Social Media Visuals and Users' Attitudes Towards COVID-19 Vaccines: A Cluster Analysis Study

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Introduction

Social media have rapidly grown as a main source of news in the last decade, and perhaps recently it has overtaken the traditional news sources such as TV news channels, and newspapers. Researchers believed that the internet enables the formation of a "Fifth Estate" through a platform which the networked individuals use (Dutton, 2009). Independently, users can find their information away from any single institution, through search and social media capabilities. In addition, users are capable of creating content in different forms – such as: tweets, blogs, comments on websites, emails – which provide more independence from institutions, and consequently allow a way by which public opinion can be expressed (Newman, Dutton, & Blank, 2013). Visuals on social media – including memes, videos, posters, images, and emojis – furthermore, provide easier access and faster processing of information. When this information is taken in a comical context, they become more persuasive and remembered for longer period than text posts.

Health care information is one of the most sought areas and as a result has become a common topic in social media. With people's engagement on social media, people relied on online information in making informed decisions about healthcare providers, hospitals, and any other health-related concerns. With the emergence of the Covid-19 and its vaccinations, information about the COVID-19 Vaccines has become amongst the most trending searches.

Theoretical Framework

The Theory of Reasoned Action and Reasoned Actions Approach:

The theory of reasoned action (TRA) was introduced first by Martin Fishbein in 1967 and was further extended by Fishbein and Icek Ajzen. The theory was largely developed due to the frequent failure of traditional measures of attitudes in foreseeing particular behaviors. It started with the basis that the most effective and simplest way for predicting a certain behavior was asking an individual whether he/she was/was not going to do such behavior. Therefore, within the theory premise, it is primarily the strength of an individual's intention to do or not to do a certain behavior is the determinant of the performance or non-performance of such behavior, in which the intention is defined as the subjective prospect that an individual will perform the behavior (Yzer, 2017). TRA assumes that a behavior of an individual is determined by the behavior intention of the individual to perform such behavior (Lin, Featherman & Sarker, 2013). Intention is thought of as the function of two belief-based structures which are the attitudes and the subjective norms. Attitudes are the positive or negative assessments of doing the behavior in the future, but the subjective norms present the beliefs that other people may want them to do. The TRA excelled in demonstrating predictions of variations in people's behavior throughout different populations, contexts, and behaviors. The theory was modified by Ajzen to consider the behaviors that are not fully controlled by the individual (Hagger, 2019). An additional predictor of intentions was introduced by the theory of planned behavior which is the perceived behavioral control. The strength of the relationship of Intention-behavior would be determined through perceived behavioral control when the individuals' control perception reflects actual control. When the perceived behavioral control is high, it will result in an act which is based in these intentions. Moreover,

Ajzen indicated that the behavioral control will predict behavior if it closely reflects actual control. As a further development, Fishbein and Ajzen proposed the reasoned action approach, which is an extension for the theory of planned behavior. It distinguishes different components the attitude, perceived behavioral control, and subjective norm of the theory of planned behavior. The simplicity and flexibility of the theories contributed to their popularity, along with their efficiency in describing essential variation in behavior. They also act as the source for other theories that hold new views towards mounting extensive descriptions of behavior, and to examine significant processes which define action like the relationship between behavior and intentions (Hagger, 2019).

The Theory of Reasoned Action intends to explain volitional behavior. Thus, involuntary behaviors such as habitual, mindless, impulsive, or spontaneous behaviors are excluded. This is because such behaviors do not involve a conscious decision by the actor (Hale, Householder, & Greene, 2002).

