, 2017).

Aside from these uses, social networks also allow for diverse groups of the population to express, in their publications, their opinions and experiences, through which they also express sentiments and emotions (Serrano-Puche, 2016; Papacharissi, 2014). Considering this context, we began our analysis in this study with the following research question: Which sentiments and emotions were expressed in relation to the Covid-19 vaccine and vaccination processes in the Brazilian context? To this end, we used the Crowdtangle graphical interface to randomly select 1,067 posts from public Instagram pages published during 2020 and 2021.

The selection of public Instagram posts was made due to the fact that the majority of studies on emotions and vaccines have been performed on other platforms and social networks (see, for example, Chou & Budenz, 2020; Greyling & Rossouw, 2022; Hu et al., 2021; Rodas et al., 2022; Obeica & Martins, 2022), which underlines the relevance of investigating sentiments and emotions regarding vaccines on this particular social network. Additionally, as reported by the Reuters Institute Digital News Report (Newman et al., 2022), more than a third (35%) of Brazilians use Instagram as a source of information. These data corroborate the report published by We Are Social and Hootsuite (2022), which indicate that Brazil is among the four most intense users of Instagram as ranked by country. Given this scenario, the potential impact of content produced and published on Instagram on how Brazilians inform themselves and express opinions on Covid-19 (Soares et al., 2021) and vaccination processes becomes evident. Taking this premise as a foundation, our objective in this article was to widen the scope of this discussion and investigate which sentiments and emotions were evoked in regard to vaccines and vaccination processes on Instagram during 2020 and 2021.

We emphasize that this study does not take a universalist perspective on emotions, considering them rather as aspects from which useful indicators can be derived for the comprehension of historical events and social data (Ahmed, 2014; Corbin, Courfine & Vigarello, 2020), as well as constitutive elements of individual and collective motivations, interests, perceptions, and attitudes. The investigation of sentiments and emotions related to the Covid-19 vaccine, particularly on Instagram, avails itself as a strategy for the assessment of how this global public health resource has been perceived and evaluated by the Brazilian public, accentuated by a scenario of resurgence of vaccination reluctance on a global scale and a reduction in vaccination rates^[3] in Brazil.

2. Theoretical Background

As has also occurred in the case of other social networks, Instagram experienced several changes over the last few years that increased its popularity and accessibility, which in turn impacted the uses and social practices of its user base. These changes, according to Manovich (2017), caused a shift in Instagram's primary purpose from the simple sharing of images to the mediation of experiences, and it is now used for a number of purposes, of which commercial and informational objectives, as well as, as other studies have indicated, its use as a tool for the dissemination of public health information, are of particular note (Boulos, Giustini & Wheeler, 2016; Pinto et al., 2021).

International health agencies such as the WHO have used Instagram^[4] as a strategic communication tool, publishing content both for other agencies and for wider audiences in order to provide the population with information from credible and official sources (Pinto, Antunes & Almeida, 2020; Pinto et al., 2021; Lwin et al., 2018). According to Pinto, Antunes & Almeida (2020), the increase in activity and use of social networks, including Instagram, in order to deliver health-related information occurred during the emergence of certain public health outbreaks, such as Ebola (2013-2016) and the Zika Virus (2016-2016).

Investigating Instagram usage in public health in more detail, Pinto, Antunes & Almeida (2020) performed a systematic review on the theme, in which they indicated the network's potential as a tool for health promotion, especially due to its focus on imagery. In light of these uses and appropriations, other studies have investigated the sentiments and emotions articulated in content related to public health on Instagram, as we also propose to do in this study.

Studies on the emotions evoked in regard to vaccines on social networks have been performed with varying objectives, in distinct localities, and on specific networks, attempting to gain an understanding of the motivations and attitudes of the public in regard to vaccines through analysis of the content produced on the theme (see, for example, Monselise et al., 2021; Chou & Budenz, 2020; Hu et al., 2021; Yang & Sornlerlamvanich, 2021). Public sentiments and emotions present in content published on social networks, from this perspective, are understood to be elements that may elucidate interests and beliefs around vaccination, as well as public perceptions.

Xu, Chang & Jayne (2022) note that, for governments and authorities, knowledge of public opinion and sentiment on public health resources gained through emotion and sentiment analysis may prove highly useful in the clarification of rumors, as well as in the design and adoption of opportune and appropriate strategies in order to dispel misinformation and conflict.

Taking this premise as a foundation, Kearney et al. (2019) studied how Instagram is used as a communication tool in the field of child and adolescent healthcare, specifically in regard to information about the Human Papillomavirus (HPV) vaccine and sentiments around publications on the topic. Their findings indicated that posts that were favorable toward the vaccine (positive sentiments) were more prevalent than anti-vaccine (negative sentiment) publications.

