

## The Use of Emotional Artificial Intelligence in Plastic Surgery

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**Background:** The use of social media to discuss topics related to and within plastic surgery has become widespread in recent years; however, it remains unclear how to use this abundance of largely untapped data to propagate educational research in the field of plastic surgery. In this prospective, observational study, the authors aimed to delineate which plastic surgery–related topics evoked a significant emotional response within the study population and to assess the utility of motivational artificial intelligence within the field of plastic surgery.

**Methods:** Over a 4-month period (January to April of 2018), Cognovi Lab’s artificial intelligence technology was used to search and analyze emotional reactions to several commonly hashtagged words. This innovative software uses several key metrics to describe its findings, including awareness, engagement, and motivation.

**Results:** Of the search terms examined, “nose job” had the most awareness during the study period, and the topic that most engaged consumers emotionally was “liposuction.” Interestingly, “liposuction” ranked only fifth in terms of awareness. Consumers showed the strongest positive motivation toward the subjects of “plastic surgery” and “cosmetic surgery,” and the lowest motivation toward the topic of “tummy tucks.”

**Conclusions:** This analysis by Cognovi Labs is the first quantitative effort to use the plethora of data on social media to interpret patient motivations and subsequent behavior. Moving forward, artificial intelligence technology will make it possible to predict which plastic surgery products, procedures, and practices will be successful. The findings presented in this article describe the unique viewpoint and power that this technology can deliver. (*Plast. Reconstr. Surg.* 144: 499, 2019.)

The use of social media in plastic surgery is a subject that has recently come to the forefront of interest in our field. With the advent of social media, plastic surgery has a completely new forum for discussion by the public. To aggregate and analyze social media data on the subject of plastic surgery, we have engaged with Cognovi Labs and their emotional artificial intelligence technology.

Artificial intelligence is an emerging field that uses computers to perform tasks with speed and scale that have previously been unachievable.

Sometimes called “machine intelligence,” artificial intelligence can be thought of as a machine capable of simulating the capacity for abstract, creative, and deductive thought.<sup>1</sup> The term “artificial intelligence” is applied when a machine mimics “cognitive” functions that humans associate with other human minds.<sup>2</sup>

The understanding of several key terms is critical in the study of artificial intelligence. Machine learning is often used interchangeably with artificial intelligence, but it is more accurately a component of it. The foundation of machine learning is that rather than needing to be taught to do everything step by step, machines, if they can be programmed to think like us, can learn to work by observing, classifying and learning from their

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mistakes.<sup>3</sup> In the simplest terms, machines are given a large amount of trial examples for a certain task. As they go through these trials, machines learn and adapt their strategy to achieve those goals. Artificial intelligence uses models built by machine learning to reason about the world and give rise to intelligent behavior. Many complex artificial intelligence algorithms are capable of learning from data; they can enhance themselves by learning new heuristics (strategies, or “rules of thumb,” that have worked well in the past), or can themselves write other algorithms.<sup>4</sup>

From a data processing point of view, semantics are “tokens” that provide context to language. They provide clues not only to the meaning of words, but to their relationships with other words and other tokens—this is semantic analysis. The goal, as it is for any good reader, is to look beyond the words on the page to see the meaning, something that humans do well and machines have historically had difficulty with. Natural language processing is a branch of artificial intelligence concerned with both automated interpretation and generation of human language. Natural language processing uses artificial intelligence algorithms to filter out extraneous information in text, to extract the implied meaning in a piece of writing. There is considerable commercial interest in the field because of its application to news gathering, text categorization, and voice activation.

Cognovi Labs, headquartered in Columbus, Ohio, with offices in Dayton, Ohio, and New York City, is a unique predictive analytics company that applies artificial intelligence to human behavior. Cognovi uses supervised machine learning to train the artificial intelligence algorithms. Millions of emotion records were used to train Cognovi’s algorithms to detect six primary emotions. Cognovi distills emotions from social media using algorithms. These emotions can be sorted by topics designed by the user. These topics can then be used to help determine actionable information and insights. For this analysis, the source of data was Twitter, but any short-form textual data can be used, from social media to blogs and transcripts. Wright State University in Dayton, Ohio, a leader in semantic processing, developed the core of Cognovi Labs’ artificial intelligence technology, over 8 years, which aggregates and analyzes social media in real time to forecast consumer awareness of, engagement around, and motivation toward any specific topic, brand, or company. Cognovi uses supervised machine learning and natural language processing to develop intelligent algorithms that have been used to provide consultative data for

financial investment performance, political races and campaigns, corporations and brands, and advertising agencies, among others. For example, these data have been used recently to correctly predict the outcome of the 2016 presidential election and Brexit.