Fisher et. al. (2013) used the theories of reasoned action and planning behavior to understand the intentions to get the HPV vaccination among targeted citizens in a correlational study in Canada. The sample included 118 men and 146 women. Results have revealed that people's perceptions of social support for the vaccination of HPV added to their intentions to be vaccinated, thus this confirmed the assumptions of the Theory of Reasoned Actions (Fisher et. al., 2013). Similarly, Lueck and Spiers (2021) used the reasoned action approach to explore the leading beliefs and psychological determinants of intentions of COVID-19 vaccination in order to produce an efficient vaccine-oriented promotional efforts through means of qualitative and quantitative research. For the qualitative research, 198 participants were included in the sample, and 1656 participants for the quantitative. The researchers concluded that behavioral beliefs described as instrumental attitude was the deepest forecaster of intention of getting the vaccine. (Lueck & Spiers, 2021). Baeza-Rivera et. al. (2021) drew on the reasoned action theory to determine the underlying social psychological factors affecting the intention of people in Chile towards the COVID-19 vaccination. The sample included 1033 participants – aged between 18 to 78 – who had to answer a survey containing different sociodemographic variable and scales about COVID-19. Findings have shown that behavioral beliefs of

effectiveness of the vaccines and the injunctive normative beliefs about self-care procedures positively and considerably affected intents of vaccination, while the conspiracy mentality doesn't have a significant effect on the vaccination intent (Baeza-Rivera et. al., 2021). Also employing the reasoned action theory, Matute et. al. (2021) studied the intentions of getting the COVID-19 vaccine in Spain. The data was collected from 507 Spanish citizens. The study results suggested that there is an increased perceptions of fairness and trust associated with the political ideology described through the government's decision towards the vaccines, which affected the intentions of attitudes and behaviors to get vaccinated (Matute et. al., 2021).

Drawing on the previous studies, this study is using the TRA to test relevance of having the visuals of social media as a factor that affects behavioral intents of users towards the COVID-19 vaccines.

Literature Review

Social Media Visuals:

Large part of the artefacts that are produced and shared online are Images (Adami, & Jewitt, 2016). The shift towards the visual images as an indispensable part of social media coincides the rise of YouTube, Snapchat, and Instagram. The popularity of usage of social media platforms focuses primarily on visuals such as videos and pictures. More pervasive platforms such as Facebook and Twitter have also toed the line and enabled visual images as in their services. Actually, sharing images has become a complementary part of social media experience nowadays, taking in account that social media platforms are the main venue for sociability – at least amongst young people. Shifting towards the visual images probably changes how we relate to each other and the world around us, and our perceptions and construction of our sense of self (Russmann & Svensson, 2017).

Visual images can be depicted as supplementary ways of communication accompanying spoken or written text – which aid the user to better understand the message (Russmann & Svensson, 2017). Visual social media content enables highlighting emotions, scenes of importance, key information, political views, and reactions (Highfield & Leaver, 2016). The visuals used are represented in different modes to present news and commentary, out of GIFs listicles and vine clips, and the political purposes of manipulated profile pictures. These

visual social media contents are not merely isolated and individual social media artefacts but are embedded in discussions and debates that may have sociocultural, economic, political, technological, and legal dimensions (Highfield & Leaver, 2016). Editing and manipulating of images, through Photoshop and other similar photo editing software, is a confirmed component of social media visuals, for meme invention and intentionally misleading material much the same. These memes and templates of Photoshop including visual composition and contiguity, differently provide commentary and humor, usually with visible clues that the depicted scene is not real (Highfield & Leaver, 2016).

Vaccine-related Content on Social Media:

COVID-19 Vaccine-related content is expansively present across different social media platforms, encompassing many studies demonstrating how vaccine-related content is portrayed on these platforms and, more widely, the Internet (Puri, et. al., 2020).

The rapid blowout of the COVID-19 ensuing in a global pandemic received an intensive focus in social media discourse, with twitter reporting tweets of COVID-19 every 45 milliseconds, in addition to the hashtag #coronavirus becoming fast the second frequently used in 2020 (Cinelli, et. al., 2020). Siru Liu, Jili Li, and Jialin Liu (2021) analyzed 2,678,372 tweets related to COVID-19 vaccines from 841,978 unique users and annotated 5000 tweets posted over a 3-month period (from November 1, 2020 to January 31, 2021). Results have shown that the prevalence of tweets containing positive behavioral intentions increased over time (Liu, Li, & Liu, 2021).