Basch & MacLean (2019) performed a similar study on Instagram posts on the HPV vaccine and also found that the majority of publications on the topic were positive, i.e. pro-vaccine. More recently, other investigations have analyzed sentiments and emotions in regard to the Covid-19 vaccine on other social networks, and in other contexts and regions. Hu et al. (2021), observing Twitter publications on the topic of the Covid-19 vaccine in the USA both before and after the vaccine, identified a predominance of positive emotions, especially trust, which grew significantly during the beginning of the vaccination process.

Upon analyzing perceptions of the vaccine on Twitter in the USA, England, and Japan, Yang & Sornlerlamvanich's (2021) study corroborates the results of Hu et al. (2021) in regard to the predominance of positive emotions related to the Covid-19 vaccine in the United States, a finding that was also replicated when studying the English population, which expressed positive emotions in regard to the vaccine. The Japanese, however, were more pessimistic on the topic of vaccines (Yang & Sornlerlamvanich, 2021).

Zulfiker et al. (2022) pursued a similar investigation in the context of Bangladesh. Their results indicate that positive emotions in regard to the vaccine were more frequent than negative ones, especially after January 2021, which marked the beginning of the country's vaccination campaigns. Rodríguez-Orejuela, Montes-Mora & Osorio-Andrade (2022) carried out another study in this vein, turning their focus to the Columbian Twitter panorama during the four months prior to the approval of the Covid-19 vaccine. Their results revealed a strong presence of joy at the outset of this period, associated with the possibility of a cure in the form of the vaccine. Other emotions, mostly negative ones such as fear and anger, were also identified as being directed not towards the vaccine itself, but rather towards Covid-19 and the country's management of the pandemic, respectively.

In Brazil, studies on emotions regarding vaccines on social media have also been carried out, with Twitter featuring prominently as a source of data. Among these studies, Penteado et al. (2021), which analyzed the sentiments and emotions that were evoked regarding the approval of the Covid-19 vaccine in Brazil; Rodas et al. (2022), which investigated the sentiments and emotions regarding the vaccine in its first months of administration, and Obeica & Martins (2022), which reflected on the emotions directed towards the vaccine in specific months of 2022, are of particular note.

In their results, Penteado et al. (2021) observed the emergence of positive sentiments directed towards the approval of the vaccine, an aspect also identified in Obeica & Martins' (2022) work, which pointed

out the predominance of positive emotions surrounding the vaccine and a notable preference for Coronavac, which was perceived positively in their data set. Rodas et. al (2022), in turn, observed a shift in sentiment polarity away from positive sentiments and towards neutral and negative sentiments over the course of their period of study, which the authors suggest may be due to the increase in the number of Covid-19 cases and the emergence of new strains that occurred during that period.

In general, these studies indicate that the publications analyzed carry a positive bias in regard to vaccines. We perceive, however, knowledge gaps with respect to the execution of studies on other platforms, as well as longitudinal studies, seeing as studies carried out over longer time frames would have the capacity to contribute to a more actionable knowledge base on the ways in which the Brazilian public expresses its sentiments and emotions towards vaccines and vaccination processes.

In regard to the study of emotions in general, there are three noteworthy perspectives: 1) the naturalist perspective, which understands emotions as biological and universal (Ekman, 1993; Plutchik, 1962); 2) the constructivist perspective, which understands emotions as the fruits of social, historical, and cultural relationships (Barrett, 2017; Ahmed, 2014), and 3) the integrated perspective, which considers emotions concomitantly as results of biological and socio-cultural-historical aspects (Gu et al., 2019; Hofmann & Doan, 2018; Rezende & Coelho, 2010; Clarke, Hogget & Thompson, 2006). In this study, in order to best understand the emotions expressed on the topic of the Covid-19 vaccine and vaccination processes, we have adopted the third perspective.

3. Materials and Methods

3.1 Data Collection

Data collection was performed on January 3rd, 2022, through the Crowdtangle interface, using the results of searches for the terms in Portuguese for "vaccine", "vaccines", "vaccinate", "vaccinated", "vachina"^[5], "vaccination", "vaccinal", "v4cc1n3", "coronavac", "pfizer", "janssen" and "astrazeneca"^[6] on publications posted on public fan-pages between January 1st, 2020 and December 31st, 2021, resulting in a total of 974,951 publications.

Considering the necessity of constructing a wide and diverse data set not limited to posts with the highest amounts of engagement (most likes, comments, and shares), we chose to randomly sample publications in order to produce a panoramic view, seeing as a selection of publications by order of engagement would have led to the analysis of publications containing pre-evident emotional charges, in accordance with the circulation criteria and algorithmic preferences of each platform (Berger & Milkman, 2012). As a result, our random sample consisted of 1,067 posts, with a margin of error of 3%.

3.2 Emotion identification and classification

After the collection and compilation of the data set was complete, an initial processing step, aiming to identify the presence or absence of emotions, was performed on each post. During this process, each post constituted a single analysis unit. Publications void of emotional content, for example those that were more objective in style or approach, were classified as "no emotional expression". Publications identified as containing explicit emotional content, in turn, were classified as either 1) "emotion expressed and identified", in which cases emotional descriptors were applied, as will be further discussed below, or 2) "unidentified emotion", referring to publications that, despite containing emotional content, were not clear with regard to the identity of the emotion expressed.