The purpose of this prospective, observational study was to assess the utility of motivational artificial intelligence in the field of plastic surgery. Although the potential utility of artificial intelligence in aggregating “big data” in plastic surgery has previously been introduced,<sup>5</sup> we sought to determine which topics related to our field provoked a significant emotional response within Cognovi’s proprietary emotion artificial intelligence framework. In this manner, we can effectively keep our fingers on the pulse of plastic surgery as a brand. Cognovi artificial intelligence is a tool with the capability to extract the emotional undertone of a dialogue, which in turn provides valuable information on how the general population makes decisions and, more importantly, what action they will take with regard to plastic surgery.

## METHODS

Using Cognovi Lab’s proprietary supervised machine learning technology, we entered several commonly used terms into the software: “plastic surgery,” “liposuction,” “rhinoplasty,” “nose job,” “cosmetic surgery,” “aesthetic,” “breast augmentation,” “Botox,” “breast lift,” “tummy tuck,” “implant surgery,” “flap surgery,” “breast reconstruction,” and “breast implants.” The terms “autologous, aesthetic, implant based breast reconstruction, DIEP flap breast reconstruction, and tissue expander” generated de minimis hits on the social media platform used for this analysis—Twitter—and were thus excluded. The program used data over a 4-month period, from January to April of 2018.

The software and behavioral intellectual property layer that sits on the software use several metrics to describe their findings. The behavioral intellectual property was developed using appraisal theory from the psychological discipline. Awareness is defined by share of voice, or volume of conversation. It is simply the amount of social media “buzz” around a topic and is independent of emotion. Engagement is the relative amount of social media posts that had emotion of any sort behind them. Motivation assesses the consumer’s desire to act by quantifying avoidance of and attraction toward a product or brand, and this score ranges from –100 to +100.

### RESULTS

Of the search terms examined, “nose job” had the most awareness during the study time period, with 249,687 mentions. The topic that most engaged consumers emotionally though was “liposuction,” despite ranking only fifth on the list of awareness. Consumers also showed the strongest positive motivation toward the subjects of “plastic surgery” and “cosmetic surgery,” and the lowest motivation toward the topic of “tummy tucks.”

Somewhat surprisingly, the terms “plastic surgery” and “plastic surgery” yielded opposite motivations. In looking carefully at underlying data, “plasticsurgery” has more use by physicians, whereas “plastic surgery” was generally used by consumers. It is also notable that the terms cosmetic surgery and plastic surgery generated opposite motivations. During the observational period, the terms “breast reconstruction,” “implant surgery,” and “flap surgery” generated statistically insignificant data because of low awareness. For these terms, the social media buzz was predominately composed of physician-driven posts only (Fig. 1).

Figure 2 demonstrates the emotional allocation of tweets during the study period. The fear response in early February to “nose job” was generated by a Twitter user with 75,000 followers, who tweeted “breaks my nose so I can get a nose job.”

The post was retweeted more than 4000 times and liked 17,000 times. The content of the subsequent discussion among Twitter users surrounded the fear of knowing the nose was broken during a nose job. The anger response seen in April consists of people discussing the expense of a nose job, how they feel about having to strive to find the perfect look, and not knowing which plastic surgeon to select.

