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Big crisis data, contradictions and perceived value of social media crowdsourcing in pandemics

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ABSTRACT

This study examines the impact of big crisis data on the contradictions, trust and perceived value of social media crowdsourcing in pandemics. The study also examines the impact of contradictions on trust and the perceived value of social media crowdsourcing. Finally, the study explores the impact of trust on the perceived value of social media crowdsourcing during pandemics. Data were collected from 405 respondents to an online survey. PLS-SEM was used to analyse the data and test the research model. The results show that big crisis data has a significant positive impact on contradictions and a significant negative impact on the perceived value of social media crowdsourcing. The results also confirm a significant negative impact of contradictions and a significant positive impact of trust on perceived value.

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1. Introduction

The world has always been a witness to natural and human-provoked disasters and pandemics that create long-term crises. Now more than ever, the outbreak of COVID-19 has launched an unprecedented health crisis that has profoundly affected the way we perceive the world, our relationships, and our daily lives (Krausz et al., 2020). In such pandemics, which threaten our lives and public health, social isolation, lockdowns and periods of quarantine create even more uncertainty.

Disasters, emergencies and crises have revealed the valuable role of social media in communicating, sharing and exchanging information (Conrado et al., 2016; Kaufhold et al., 2020). Within the context of COVID-19, where physical and social isolation, as well as public alarm, has been common, social media have provided a valuable opportunity for people to engage and participate in the local and wider community, leveraging the power of online crowdsourcing. The real power and value of crowdsourcing relates to the contribution of intelligent humans, providing a novel approach to

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collaborative problem-solving, creating knowledge, scouting new creative ideas and offering actionable insights (Brabham et al., 2014).

Crises and emergencies reveal the real effect and power of big data (Huang et al., 2020). In these situations, people use social media applications to interact with as events evolve, producing a massive amount of information every second. Global crises such as COVID-19 empower new kinds of communities on social media. Through crowdsourcing, information, advice and solutions on how to deal with such crises are disseminated and exchanged.

Global crises are usually complex. There are therefore contradictory institutional practices and variations, as well as differences in views, opinions and convictions within and between crowds. In the age of social media, big crisis data is prone to confusion, inconsistency and incongruity, resulting in contradictions derived from the diversity of online crowds. These contradictions inherent in social media crowdsourcing can hinder crisis management efforts, particularly those that depend on public awareness and response, such as during pandemics.

The modern world of information and knowledge societies in which the concepts of big data and crowdsourcing have prevailed has never witnessed a global crisis such as the COVID-19 pandemic. There is constant attention on big crisis data relating to natural disasters and human-provoked emergencies. At the same time, the literature lacks empirical research from the crowd's perspective on big data in global pandemics. The literature also lacks empirical research and knowledge about the impact of big crisis data and contradictions on the trust and perceived value of social media crowdsourcing in global pandemics.

To fill the aforementioned gap, this study explores the impact of big crisis data on the contradictions of social media crowdsourcing. It also investigates the impact of big crisis data and contradictions on trust and the perceived value of social media crowdsourcing in pandemics. The study of these relationships can help identify constructive practices and eliminate or reduce destructive practices to leverage the value of social media crowdsourcing during pandemics.

The findings of this study contribute to identifying possibilities for implementing constructive practices and eliminating or reducing destructive practices to leverage the value of social media crowdsourcing during pandemics. The findings of the present study can be used to support the efforts of managing future crises once further studies have empirically tested and optimised these practices.

2. Literature review

2.1. Theory development

In recent years, there has been exponential growth in social media applications as the preferred platforms for communication, social interaction and collaboration. The literature (e.g. Conrado et al., 2016; Gui et al., 2017) shows the role of social media in satisfying the need to gather, share and access up-to-date information during crises. The immediacy of social computing services has proven valuable in emergency communication (Gui et al., 2017). The literature (e.g. Huang et al., 2020; Schoch-Spana et al., 2018) confirms that social media platforms provide a real-time means of

communicating, tracking and sharing information to inform the crowd and improve situational awareness.