Impact of Social Media Health Information on Users:

Different research has shown how social media transfuses our communication over different levels of attention, from expressing identities of individuals to experiences of urban spaces, news and crime, and governmentality (Adami, & Jewitt, 2016).

Undoubtedly, the available literature agrees that social media has a remarkable impact on people's intentions for getting vaccines, not only against COVID-19 virus, but also against other diseases as well. In a study on the effect of social media on HPV vaccine, Deanna Teoh (2019) asserted that 62% of adults in America get at least some news from social media. Her study revealed the correlation between social

media exposure and the attitudes towards the state-level HPV vaccine coverage. It has shown that social media exposure explained more than 60% of the variance in HPV vaccine coverage, whereas other socioeconomic factors (education level, insurance status) explained only 40% of the variance (Teoh, 2019). This was validated by other recent studies on the COVID-19 vaccination and its relation to social media exposures. For example, a global study by Steven Wilson and Charles Wiysonge (2020) examined the effect of social media messages on COVID-19 vaccine hesitancy in 137 countries. The study showed that there is a subsequent result for the disinformation spread on social media related to COVID-19 vaccines and the declining of vaccination coverage (Wilson &Wiysonge, 2020). Another study by Siru Liu and Jialin Liu (2021) analyzed COVID-19 vaccine-related tweets that were posted in English within the period November 1-22, 2020, using a predeterminant hashtags and keywords. A total of 4796 tweets was analyzed. Results have shown that a total of 97 tweets carried positive behavioral intent, while 182 tweets contained negative behavioral intent. Of these, 28 tweets were mapped to capability factors, 155 tweets were related to motivation, 23 tweets were related to opportunities, and 74 tweets did not contain any useful information about the reasons for their behavioral intentions (Liu &Liu, 2021).

Data Mining Algorithms:

Data mining is the process of identifying patterns, correlations, and variances within large sets of data in order to predict an outcome (Baker, 2010), using technologies of pattern recognition and other mathematical and statistical techniques (Larose & Larose, 2014).

Data mining can accomplish several tasks. These tasks include prediction, association, sequential patterns, clustering, and classification (Larose & Larose, 2014). All of them have one common goal which is discovery of knowledge from databases (Raval, 2012).

1 . Association:

Association is one of the most popular techniques of data mining. In this technique, a pattern is generated by identifying the relationship between two items in the same operation. For example, this technique is used in marketing analysis to discover the most frequent purchases of products that are bought together. This helps business to have corresponding marketing campaigns which will accordingly stimulate

more purchases (Raval, 2012).

2 . Classification:

Classification is a classic technique of data mining which is based on machine learning. Its basic operation is based on classifying each item within a data set into one of a predetermined set of groups or classes. For instance, Teachers classify students' grades as A, B, C, D, or F (Raval, 2012).

3 . Prediction:

Prediction is one of the data mining techniques which predicts the relationship between independent variables and between dependent and independent variables. For example, it can be used to predict future profit in sales (Raval, 2012).

4 . Sequential Patterns:

Sequential patterns analysis in one of data mining technique that tries to find out matching patterns in data transaction within a specific business period. These patterns are furtherly used to discover relationships among data in business analysis (Raval, 2012).

5 . Clustering:

Clustering is an organizing process of objects into clusters whose members are similar in some way. Therefore, a cluster is a group of objects which are similar within the one cluster and are different to the objects of other clusters (Raval, 2012). The grouping of objects is based on the fundament of the maximization of the intraclass similarity and the minimization of the interclass similarity. With clarity, the clusters are formed in which the objects inside the cluster are high in similarity compared to one another and have dissimilarity to objects in the other clusters (Han, Pie, & Kamber, 2013).

Research Questions

RQ1: What are social media users' attitudes towards the COVID-19 vaccines?