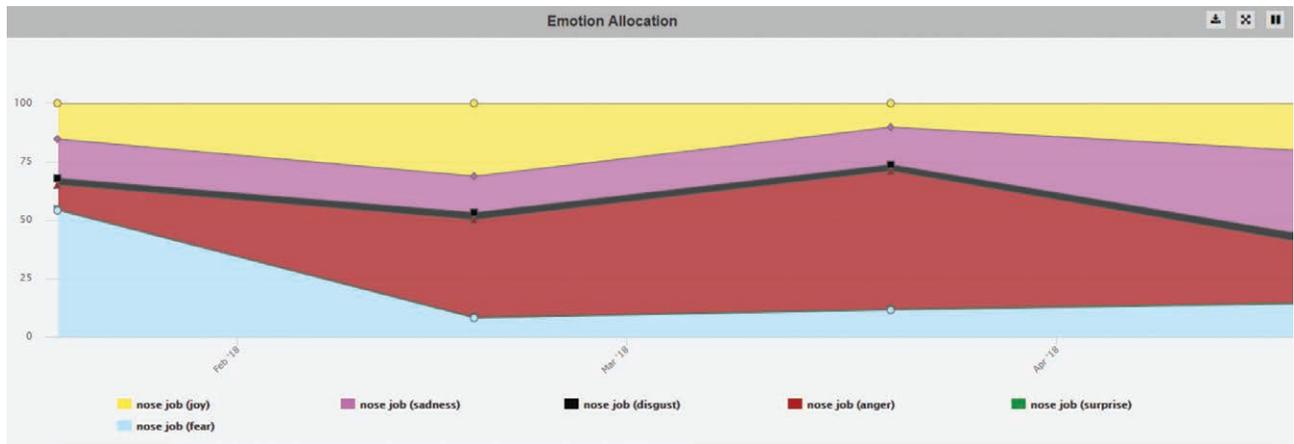
Figure 3 outlines the awareness volume by day over the study period. We elected to look specifically into the increased social media activity surrounding “nose job” on April 17. On this date, a social media post referencing “nose job” was liked approximately 250,000 times and retweeted 100,000 times but did not have a significant emotional response. Of note, the Twitter user had only approximately 1500 followers. Despite not having a large following, the post went viral, but because of the lack of emotion, it will not drive future behavior.

### DISCUSSION

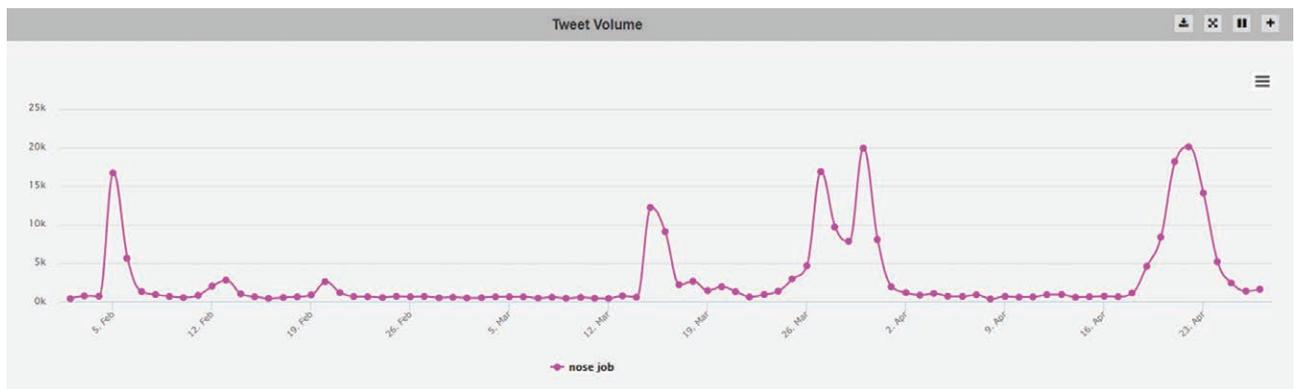
The use of social media in plastic surgery has recently moved into the spotlight.<sup>6,7</sup> The ethical dilemmas raised by social media advertising to our potential patient population have caused significant concern, specifically when such advertising is targeting young people.<sup>8</sup> Several studies have used



Fig. 1. Awareness, engagement, and motivation by search term during the study period (January to April of 2018).



**Fig. 2.** Emotion allocation of tweets during the study period (January to April of 2018).



**Fig. 3.** Awareness of the search term “#nosejob” by day from January to April of 2018.

surveys to attain information on how patients use social media.<sup>9,10</sup> The concept of using emotional analysis of Twitter in plastic surgery was introduced by Kalandar et al. in a study using data extracted from Twitter that, historically, are extracted manually.<sup>11</sup> The study highlighted the inaccuracies of public perception in plastic surgery, and that plastic surgery was most strongly associated with cosmetic surgery. It is clear that reconstructive surgery is a less common media topic and that the public is less familiar with its manifestations,<sup>12</sup> an insight supported by the findings of this study. This analysis by Cognovi Labs is the first quantitative effort to use the entire breadth of data on Twitter to determine how plastic surgeons should market their practices to the general public.