As infectious diseases emerge, social media crowdsourcing plays a pivotal role in informing, educating and empowering the public about health issues (Guidry et al., 2017). Guidry et al. (2017) investigated how public health organisations use social media as a source of public health information during infectious disease outbreaks and how this use may shape the public's response. Prior research on health care information practices has focused on the significant impact of social media crowds in collaborative decision making (Conrado et al., 2016; Gui et al., 2017). Collaborative decision making refers to a shared decision-making process in which people and authorities share information and build a consensus about which procedures to follow. These roles of social media are at the heart of the crowdsourcing paradigm as infectious diseases and public health crises emerge.

Crowdsourcing is an umbrella term for technologies and practices that outsource tasks to unknown and unlimited crowds of participants. Extensive research (e.g. Mulder et al., 2016; Schimak et al., 2015; Sweta, 2014) has studied the role of crowdsourcing in crisis management efforts. Furthermore, the literature (e.g. Brabham et al., 2014; Schimak et al., 2015) emphasises the central role of crowdsourcing in emerging pandemics and public health crises. The literature (e.g. Jain et al., 2015; Caulfield et al., 2019) confirms the pivotal role of crowdsourcing in producing and employing big data in crises and emergencies, given that few studies (e.g. Tang et al., 2018) have addressed this issue in relation to emerging infectious diseases or global pandemics.

Big data has become synonymous with social media. It is progressively attracting the attention of academics, practitioners and governments. The rapid evolution of social computing and the exponential growth in user-generated content have overloaded social platforms with massive amounts of data (Mulder et al., 2016). The term 'big data' began to be recognised in 2010 (Li et al., 2016). According to Qadir et al. (2016), big data includes the evolving ability to collect, process, and analyse massive collections of structured, semi-structured and unstructured data from various channels and sources to discover formerly unattainable insights.

Many studies (e.g. Huang et al., 2020; Jain et al., 2015; Kaufhold et al., 2020) have investigated issues related to the use and analysis of big data during disasters, crises and emergencies. Research (e.g. Brainard & Hunter, 2020; Stange et al., 2015) has confirmed that big data provides unique opportunities for collecting and using a massive amount of real-time data of prime importance to crisis management practices. However, the volume and varying forms of big crisis data raise many challenges in terms of storing, processing, analysing, visualising and verifying these data (Li et al., 2016).

The contradictions of social media crowdsourcing are considered one of the biggest challenges in public health crises and pandemics (Elsayed, 2020; Stange et al., 2015). Such contradictions may result from misleading or divergent messages (Elsayed, 2020; Schoch-Spana et al., 2018), conflicting opinions (Gui et al., 2017) and incongruity between information and actions (Huang et al., 2020). Furthermore, these contradictions may arise from changes in the status of the pandemic (La et al., 2020),

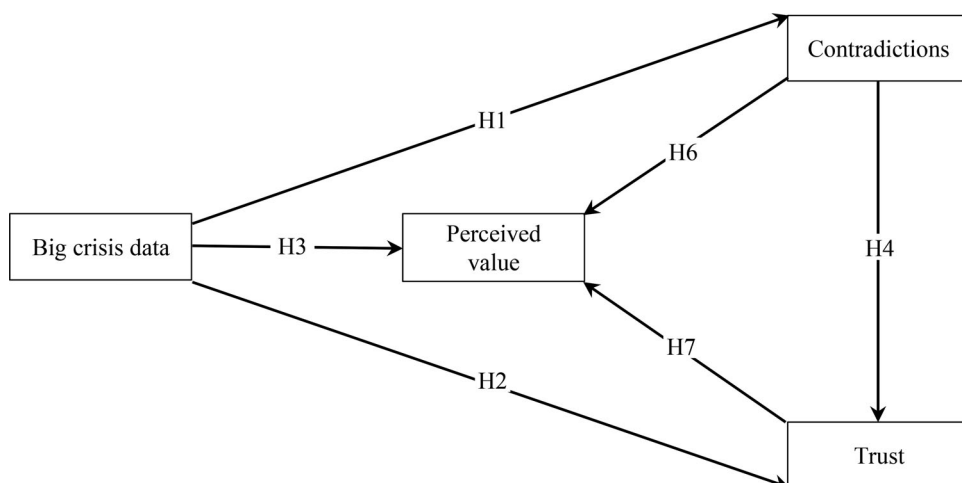


Figure 1. Research model. Source: The authors.