RQ2: To what extent social media users are affected by visuals on social media?

RQ3: What are the determinants of intentions of COVID-19 vaccination among users?

RQ4: What are the sources of information users use to get information about COVID-19 vaccines?

Research Methodology

This research explores the relationship between social media visuals and users' attitudes towards COVID-19 vaccine. For this research purpose, the researcher used self-administered survey through an online questionnaire. Results were analyzed using data mining technique of cluster analysis to categorize the participants responses to answer the research questions.

The sample was non-probability purposive sample which is chosen based on certain qualities that the respondents possess. The sample consisted of 244 respondents who are social media users aging 18 and above, as these age groups are the eligible ones to have the COVID-19 vaccines. Sixteen respondents were filtered as they were not to exposed before to social media visuals. Therefore, the total number of responses that went through the data analysis is 228.

The researcher conducted an online self-administered questionnaire via google forms. The questions varied between single-option and multi-choice questions. The questionnaire consisted of four parts; the first part focused on the extent to which users are exposed to social media visuals. The second part focused on the extent of exposure to positive and negative information about COVID-19 vaccines. The third part focused on the attitudes of users towards COVID-19 vaccines, and the fourth focused on the accountability of social media visuals to their current attitudes towards the vaccines.

Data Analysis

Data analysis is a process of applying logical and/or statistical techniques to depict, condense, and evaluate data (Ramsey & Schafer, 2012). The data of the study was analyzed using data mining technique of Cluster Analysis to answer the research questions.

The study employed the algorithm of k-means clustering which is an iterative algorithm that attempts to divide dataset into *K*pre-defined dissimilar non-overlapping clusters (subgroups) in which every data point goes only into one group (Morissette & Chartier, 2013), where *K* is the number of predetermined clusters. In this study, the researcher resolved to classify the responses into three clusters.

Results

The respondents consisted of 244 Egyptian social media users who were then filtered to 228 based on their exposure to social media visuals. Most of the respondents were females 69.5%, while the males constituted 30.5% of the respondents. The majority aged from 18 to 24 (45.5%), 37% of respondents aged from 25 to 34 years, 9.8% aged from 35 to 44, 1.6% aged from 45 to 54, and 6.1% aged 55 and above. The majority of the respondents got vaccinated against COVID-19 with a percentage of 90.4%, and only 9.6% of them did not get the vaccine.

On applying the k-mean clustering, the 228 responses were classified into three clusters:

Table 1: Number of Cases in each Cluster

Cluster	1	22.000
	2	123.000
	3	83.000
Valid		228.000
Missing		.000

As indicated in Table 1, the researcher analyzed the characteristics of each cluster through which RQ1 was answered, and accordingly the clusters were labeled as follows: Cluster 1 – The "Conspiracy Mindset" Cluster; Cluster 2 – The "Pro" Cluster; Cluster 3 – The "Hesitant" Cluster. As indicated in the above table Cluster 2 or the "Pro" Cluster is the largest in number of respondents (123), followed by Cluster 3 or the "Hesitant" Cluster (83), and the smallest in number is Cluster 1 or the "Conspiracy Mindset" Cluster (22).

1. Cluster 1 – The "Conspiracy Mindset" Cluster:

The users in this cluster did not get the COVID-19 vaccine, because they are skeptical about it. Those users are exposed to social media visuals and assured that these visuals contribute to their believes and attitudes towards the COVID-19 vaccines. They believe that these social media visuals encourage the conspiracy mentality, and their negative attitudes towards the vaccines. Their conspiracy mentality fosters the vaccination rejection and encourages distrust towards the government and health authorities. Users in this cluster believe that the vaccine is not safe and unreliable.