It is clear there is a divergence between the way surgeons describe procedures and the vernacular used on social media. For example, from the opposite consumer reactions to plastic and cosmetic surgery terms, we can extrapolate that perhaps when speaking to patients, we should use the term cosmetic surgery, as it elicits a higher positive

resonance from the general public. It is less clear why there would be opposite reaction to “plastic surgery” and “plasticsurgery”; however, opposite emotional responses may be caused by the use of “plasticsurgery” more commonly in posts driven by physicians.<sup>13</sup> Search of other terms such as “cosmeticsurgery” may shed further light on this inconsistency. Given that the term “flap surgery” was driven mostly by posts from physicians, there is a lack of either interest or knowledge among the general population relative to this terminology.

Behavioral economics research has demonstrated that emotions heavily influence our economic decision-making. Specifically, behavioral economists have argued that consumer decision-making is up to 70 percent emotional.<sup>14</sup> Although others have described the importance of looking solely at the number of followers a person has on social media,<sup>15,16</sup> we believe that there is a distinct difference between having the highest number of hits, likes, or followers and acting as a true emotional influencer (i.e., one that produces action). To demonstrate this point, a search for the top

100 influencers in plastic surgery (i.e., those who produce emotion around the field of plastic surgery) yields a very different list than a search for the 100 plastic surgeons with the most followers. This distinction can also be observed through the example of the social media post driving the “nose job” awareness spike on April 17, 2018. Although the post generated enormous buzz, there was no emotional response, and therefore, it will likely not drive action.

Looking at plastic surgery as a brand, the overall emotional allocation is not strong. Looking at a real-life example of brand analysis, on March 14, 2018, a Bloomberg analyst used Cognovi artificial intelligence to analyze the marketing of certain McDonald’s products. The analysis was distributed through Bloomberg’s proprietary network. Social media-generated consumer motivation scores showed that the McDonald’s Dollar menu had a score of 53 out of 100, triple the overall score for McDonald’s. Recommendations in marketing strategy included shifting attention away from products such as the Big Mac, which generated a negative motivation score in the first quarter of 2018, and toward the value menu. As a result of continuing to focus on the Big Mac versus the value meal and breakfast, McDonalds experienced softening U.S. sales growth and subsequently incurred layoffs.<sup>17</sup>

Based on previous experience analyzing brands such as McDonald’s, Cognovi Labs has seen that the propensity of a consumer to buy a particular brand or take a particular action is highest when the positive emotional response, “joy,” is in the range of 40 to 60 percent. As demonstrated above, “nose job” as a brand is particularly weak, with “joy” constituting only 10 percent of the emotional response during the study period.

In the future, we will be able to assess which products, procedures, and plastic surgery practices succeed or fail based on the emotional response of our patients using artificial intelligence applications provided by companies such as Cognovi Labs. Applications to plastic surgery include analyses of industry, private practice, or other organizations’ marketing campaigns, which can be done in real time. We can determine which products or procedures will succeed or fail in specific regions based on the emotional reactions of social media users. In addition, a list of social media influencers can be generated based on their emotional impact rather than simply their number of followers. Fake accounts or “bots” have been found to play a large role in analysis of political campaigns, a fact not lost on

Twitter, which has recently commenced a process to delete these accounts.<sup>18</sup> Cognovi developed bot detection software to understand those tweets that are initiated by bots. This software, although imperfect, was used in our analysis. Notably, the effect was minimal in comparison to what is seen in the political area. This study is limited in that data were extracted only from Twitter. Consequently, the results may not capture the full range of sentiments of social media users: generally, an older population using Facebook and a younger one favoring Instagram. However, if older and younger people are equally passionate about their beliefs, the percentage of emotion would be constant across platforms, despite potentially differing topics. The advancements needed to extract data from other social media platforms are currently in development.

## CONCLUSIONS

The findings presented in this article are the first to describe in the plastic surgery literature the unique viewpoint and power that the emotional artificial intelligence technology can deliver. Not only can data be viewed by social media terms, they can also be analyzed specific to gender, political affiliation, and geographic location, among other variables of interest to the plastic surgery community at large. The detail that can be derived from this tool is as limitless as the investigator’s imagination. As board-certified plastic surgeons, we need to embrace this and similar technologies or ignore them at our own peril.

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