conflicting facts and news (Stange et al., 2015), misinformation and rumours (Brainard & Hunter, 2020; Caulfield et al., 2019), false information (Kaufhold et al., 2020; Rodríguez et al., 2020), and variations in perceptions, beliefs and understandings (Conrado et al., 2016; Swire-Thompson & Lazer, 2019).

When the members of society encounter high uncertainty and a lack of knowledge or facts about risks, they turn to trusted information sources to guide them (Jain et al., 2015). The literature reveals widely divergent and mixed perspectives on trust and confidence in social media during crises. Many scholars (e.g. Jain et al., 2015; Sharma et al., 2019; Sweta, 2014) consider social media more trustworthy than traditional media channels in crises and emergencies. However, a contradictory view (e.g. Swire-Thompson & Lazer, 2019; Rodríguez et al., 2020) is that the lack of a legal, verification and ethical framework raises broad scepticism about social media trustworthiness during such crises and emergencies. In any case, the role of trust in social media crowdsourcing has attracted the attention of many researchers (e.g. Schimak et al., 2015; Sharma et al., 2019; Wang & Wang, 2019).

In summary, the literature reveals that although social media crowdsourcing has attracted growing interest in research on crises and emergencies, little is known about the impact of big crisis data on the contradictions of crowdsourcing, especially in the case of global health crises such as the COVID-19 pandemic. Furthermore, the literature lacks empirical research and knowledge about the impact of big crisis data and contradictions on the trust and perceived value of social media crowdsourcing in global pandemics.

The research model used in this study is shown in Figure 1. Big crisis data is predicted to have a significant impact on the contradictions of social media crowdsourcing.

The research model proposes a significant impact of big crisis data on trust in social media crowdsourcing. Furthermore, it suggests that big crisis data, contradictions and trust have significant impacts on the perceived value of social media crowdsourcing. Finally, it proposes a mediating role of contradictions and trust in the

relationship between big crisis data and perceived value. The proposed relationships between the research model constructs are investigated below in more detail.

2.2. Big crisis data and the contradictions of social media crowdsourcing

Size is not the only defining feature of big data. Big data is characterised by the Gartner description as sets of data that are high volume, high variety and high velocity, otherwise known as the 3Vs (Laney, 2001). Veracity has also been added to describe the truth, accuracy, certainty and trustworthiness of big data (Zikopoulos & Eaton, 2011).

The literature (e.g. Sweta, 2014; Schimak et al., 2015) confirms that the rise of big data has been accompanied by advances in crowdsourcing. Crowdsourcing is rapidly gaining recognition as an important source of data in crises and a way of sharing large-scale public data from a large number of sources (Schimak et al., 2015; Huang et al., 2020). Social media crowdsourcing is characterised by the diversity and number of participants and communication networks that appear in crises. In the context of crowdsourcing data, prior research (e.g. Huang et al., 2020; Mulder et al., 2016) has confirmed the critical impact of crowd behaviours on the variety, velocity and veracity of big crisis data. According to Li et al. (2016), in light of its features, big data is more prone to include contradictory information, opinions and actions.

Contradictions are one of the biggest communication challenges during pandemics (Schoch-Spana et al., 2018). Huang et al. (2020) claims that during the COVID-19 outbreak, public health organisations, other government agencies and the public all have different reactions and take different actions, resulting in massive amounts of data with many contradictions. Social media crowdsourcing is subject to a variety of beliefs surrounding a particular topic, some of which contradict others (Swire-Thompson & Lazer, 2019). Prior studies (e.g. Rodríguez et al., 2020; Stange et al., 2015) have confirmed that in pandemics, many sources of big crisis data contribute to increasing uncertainty and generating contradictions to attract the audience's attention. In light of this discussion, the following hypothesis is proposed:

Hypothesis 1: Big crisis data has had a significant impact on increasing the contradictions of social media crowdsourcing during the COVID-19 crisis.