2 . Cluster 2 – The "Pro" Cluster:

The users in this cluster got vaccinated against the COVID-19. They believe that it is essential to get the vaccine. Those users believe that their exposure to social media visuals does not have any effect on their attitudes or beliefs towards the COVID-19 vaccines. Moreover, their actions are due to their deep belief that the vaccine is mandatory and would help in prevention against the virus. They believe getting the vaccine is essential because of the perceived vulnerability and perceived risk of infection. Those users aim at infection prevention, not only for themselves, but also for the significant others. Their attitudes are based on the behavioral beliefs of evaluating the consequences of the infection.

3 . Cluster 3 – The "Hesitant" Cluster:

In this cluster, the users got the COVID-19 vaccine, even though, they are perplexed about it. They got vaccinated due to the obligations set by the Egyptian government or due to travelling reasons. They view the social media visuals as a neutral stimulus that do not relate to the issue or the state of hesitancy that they are facing. The reluctance of those users to receive the vaccines, however, are more affected by the friends and relatives who reinforce the emotions of hesitancy to them. They are concerned about the safety of the vaccine and consequences of getting it due to its rapid development. Therefore, they fear its potential adverse effects, and the quality of the produced vaccines.

The analysis of the clusters provided an answer for RQ2 in which they demonstrated that users in two clusters (Pro and Hesitant Clusters) are not affected by the social media visuals. As for the "Pro Cluster" users, they strongly disagree that the social media visuals encourage or discourage them to get vaccinated or to form an attitude towards the COVID-19 vaccines. The "Hesitant Cluster" users indicated that the effect of social media visuals on their attitudes is neutral as they do not have any effect regarding the concept of vaccination. And lastly, the users of the "Conspiracy Mindset Cluster" agreed that social media visuals play a role in their conspiracy perceptions regarding the COVID-19 vaccines.

Furthermore, the clusters presented the behavioral intents of user regarding the COVID-19 vaccines, and this postulated an answer to RQ3. Users of the "Conspiracy Mindset Cluster" contended that social media visuals play a major role in shaping their attitudes towards the COVID-19 vaccines. Therefore, intents of users with conspiracy mentality are affected an external variable which is the visuals on social media. On the contrary, users of the "Pro," and the "Hesitant" Clusters are not affected by external variables. On the one hand, intents of users of the "Pro" Cluster are determined by behavioral beliefs as they fear the consequences of catching the virus. On the other hand, intents of users of the "Hesitant" Cluster are determined through the injective and descriptive normative beliefs as they are seeking compliance to governmental or travelling obligations even though they are worried about the consequences of getting the vaccine. Therefore, their behavior is out of conformity which creates normative pressures on users.

Table 2: Source of Information about COVID-19 Vaccines

Source of Information	Percentage of Users
Social Media	67.20%
News Websites	42.90%
TV	40.80%
Other	10.10%
Newspaper	6.90%
Radio	5.90%

The above table indicates the source of information about COVID-19 vaccines that users depend on, which subsequently answers RQ4. It shows that users depend mainly social media outlet, followed by the news websites, followed by TV. Those users who indicated "other" sources depend on WHO media outlets, the Egyptian Ministry of Health, and academic research papers. This is then followed by newspapers and then the least used medium is radio.

Discussion

This study has been conducted on 244 Egyptian social media users to explore the relevance of social media visuals to users' attitudes towards COVID-19 vaccines using an online questionnaire. The data were analyzed using K-mean Cluster analysis within the framework

of the Theory of Reasoned Action. Results have revealed that the majority of the respondents got vaccinated against COVID-19, which indeed corresponds the obligations set by the Egyptian government of mandating the vaccines in mostly all of the sectors of the country. Therefore, it would be common to find a portion of the respondents who got vaccinated although they are against the vaccines. Most of the studies related to people's attitudes towards the vaccines reviewed in the literature were done before obligating citizens to get vaccinated (e.g., Wilson &Wiysonge, 2020; Liu &Liu, 2021; Lueck & Spiers, 2021; Baeza-Rivera et. al., 2021; Matute et. al., 2021).