Of the 1,067 Instagram publications that initially constituted our random sample, 620 (58.1%) were classified as "emotion expressed and identified", 438 (41%) as "no emotional expression" and 9 (0.8%) as "unidentified emotion". Given this study's stated interest in analyzing only those posts in the "emotion expressed and identified" category, posts in the "no emotional expression" and "unidentified emotion" categories were discarded. As such, the final data set for this study was composed of 620 publications.

In sequence, posts in the "emotion expressed and identified" category were classified and labeled using the principles of sentiment and emotion analysis. According to Liu (2010), sentiment analysis, also known as opinion mining or emotion analysis, has the objective of analyzing the opinions, sentiments, and emotions expressed in a given data set. Benevenuto, Ribeiro & Araújo (2015), Gonçalves et al. (2013) and Xu, Chang & Jayne (2022) corroborate this definition, describing sentiment and emotion analysis as a process of analyzing natural language in order to observe and interpret its emotional content. Given these premises, it becomes possible to identify the polarity or valence (positive or negative) of different emotions, their level of excitation (activation or deactivation), and the identity of the emotion itself through the use of standardized descriptors.

Sentiment and emotion analysis has been used in a diverse array of areas, including the health sciences, cinema, business, and politics, among others (Xu, Chang & Jayne, 2022). In general, its application

takes one of three distinct forms: automated, semi-automated, or manual analysis (Aman & Szpakowicz, 2007; Siegert, Böck & Wendemuth, 2014; Devillers, Vidrascu & Lamel, 2005; Xu, Chang & Jayne, 2022). Despite being understood as more agile, the first two forms of classification contain some drawbacks, such as the difficulty in identifying emotions in content with grammatical inconsistencies or ambiguous meanings (in the cases of irony and sarcasm, for example). Moreover, challenges exist in relation to recognizing certain emotions with delimited cultural expression.

In this article, we employed manual classification (Almars et al., 2022; Lombardo et al., 2019; Devillers, Vidrascu & Lamel, 2005), due to the relatively small size of the data set, in order to reduce potential errors regarding the identification of emotions expressed around the theme of vaccines in the Brazilian context. Codification was initially performed by one of the authors. Posteriorly, these results were shared and discussed with the other authors for verification and conflict resolution, as well as to arrive at a consensus regarding the data and avoid any potential biases.

Emotional classification was initially performed utilizing the 48 descriptors of the *Human-Machine Interaction Network on Emotion (HUMAINE) for Emotion Representation and Annotation Language (EARL)*, as indicated by Douglas-Cowie et al. (2007) and Schröder, Pirker & Lamolle (2006). Upon reviewing the data, eight more descriptors were added and included in the code list, as described in previous studies (Rowe et al., 2023). The list of descriptors is presented in Table 1.

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

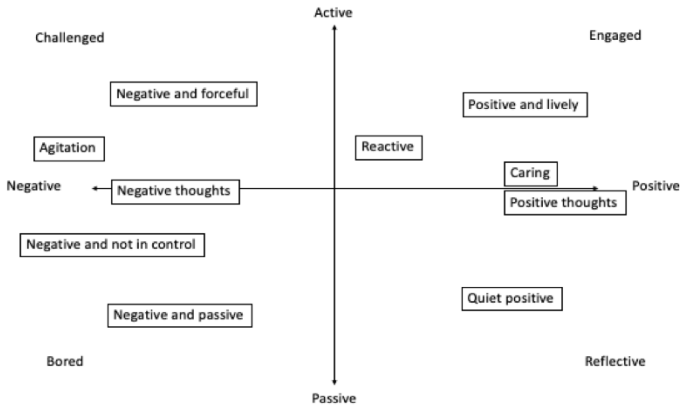
Negative and forceful	20 – Shame	38 – Happiness
1 – Anger	Negative and passive	39 – Joy
2 – Annoyance	21 – Boredom	40 – Pleasure
3 – Contempt	22 – Despair	Caring
4 – Disgust	23 – Disappointment	41 – Affection
5 – Irritation	24 – Hurt	42 – Empathy
6 – Impatience	25 – Sadness	43 – Friendliness
7 – Disapproval	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

Source: Adapted from Rowe et al. (2023) and HUMAINE/EARL.

3.3 Emotional valence and objects

After classification, which was performed using the aforementioned descriptors, emotions were grouped into larger categories, as developed by Rowe et al. (2023) as an adaptation of Russell's (2003) Core Affect Model and his circumplex model, which possess two dimensions with distinct and independent poles: excitation and valence (Figure 1). Valence corresponds to the analysis of emotions experienced in relation to the vaccine and vaccination processes in terms of their classification as positive (agreeable) or negative (disagreeable), whereas excitation refers to the level of emotional activation or deactivation, which can vary from excited (active) to calm (passive) (Russell, 2003).