2.3. Big crisis data and trust in social media crowdsourcing

Trust and data credibility is a common issue in crises and emergency management studies. Deciding which information providers and sources to rely on and what information to trust is critical in shaping and influencing the crowd's awareness of a crisis (Schoch-Spana et al., 2018). Branched and dispersed big crisis data is a major challenge, especially for the trustworthiness, truthfulness and credibility of resources (Nativi et al., 2015). According to Stange et al. (2015), social media crowds frequently publish and exchange information with no evidence or contradict conventional, established guidelines.

Misinformation, rumours, half-truths, lies, fakes and spam disseminated via social media are key features in the narration of crises and emergency events in order to

attract the affection and attention of the audience (Kaufhold et al., 2020; Rodríguez et al., 2020). This distorted exploitation and use is a concern and a key challenge for trust in big crisis data. There are even more complex trust problems in using big data due to a lack of accountability (Qadir et al., 2016). In the context of disasters and emergencies, prior research (e.g. Swire-Thompson & Lazer, 2019; Rodríguez et al., 2020) has discussed the difficulties of using big social media data containing inaccurate, false and irrelevant information, as well as harmful rumours that increase chaos and distrust.

According to Li et al. (2016), because the sources of big data are often public, crowd-generated content, questions of trust are important to evaluate big data quality. Recent studies (e.g. Elsayed, 2020; Rodríguez et al., 2020) of the COVID-19 pandemic have examined trust in social media and published data. Studies (e.g. Conrado et al., 2016; Li et al., 2016; Stange et al., 2015) have also examined the risk and positive impact of trust when using social media crowdsourcing to collect data and make decisions during an emergency. Drawing on this discussion, the following hypothesis is proposed:

Hypothesis 2: Big crisis data has had a significant impact on trust in social media crowdsourcing during the COVID-19 crisis.

2.4. Big crisis data and the perceived value of social media crowdsourcing

In essence, when people engage in social media crowdsourcing, they agree to grapple with different dynamic sources and levels of risk of the free actions of other participants. Many scholars (e.g. Fischhoff et al., 2018; Gui et al., 2017) have confirmed that the perceived risks of social media crowdsourcing push users to change their estimation of the value of participation over time. The literature (e.g. Wendling et al., 2013; Schimak et al., 2015) explains how big data results in redundant information, with a risk of conflicting facts that lead to panic in crowds who do not justify the truth but only disseminate misinformation. Kaufhold et al. (2020) suggest that the enormous use of social media, which creates big data during crises and emergencies, increases the risk of information overload, leading to adverse effects on decision-making abilities.

Big crisis data promises valuable solutions and opportunities but also involves serious risks of misuse and abuse (Qadir et al., 2016). Gao et al. (2020) claim that diversity and repetitive media exposure to big data during the COVID-19 outbreak has fragmented social responses and impeded governments' efforts to prevent the spread of the virus. The massive unknowns and the information ineffectively communicated to the public and authorities create uncertainty that leads to heightened assessments of threats amongst health care specialists working under different degrees of pressure (Fischhoff et al., 2018). These reasons prompted the WHO (2020) to encourage people to minimise their listening, watching or reading of news reports on the COVID-19 outbreak because they lead individuals to feel frustrated or anxious. However, the literature (e.g. Nativi et al., 2015; Qadir et al., 2016) emphasises that the value of big crisis data is governed by whether it is accurate and up-to-date.

A recent study (Gao et al., 2020) revealed a significant relationship between the massive exposure of big data on social media and the prevalence of mental health problems during the COVID-19 outbreak. In the context of big crisis data, prior research (e.g. Mulder et al., 2016; Stange et al., 2015) has also confirmed that massive volumes of data within a short time might result in fear, anxiety and crowd panic. Based on this discussion, the following hypothesis is proposed:

Hypothesis 3: Big crisis data has had a significant impact on the perceived value of social media crowdsourcing during the COVID-19 crisis.