In the current study, the researcher obtained three clustered in which the users were divided: the "Conspiracy Mindset, the "Pro", and the "Hesitant" Clusters. These clusters provided an explanation for the attitudes of users towards the COVID-19 vaccines. The biggest cluster is the "Pro" cluster whose users get vaccinated and believe in the essentiality of getting the vaccine to prevent them from the hospitalization or severe complications of the virus. Factors affecting their intents are mainly their care about themselves and they fear death. The determinants of their intents are behavioral beliefs as prevention would be a significance for this behavior of getting the vaccine. Media exposures and consequently visuals in social media do not have any effect on their intents. Thus, they are not affected by external variables. This coincides with (Lueck & Spiers, 2021), whose study has shown that behavioral beliefs described as instrumental attitudes were the reasons behind the participants intents. This is because they belief that this would prevent them from negative consequences of the virus. On the contrary, this contradicts with (Baeza-Rivera et. al., 2021) who found that attitudes of citizens in Chile are affected by the injunctive norms of self-care intentions.

The "Hesitant" Cluster comprises the baffled users. They got the COVID-19 vaccine; however, they're worried about the consequences of the vaccination. They were vaccinated to conform with the governmental compulsions, their work obligations, or travelling requirements. They are experiencing a state of cognitive dissonance as their behavior was against their behavioral beliefs. Moreover, they believe that social media visuals are a neutral stimulus that is not taken into their consideration or affects their intents. (Joska, Rabie, & Sibeko, 2021) study in South Africa proclaimed that hesitancy towards the

COVID-19 vaccination creates cognitive dissonance among 80% of the study participants.

The "Conspiracy Mindset" Cluster includes the non-vaccinated users. They are completely against the COVID-19 vaccines as they believe that there is a conspiracy behind the COVID-19 virus. Their intents of being against having the vaccine is mainly out of behavioral beliefs along with the external variable of media exposures. They confirm that social media visuals encourage and reinforce their perceptions and attitudes towards the COVID-19 vaccines. This opposes the findings of (Baeza-Rivera et. al., 2021) which indicated that the conspiracy beliefs were not one of the determinants of intents of behaviors towards the vaccines, while matches the study of (Ryaguzova, 2021) which was done on Russian and Belarusian students. (Ryaguzova, 2021) indicated that the conspiracy mentality and mistrust scored the highest among other reasons for refusal of the vaccines.

As for the source of information about the COVID-19 vaccines, participants rely mainly on social media outlets to get information, which is highly associated with the conspiracy mentality. However, it does not have an effect on the vaccine hesitancy. This partially matches the study of (Sallam, et. al, 2021) who indicated that having the social media as a source of information about the COVID-19 vaccines, created doubts and mistrust about the vaccines. Accordingly, a conspiracy belief is developed, and results in vaccine hesitancy. So, (Sallam, et. al, 2021) attempted to relate hesitancy to conspiracy, which is not the case in the current study.

Although all of the participants were exposed to social media visuals, they do not search for these visuals; however, they find it by chance and in most cases do not share them.

Conclusion

The study aimed at investigating the effect of social media visuals on users' attitudes towards the COVID-19 vaccines in Egypt within the framework of the Theory of Reasoned Actions and Reasoned Actions Approach. It is concluded that the social media visuals do not have a direct impact on the intents of users and accordingly towards their attitudes towards the vaccines except in creating a conspiracy mentality. Therefore, the external variables according to the Reasoned Actions Approach do not have a direct impact on users' intents except

in creating a mistrust towards the vaccines. In the other two cases, such as the users who are pro the vaccine or those hesitant users, social media visuals are not one of the determinants of their intents; however, it is a combination of behavioral beliefs and descriptive and injunctive normative beliefs. Although the social media outlets are considered the main source of information for most of users, these outlets do not affect their perceptions and attitudes towards the vaccines except with those who have the conspiracy mentality.

Recommendations for Further Research:

It is recommended to replicate the study with a bigger sample. In addition to using the Cluster Analysis in classification of social media visuals. It is also recommended to conduct a content analysis on these visuals.

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