Figure 1. HUMAINE/EARL descriptors, as grouped by the circumplex model



Source: adapted from Russell (2003) and Rowe et al. (2023).

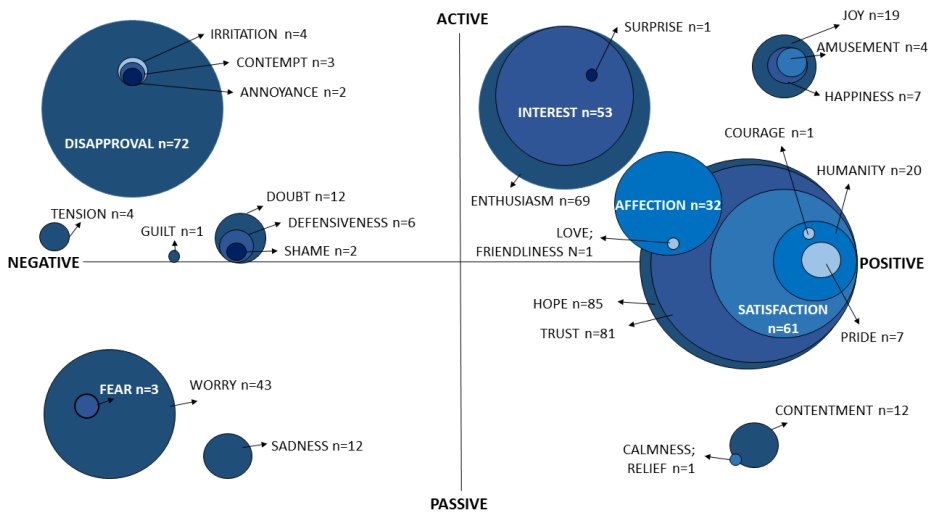
After the classification and definition of the valence (positive or negative) and excitation (active or passive) of the emotions present in the data set, we identified the object of each instance of emotional expression. This step was included because we observed that many posts mentioned the vaccine or vaccination processes, but were principally directed towards other contextually related themes, such as pandemic management strategies, political figures, or challenges inherent to the spread of Covid-19. This strategy was important in the comprehension of which other topics, related to the vaccine, evoked emotional expression. Moreover, we observed that many of these objects evoked emotions distinct from those evoked by the vaccine itself, which allowed us to deepen our analysis.

4. Results

Of the 56 aforementioned emotion and sentiment descriptors, 30 were identified in this study, indicating the vaccine and vaccination processes as topics capable of evoking a significantly diverse array of emotional expression. The most frequently expressed emotion was hope (n=85, 13.7%), followed by trust (n=81, 13.1%), disapproval (n=72, 11.6%), enthusiasm (n=69, 11.1%), satisfaction (n=61, 9.8%), interest (n=53, 8.5%), worry (n=43, 6.9%), affection (n=32, 5.2%), humanity (n=20, 3.2%) and joy (n=19, 3.1%). Other emotions were expressed at lower frequencies (fig. 2).

In regard to emotional valence, we found that 456 (73.5%) were positive, while 164 (26.5%) were negative. Using Russell's (2003) circumplex model (fig. 1) as a base and grouping the emotions identified in this study, we observed 291 emotional descriptors with high degrees of activation, of which 187 had positive valence and 104 had negative valence. Passive descriptors, in turn, were applied 329 times, with 269 having positive valence and 60 having negative valence, respectively.

Figure 2. Emotions identified in the data set



Source: authors' compilation.

Hope, the most frequent emotion (n=85, 13.7%) in the data set, was associated with positive perspectives related to the vaccine approval process, the arrival of the vaccine in Brazil, and the initiation of vaccination, as well as being related to other emotions with an element of expectation, such as trust (n=81, 13.1%), enthusiasm (n=69, 11.1%), and interest (n=53, 8.5%). Emotions considered to be responses to specific events, such as satisfaction (n=61, 9.8%) and joy (n=19, 3.1%), were demonstrated in posts that gave thanks for and celebrated access to vaccines.

As previously mentioned, some of the emotions identified in our data set were not primarily directed towards the vaccine, as was the case of disapproval (n=72, 11.6%), which was directed mainly towards former president Jair Bolsonaro, his actions, and his statements in regard to the vaccine. This also occurred for the emotion of worry (n=43, 6.9%), which was associated with the spread of Covid-19, low demand for vaccine booster doses, and the emergence of new strains. Expressions of affection (n=32, 5.2%) were associated with publications related to posts about animal adoption and vaccination, which had an explicit element of care. Humanity (n=20, 3.2%) in turn, was expressed in association with campaigns and initiatives of solidarity that aimed to gather donations in order to assist groups that were vulnerable in the context of Covid-19.

In Table 2, we present some representative posts of the principal emotions identified in the data set.