2.5. Contradictions and trust in social media crowdsourcing

Communication and trust have long been associated with pandemics and other public health emergencies (Elsayed, 2020). The WHO has warned that contradictory public health information is threatening not only humans' well-being but also a century of public trust in health care authorities and medical organisations (Gao et al., 2020). Recent studies (e.g. Swire-Thompson & Lazer, 2019; Rodríguez et al., 2020) have emphasised the fact that timely updates of information from trusted sources are essential to hinder the escalation of public fear and the amplification of contradictions.

In many cases, the media and officials contradict themselves about the risks to the population and preventive and control measures. Prior studies (e.g. Schoch-Spana et al., 2018; Tang et al., 2018) indicate that in such cases, people express their doubts about these contradictions and look for alternatives through social media crowdsourcing. Therefore, the public is influenced by information published and disseminated on social media that undermines recommendations from public health authorities (Atlani-Duault et al., 2015). Contradictory information or messages have raised speculation or created distrust of authorities and the WHO itself, creating an opportunity for a wide range of rumours and conspiracy theories about the origin and spread of COVID-19 (La et al., 2020). According to Rodríguez et al. (2020), belief in conspiracy theories is affected by the dissemination of contradictory information.

In the context of health misinformation, Caulfield et al. (2019) claim that many forces are playing an increasingly pernicious role in how health information on social media is shared, used and interpreted, raising uncertainty and generating contradictions. According to Atlani-Duault et al. (2015), threatening information that exaggerates minor risks or contradicts public consensus can weaken public trust in government agencies and the media. Therefore, the following hypothesis is proposed:

Hypothesis 4: Contradictions have had a significant impact on trust in social media crowdsourcing during the COVID-19 crisis.

2.6. Contradictions and the perceived value of social media crowdsourcing

The recent history of the pandemic has confirmed the role of social media, leading the public and other stakeholders to view these platforms as a valuable and essential avenue for communication about the pandemic (Guidry et al., 2017). This role has

not prevented a growing literature from investigating the impact of different forms of contradictions on the perceived value and usefulness of social media during pandemics and other public health crises. Contradictory information and messages create dissonance, which is something most people want to avoid. The literature (e.g. Brainard & Hunter, 2020; Caulfield et al., 2019) reports that contradictions in social media crowdsourcing might harm the efforts of crisis management, threatening people's lives and safety.

In general, studies (e.g. Brainard & Hunter, 2020; Guidry et al., 2017; La et al., 2020) have confirmed that contradictions lead to negative health outcomes for the population. Such contradictions may affect the willingness of individuals to take the recommended medical countermeasures during infectious disease outbreaks (Schoch-Spana et al., 2018). However, previous studies (e.g. Caulfield et al., 2019; Fischhoff et al., 2018; Stange et al., 2015) suggest different solutions to maximise the perceived value of social media by addressing different forms of contradictions during pandemics, public health crises and emergencies. Similarly, research (e.g. Caulfield et al., 2019; Fischhoff et al., 2018; Stange et al., 2015) has also advocated public use of social media crowdsourcing as a means of collecting and validating crisis information. Some researchers (e.g. Gao et al., 2020; Guidry et al., 2017) have underlined the pivotal role of public health institutions in monitoring and counteracting the spread of contradictory information by acting as moderators. Based on this discussion, the following hypothesis is proposed:

Hypothesis 5: Contradictions have had a significant impact on the perceived value of social media crowdsourcing during the COVID-19 crisis.

2.7. Trust and the perceived value of social media crowdsourcing

Participation in social media crowdsourcing is a trust-related behaviour. Trust is a determinant of communication effectiveness and the ability to achieve the full potential of crowdsourcing (Schimak et al., 2015). The literature (e.g. Sweta, 2014; Wang & Wang, 2019) confirms that the perceived value of social media crowdsourcing depends on the extent to which participants trust it. Rodríguez et al. (2020) claims that honourable people will not continue as members of online communities, despite their positive intention, if they believe that other participants are opportunistic.