Table 2. Representative posts of principal identified emotions (our bolding)

Hope	<p>Excellent news to share on this Wednesday the 2nd. It's the United Kingdom that's the first country to approve the Pfuzer-BioNTech vaccine against COVID-19. The country also announced that immunizations will be available to the British public next week. This news brings hope for effective action in order to eradicate the Coronavirus, which has caused so much suffering and pain for the world^[7].</p> <p>Today I received a dose of hope for better days..... ! Now I can say.... Happy new year! 2021 has startedvaccinated(dose 1) !!!! I feel privileged/happy as a Nurse for being vaccinated without having contracted the disease and not even being quarantined as a suspected case. Don't miss the opportunity to get vaccinated! #longlivescience</p>
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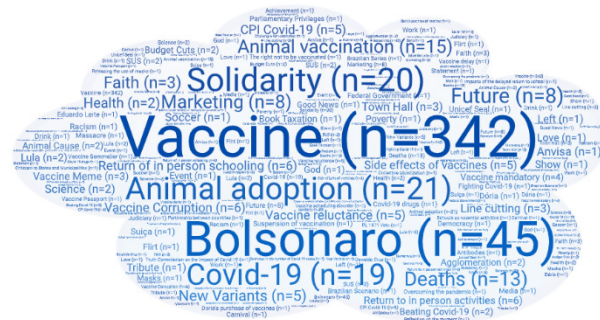
Trust	<p>Vaccines that u can choose in recife: whucheverone themgot themwannagimme whatevs so what, which one you gonna get??? In recife we have a bunch of vaccines being given and you can choose the best one of all: the one that saves your life. 📌💙 but now leaving jokes aside, let's get real: the brand doesn't matter, all the vaccines have scientifically proven efficacy. did you know that in our city people who refuse to take the vaccine by preference will have to wait 60 days to reschedule? when your turn comes, don't get squeamish. the only good vaccine is an injected vaccine.</p> <p>"don't wait, go get vaccinated, after all all the vaccines are effective, so quit foolin and go get vaccinated. #vaccinesaves #joksjohnes #covid #art #urbanart #urbanstyle #streetphotography #streetstyle #streetart #graffitiart #graffiti #sampangraffiti^[8] #vaccine</p>
Disapproval	<p>Get out bozo-naro @forabozonario vaccination might be delayed in Braz due to shortages of cotton and syringes. meanwhile, Brazil has an 18 year stock of chloroquinone. Congratulations to those involved! 23:25 08/12/2020 twitter for iphone "at least we got rid of the pt"^[9], says the right-wing poor, in poverty and now with no hope of vaccination.</p> <p>We continue with no vaccination plan or any indication of a start date, without enough syringes and without listening to science. Even worse: forging researchers' signatures. Bolsonaro keeps playing with lives!</p>
Enthusiasm	<p>big saturday with vaccines for the little ones! you got your socks and shoes on? come on down!</p> <p>me going to get vaccinated "go work that butt tantan, move that butt tantan, long live butantan..."^[10] me and who else can't wait and is already in the waiting area ???? @butantanoficial #comevaccine #allforvaccines #amocdg @butantan institute</p>
Satisfaction	<p>Today I took my father to take the second dose of the vaccine! thanks be to god!!! but we're going to continue with all the precautions!!! even people who have been vaccinated have to keep wearing masks and always remember to wash their hands. #vaccine #covidvaccine #health</p> <p>thank god! it's my turn, via comorbidity: vaccinated</p>
Interest	<p>we have formalized a request to the municipal secretary of health that these women be included on the covid-19 vaccination schedule. preserving their health is also caring for their children and for life. one of the arguments of @lactantespelavacinago (<i>nursing mothers of Goiás for the vaccine</i>) is cross-immunization, in which the vaccine would be "two for one" and also, we can list here the incentive for breastfeeding and the reduction of chances of this mommy being infected, which would contaminate her child and family. we're in this together!</p> <p>assisted by the stf's decision, we inform that juiz de fora city hall has total interest in implementing the conceded prerogative for vaccine purchases, respecting its prerequisites: lack of compliance with the pni^[11] on the part of the federal government or dose insufficiency.</p>
Worry	<p>don't take your mask off! we're still in a very delicate situation in our country, even with the vaccine, precautions need to be maintained for the good of everyone. unfortunately only 11% of the population has been vaccinated with both doses and even people who've been vaccinated can still transmit the virus. we're only going to get out of this one way, wearing masks! believe in science, in doctors, and in the WHO and take care of yourselves! #yesvaccine #wearamask #outwithgenocides</p> <p>m^[12] bus terminals must request proof of covid-19 vaccination as per guidelines published by sesap, aiming to prevent a new wave of cases of the disease, given the arrival of the omicron strain in the country, these precautions are even more important due to it being during the holidays, when the number of tourists circulating in the state increases.</p>

Source: Authors' compilation.