Under the risk-benefit approach, participants will not continue to participate and interact with online communities when further risk is perceived, despite their positive assessment of membership (Tang et al., 2018). However, the literature (e.g. Schimak et al., 2015; Tang et al., 2018; Wang & Wang, 2019) reports that, despite the different perceived risks, people may decide to continue their membership in online crowds based on trust in their leaders, other members and disseminated information. According to Guidry et al. (2017), online social platforms that enable collective perception and promote trust between participants are likely to be more attractive for collaborative activities and the adoption and use of social media crowdsourcing.

Research on the mediating role of trust (e.g. Guidry et al., 2017; Sharma et al., 2019) has shown that the extent of satisfying members' needs will affect the confidence level and eventually the acceptance to continue using social media platforms.

Table 1. The sources and references for measures.

Construct	Code	No. items	References
Big crisis data	BCD	8	Laney, 2001; Nativi et al., 2015; Ghasemaghaei & Calic, 2019.
Contradictions	CO	6	Stange et al., 2015; Gui et al., 2017; Schoch-Spana et al., 2018; Brainard & Hunter, 2020.
Trust	TR	7	
Perceived value	PV	8	Wendling et al., 2013; Sethi, 2017; Fischhoff et al., 2018; Gao et al., 2020.

Prior research (e.g. Kaufhold et al., 2020; Elsayed, 2020) has confirmed that trust-worthiness is not easily verifiable, so distressed crowds may receive misleading messages, complicating rather than relieving the crisis. Based on prior research, the following hypothesis is proposed:

Hypothesis 6: Trust has had a significant impact on the perceived value of social media crowdsourcing during the COVID-19 crisis.

3. Research method

3.1. Measurement instrument and scale development

The measures of the constructs in the research model were obtained from the literature (Table 1) on big crisis data, contradictions, trust and the perceived value of social media crowdsourcing.

Data were collected using an online questionnaire. As shown in Table 2, the survey included 29 questions on the constructs of the research model. Three social media adoption experts and two experts on using information technology in crises validated the survey instrument and provided feedback on its relevance, clarity and logical consistency. A small pretest (20 respondents) was conducted using the survey instrument to identify any formatting problems, ambiguities or problematic questions. The measurement items were refined based on the feedback from experts and respondents. All instrument items were measured using a five-point Likert-scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

3.2. Sampling and questionnaire distribution

Given the exceptional conditions and preventive measures against the COVID-19 pandemic, as well as the nature of the study, an electronic questionnaire-based survey was used to collect the data. Facebook was employed as a primary platform for social media crowds. Facebook pages and groups were targeted, with users urged to fill out the questionnaire. The participants were asked to share the link to the survey and invite more respondents using a snowball approach. The link to the online survey was shared in large Jordanian Facebook groups to attract more respondents. Such groups and pages usually include members from other Arab countries.

A total of 419 responses were received and inspected, of which 14 incomplete questionnaires were discarded for the data analysis. As a result, 405 usable

Table 2. Constructs and measurement items.

Construct	Code	Measurement items
		<i>Please indicate the extent to which you agree with the following statements regarding the data of social media crowdsourcing during the COVID-19 pandemic:</i>
Big crisis data	BCD	
	BCD1	Social media crowdsourcing provides data from multiple and diverse sources.
Variety	BCD2	Social media crowdsourcing deals with different forms of data, including images, numbers, text, e-mails, video and audio.
Veracity	BCD3	It is easy to judge that the data provided are of high quality and validity.
	BCD4	Data sources of social media are often reliable and verifiable.
Velocity	BCD5	Data are sufficiently up-to-date for the rapidly-changing situation of COVID-19.
	BCD6	Social media enable real-time COVID-19 data collection and information sharing, making it accessible for the crowd.
Volume	BCD7	Social media generate immeasurable volumes and massive sets of COVID-19 data.
	BCD8	Social media receive and distribute a huge amount of information and news about COVID-19.
		<i>Please indicate the extent to which you agree with the following statements regarding social media crowdsourcing during the COVID-19 pandemic:</i>
Contradictions	CO1	Social media crowdsourcing is full of contradictions.
	CO2	Social media include a flood of misleading or varying information and messages.
	CO3	There is a perceivable inconsistency in information and news between traditional media and social media.
	CO4	Pandemic status changes give rise to conflicting facts and news amongst social media crowds about COVID-19.
	CO5	There are many conflicting opinions on social media concerning the facts, symptoms and prevention of COVID-19.
	CO6	Social media crowdsourcing provides a fertile environment for misinformation and rumours regarding COVID-19.
Trust	TR1	Overall, the health advice and recommendations of social media crowds during COVID-19 are experienced and reliable.
	TR2	The reliability and credibility of online volunteers during the pandemic are high.
	TR3	I believe that social media crowds have kept society's best interests and safety in mind during the crisis.
	TR4	Social media provide trustworthy information about COVID-19.
	TR5	I am comfortable relying on social media crowds regarding the latest developments in the pandemic.
	TR6	The members of social media crowds use multiple sources of information to verify truthfulness about COVID-19.
	TR7	I believe that in the pandemic, the members of social media crowds have expressed their opinions and feelings honestly and sincerely.
Perceived value	PV1	I find social media crowdsourcing very useful in the crisis of COVID-19.
	PV2	Social media have played a central role during COVID-19 in securing and fulfilling my basic needs, such as food, drinking water, medical assistance and transportation.
	PV3	Social media crowdsourcing is a valuable channel for understanding more accurately what is happening and improving my perception of the COVID-19 crisis.

(continued)

Table 2. Continued.

Construct	Code	Measurement items
	PV4	Social media platforms save me effort, time and costs of interaction in following prevention tips and the events of the pandemic.
	PV5	Social media facilitate collaboration between people in the crisis.
	PV6	Social media crowdsourcing promotes cohesion and social solidarity in the pandemic.
	PV7	Social media platforms enhance my knowledge about the pandemic when compared with traditional media.
	PV8	Participating in online crowdsourcing is likely to enhance my sense of belonging and feeling of attachment to society and the world and make me feel that I'm not alone in the crisis.

questionnaires were used in the analysis. Table 3 shows the demographic features of the sample.

3.3. Data analysis

Smart Partial Least Squares (PLS) version 2.0 was used to analyse the data. PLS provides a valuable way of examining new causal models in communication- and behaviour-related research fields. According to Chin (1998), PLS is highly effective when a theoretical paradigm or model that explains a new phenomenon is very limited (Chin, 1998), as is the case of the impact of big crisis data and contradictions on the perceived value of social media crowdsourcing in pandemics. Fornell and Larcker (1981) confirmed that PLS-SEM does not require normally distributed multivariate data or a large sample.

3.4. Measurement

The measurement model was tested for convergent validity, internal consistency and discriminant validity. Factor loadings, composite reliability and the average variance extracted (AVE) were used to estimate convergent validity (Hair et al., 2013). Any indicator with an outer loading between 0.4 and 0.7 was eliminated only when removing it improved the composite reliability (CR) or AVE above the suggested threshold value (Hair et al., 2013, p.103). Any item with a low outer loading (< 0.4) was removed from the scale.

The majority of the scale items were greater than 0.4, thus demonstrating validity. However, one item was removed from the big crisis data scale (BCD4), the contradictions scale (CO4) and the trust scale (TR1), and two items were removed from the perceived value scale (PV2, PV6). In all cases, the items were removed because of a low item loading (at level $\alpha = 0.05$). Cronbach's alpha, rho_A and CR were employed to assess the internal consistency reliability. Table 4 shows that all constructs have acceptable values exceeding the 0.70 threshold (Hair et al., 2013). Table 4 also indicates that all values of AVE are greater than 0.5, which shows that all constructs

Table 3. Sample characteristics.

Sample characteristics		No. respondents	%
Gender	Male	231	57
	Female	174	43
Total		405	100
Age	< 24	117	29%
	25–34	97	24%
	35–44	81	20%
	45–54	63	16%
	> 54	47	12%
Total		405	100

explain more than half of the variance of their measures, suggesting adequate convergent validity (Fornell & Larcker, 1981; Hair et al., 2013).