Aside from the previously highlighted negative emotional descriptors (disapproval and worry), several other negative emotions were also identified in the data set at lower frequencies, such as doubt (n=12, 1.9%), sadness (n=12, 1.9%), defensiveness (n=6, 1%), tension (n=4, 0.6%), irritation (n=4, 0.6%), contempt (n=3, 0.5%), fear (n=3, 0.5%), shame (n=2, 0.3%), annoyance (n=2, 0.3%), and guilt (n=1, 0.2%). Of these, only doubt (n=5), defensiveness (n=3), contempt (n=3), fear and tension (n=1) had posts directed specifically towards the vaccine, which contained questions, defenses of the right to refuse vaccination, lack of interest in the vaccines, and indications of their supposed risks.

The other negative emotions – sadness, tension, shame, irritation, and annoyance – had as their principal objects, respectively, deaths caused by the pandemic, the Covid-19 Parliamentary Commission of Inquiry (*Comissão Parlamentar de Inquérito*), and Jair Bolsonaro and his government. Other objects and topics were identified at lower numerical frequencies (Figure 3).

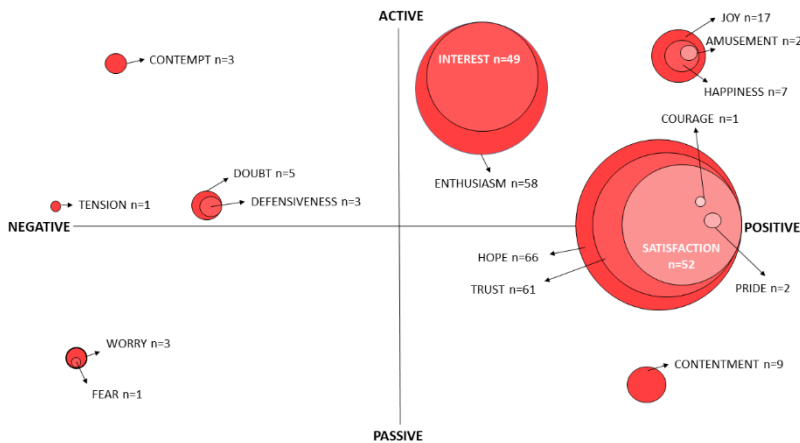
Figure 3. Objects of expressed emotions



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

The theme of vaccines and vaccination processes was the principal object of emotional expression in 340 publications (55.5%). Of these, 95.3% were positive and 4.7% were negative, reinforcing the positive bias with which the theme was treated.

Figure 4. Emotions identified specifically in regard to the vaccine



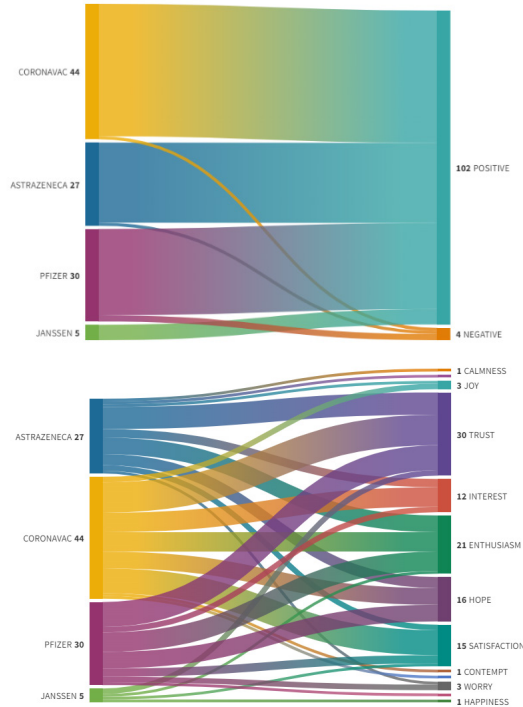
Source: Authors' compilation.

Among the positive emotions observed specifically related to the vaccine, 133 were classified as having a high degree of excitation (active) and 191 with a low degree of activation (passive). Negative emotions, in turn, were classified as high activation (active) in 12 instances and low excitation (passive) in 4 instances.

Publications that were primarily directed toward the vaccine (n=340) addressed vaccines in a general way, without mentioning, in the vast majority of occurrences, which brands or manufacturers were

responsible for their production. Identification of brand occurred in only 76 posts containing emotional expression related to the vaccines themselves. Among the brands, the most cited was Coronavac (n=44), followed by Pfizer (n=30), Astrazeneca (n=27) and Janssen (n=5). It is important to highlight that, in some posts, more than one brand or manufacturer was mentioned simultaneously.

Figures 5 and 6. Emotions identified by vaccine brand or manufacturer



Source: Authors' compilation.

The emotions expressed regarding the vaccines generally reinforces the positive bias around vaccines identified in previously presented results. Upon comparison, the Pfizer vaccine was found to be most mentioned in a negative light (n=2), citing worries about its side effects, which was also the case of the Astrazeneca vaccine (n=1). Coronavac, in turn, was the object of one instance of negative emotional expression (n=1), in which it was treated with contempt and denominated a "vachina". The Janssen vaccine was not the target, specifically, of any negative emotional expression.

5. Discussion

After completing the identification and classification of the data set, we identified the incidence of a diversity of sentiments and emotions that were expressed in relation to the vaccine and vaccination processes on Instagram during 2020 and 2021, indicating that publications on this theme constitute a field through which perceptions, opinions, interests and beliefs, as well as information, transit while permeated by affective expression..

Instagram, in this context, was shown to not only be a social network for the sharing of photos and videos for the purpose of entertainment and, as identified by other studies, to have a predominant positive bias in emotional tone (Sonne & Erickson, 2018), but also as a platform that capable of being utilized for the posting and disseminating of health information, as has been indicated by previous studies (Pinto, Antunes & Almeida, 2020; Pinto et al., 2021; Lwin et al., 2018) and demonstrated in the case of publications about the vaccine.

Generally speaking, we observed a very high prevalence of positive emotions in regard to the vaccine, indicating good reception of the vaccine on the network studied in this article. This result corroborates other studies on the perceptions of the Brazilian public in regard to vaccines prior to the pandemic (see Gallup, 2018), and also articulates well with studies performed in other contexts, such as those by Hu et al. (2021), Kearney et al. (2019), Basch & MacLean (2019) and Zufiker et al. (2022), which also identified the predominance of positive emotions in regard to the vaccines.

Hope was the most frequent emotion (n=85, 13.7%) in posts about the vaccine, indicating how much the vaccines were the object of expectations, desires, and anticipation, as well as being seen as a way to overcome the pandemic and to reestablish daily normalcy, given the changes provoked by Covid-19. Close behind hope with only a small numerical difference, trust (n=81, 13.1%) reinforced the positive bias around vaccines, emerging in publications in the feelings evoked regarding the efficacy and safety of the vaccines, mitigating remaining reluctance or uncertainty. Expressions of positive emotions, such as those identified in this study, may prove productive for the development of pro-vaccine public discussions and perceptions (Kwok, Vadde & Wang, 2021), while negative emotions may contribute to the construction of anti-vaccine positions and attitudes (Greyling & Rossouw, 2022).

Other emotions were also observed in the dataset, which, in their majority, reinforced the positive bias around vaccines at a low level of excitement. Despite being expressed in this study, negative emotions identified in the analyzed publications were not primarily directed towards the vaccine, instead being directed towards contextual aspects, as was the case for the emotions of disapproval (n=72, 11.6%) and worry (n=43, 6.9%), the most frequently observed negative valence emotions in this study's data set.

Disapproval was particularly strongly associated with the speech and actions of then-president Jair Bolsonaro, as well as his government and strategies for managing the pandemic. In regard to this aspect, it is worth noting that Jair Bolsonaro and his government placed themselves in opposition to the Covid-19 vaccines on numerous occasions while simultaneously contributing to the scenario of disinformation surrounding Covid-19 (Recuero et al., 2022; Recuero & Soares, 2021; Soares et al., 2021; Paes, Brasil & Massarani, 2022) and promoting the utilization of medications without proven efficacy (Duarte, 2020; Monari, Santos & Sacramento, 2020), which was seen predominantly in a negative light in the posts analyzed in this study.

Situations in which public figures placed themselves in opposition to the development of scientific progress and public health resources may impact the ways in which the debates surrounding vaccines are understood, as highlighted by Hu et al. (2021), reverberating in the ways in which the public expresses its sentiments and emotions as it processes related events. Rodríguez-Orejuela, Montes-Mora & Osorio-Andrade (2022), in this sense, identified anger as an emotion associated with the management of the pandemic in Colombia. In our data set, the expression of disapproval demonstrates that, even while the vaccine was cast in a positive light, former president Jair Bolsonaro was seen as an obstacle to the advancement of vaccination in Brazil.

The emotion of worry, in turn, was identified in publications as resulting from fears regarding the spread of Covid-19 and the emergence of new strains, seen as potential risks not only for vaccination but also for efforts to control the pandemic in general. Other studies, such as those by Greyling & Rossouw (2022) and Mahyoob et al. (2022), also demonstrated the occurrence and growth of negative emotional expression around the spread of Covid-19 and new strains. Issues related to low demand for vaccines (especially booster doses), as well as potential side effects, were also associated with worry, however, in a proportionally smaller number (only 8 posts or 2.3% of publications that were primarily directed towards the vaccine).

As such, our analysis characterizes the vaccine as a resource and strategy that, isolated from its context, was perceived mainly in a positive light, regardless of brand or manufacturer, indicating a positive reception of the vaccine by the public, as well as expectations prior to its arrival and satisfaction after receiving doses. This scenario was juxtaposed with sentiments related to pandemic management strategies and the figure of Bolsonaro himself, who, as seen above, was the principal object of expressions of disapproval.

6. Final Considerations

This study's objective was to identify and analyze the sentiments and emotions expressed in regard to the vaccine and vaccination processes on Instagram during the years of 2020 and 2021. Considering the diversity of identified sentiments and emotions (30 from a list and 56 descriptors), the results provide means to comprehend not only emotional expression related to the vaccine, but also public responses in regard to an essential resource for the containment and eradication of diseases. Moreover, they describe a panorama in which a number of topics were associated with the vaccine and garnered attention, both positive and negative.

Among the identified emotions, those with positive valence, such as hope and trust, stood out, evoked specifically in regard to the vaccine, which was shown to be a public health resource of interest and essential to the overcoming of the pandemic. Negative emotions, such as disapproval and worry, were primarily directed toward public figures, such as Bolsonaro, his government, and his management of the pandemic, as well as the resurgence of Covid-19 and the emergence of new strains, which can be characterized as contextual aspects of this study's temporal cross-section.

Despite being expressed in lower numbers, negative emotions identified in the data set must also be observed with special attention, as, differently from positive emotions, which tend to reinforce an aggregative and positive character in regard to vaccines (Kwok, Vadde & Wang, 2021), can be constituted as barriers (Greyling & Rossouw, 2022) to the recognition of vaccines as a public health strategy. Observation of the focal objects of these emotions was also relevant, due to the necessity of determining the object of each incidence of emotional expression, which can posteriorly be used as source data for the development of strategies around vaccination campaigns, especially in light of the recent reduction in vaccine coverage in Brazil. Moreover, in a scenario such as this, the identification of emotions in publications that are questioning in nature, are defensive of the right to not be vaccinated, or that demonstrate little interest in the vaccines, for example, becomes important, although they occurred in proportionally smaller numbers.

Given these considerations, the results of this study contribute to reflections on the sentiments and emotions evoked by the Covid-19 vaccines and vaccination processes on social networks from the perspective of a temporal cross-section of Instagram posts in the Brazilian context, especially in light of the disputes and tensions that emerged in regard to these processes. For this reason, recognizing the limitations of this study, we reinforce the need for continued promotion of further investigations with similar proposals, using data from other networks, groups, and distinct temporal cross-sections, in order to produce and provide not only additional comparative studies, but also a more complete understanding of the sentiments and emotions expressed in regard to the Covid-19 vaccine in Brazil.

7. Contributions

Contributions	Author
Conception and design of the study	Author 2
Academic literature review	Author 1, Author 2, Author 3, Author 4
Data collection	Author 5
Data analysis and critical interpretation	Author 1, Author 2, Author 3, Author 4, Author 5
Manuscript revision and approval	Author 1, Author 2, Author 3, Author 4, Author 5

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Translator: Jonathan Hill.

9. Conflict of Interest Statement

The authors declare that no conflicts of interest exist.

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Notes

[1] "WHO issues its first emergency use validation for a COVID-19 vaccine and emphasizes need for equitable global access". Available at: <https://bit.ly/3l2OyQG> Accessed on: Sept. 20, 2022.

[2] "Anvisa approves emergency use of the first coronavirus vaccines in Brazil." Available at: <https://bit.ly/3jjBLza> Accessed on: Sept. 20, 2022.

[3] According to the DataSus (the Brazilian Unified Health System's Information Technology Department) Office of the Secretary of Strategic and Participative Management, vaccine coverage rates were listed at 59.8% in 2021, which is lower than the figures presented for 2020 (67.2%) and 2019 (73.4%). Available at: <https://bit.ly/3PK3ZPG> Accessed on: Sept. 20, 2022

[4] @who - <https://bit.ly/2r08NFz>

[5] *Translator's note*: 'vachina' is a neologism coined by former president Jair Bolsonaro as a derogatory term combining the words 'vaccine' and 'China'.

[6] *Translator's note*: other search terms corresponding to additional conjugations and agglutinations of the verb "to vaccinate", lacking unique English counterparts, were also used.

[7] Despite the public character of the messages contained in these republished posts, it was decided, for ethical reasons, that their authors would not be identified.

[8] *Translator's note*: 'sampa' is a colloquial term for the city of São Paulo.

[9] *Translator's note*: "pt" is a common abbreviation for the Brazilian Workers' Party (*Partido dos Trabalhadores*).

[10] *Translator's note*: the section in quotation marks is a play on words in Portuguese taken from a remix of the popular Brazilian funk song "Bum Bum Tam Tam", by MC Fioti, made in homage to the Butantan Institute's Coronovac vaccine.

[11] *Translator's note*: 'STF' is an abbreviation for the "Supremo Tribunal Federal", the Brazilian Supreme Court. 'PNI' is an abbreviation for the "Programa Nacional de Imunização", the National Immunization Program.

[12] *Translator's note*: 'RN' is an abbreviation for the Brazilian state of Rio Grande do Norte. 'Sesap' is an acronym for the "Secretaria de Saúde Pública", or Secretary of Public Health.