Table 5 reveals that the square root of the AVE of each construct is greater than the correlations with the other constructs, confirming adequate discriminant validity (Fornell & Larcker, 1981).

3.5. Assessing the structural model and testing the research hypotheses

Figure 2 represents the outcome of the structural modelling analysis, showing the causal relationships between the constructs. The path coefficient (β) and t value for each relationship were used to test the research hypotheses. A rule of thumb is that path coefficients higher than 0.1 with t values higher than 1.96 are significant at the 0.05 level (Hair et al., 2013).

Table 6 summarises the results of the testing of the direct relationship hypotheses. The results support a significant direct impact of big crisis data on pandemics (H1) on the contradictions of social media crowdsourcing. Unexpectedly, the results do not support the role of big crisis data on pandemics (H2) as a significant predictor of trust in social media crowdsourcing.

The results indicate that big crisis data on pandemics (H3) has a significant impact on the perceived value of social media crowdsourcing. The results show a significant impact of contradictions on the trust and perceived value of social media crowdsourcing. Accordingly, the associated hypotheses (H4, H5) are supported. Finally, the results suggest that trust (H6) has a significant impact on the perceived value of social media crowdsourcing.

3.6. Summary of results

The results of the study confirm that social media crowdsourcing contributes to big data during pandemics, providing a high volume, variety, velocity and veracity of data. The results reveal that big crisis data in pandemics includes a flood of misleading or divergent information and messages. Such data also include conflicting facts and news amongst social media crowds, as well as conflicting opinions concerning the reality, symptoms and prevention of COVID-19, creating a fertile environment for misinformation and rumours about the pandemic.

The findings reveal that the contradictions of social media crowdsourcing play a destructive role in that they erode trust. These contradictions give rise to scepticism

Table 4. Validity and reliability of research constructs.

Construct	Cronbach's alpha	rho_A	CR	AVE
Big crisis data	0.950	0.965	0.959	0.770
Contradictions	0.909	0.928	0.932	0.735
Trust	0.860	0.874	0.900	0.647
Perceived value	0.883	0.881	0.912	0.636

Table 5. Discriminant validity.

No.	Construct	1	2	3	4
1	Big crisis data	0.878			
2	Contradictions	0.336	0.857		
3	Trust	-0.247	-0.429	0.804	
4	Perceived value	-0.408	-0.291	0.648	0.797

in the reliability and credibility of online volunteers and the information sources of social media crowds. They also provide justification for doubting the intentions of social media crowds and online volunteers regarding the priority of society's best interests and safety during the crisis. Contradictions contribute to creating distrust in others' opinions, advice and feelings or in relying on social media crowds regarding the latest developments in the pandemic.

The results reveal that big crisis data and contradictions negatively affect the perceived value of social media crowdsourcing in a pandemic. It seems that big crisis data creates serious challenges for the members of crowds in collecting, storing, managing, processing, analysing, validating and verifying the quality of such data, as well as understanding how and which information to extract, trust and use. Big crisis data and contradictions impose the need for more effort, time and cost to interact and follow prevention tips and the events of the crisis. Furthermore, the results reveal that big crisis data and contradictions may hinder the collaboration, participation, and sense of belonging and attachment to social media crowds in pandemics.

In contrast, the results reveal that trust plays a constructive role in leveraging the perceived value and usefulness of social media crowdsourcing. These findings confirm the importance of trust in social media crowdsourcing to overcome the challenges of big crisis data. They show that trust promotes collaboration, connectivity, belonging, cohesion and social solidarity amongst a crowd's members, opening the way for collective actions and efforts that enhance the perceived value of social media crowdsourcing in such crises.

4. Discussion

4.1. Theoretical implications

The results show a significant direct impact of big crisis data regarding pandemics on the contradictions of social media crowdsourcing. These results are in line with prior research (e.g. Huang et al., 2020; Li et al., 2016; Tang et al., 2018), which have confirmed that big crisis data is more likely to capture huge amounts of contradictory narratives, rumours and news. These findings are also consistent with previous studies (e.g. Elsayed, 2020; Stange et al., 2015) confirming that the contradictions of social

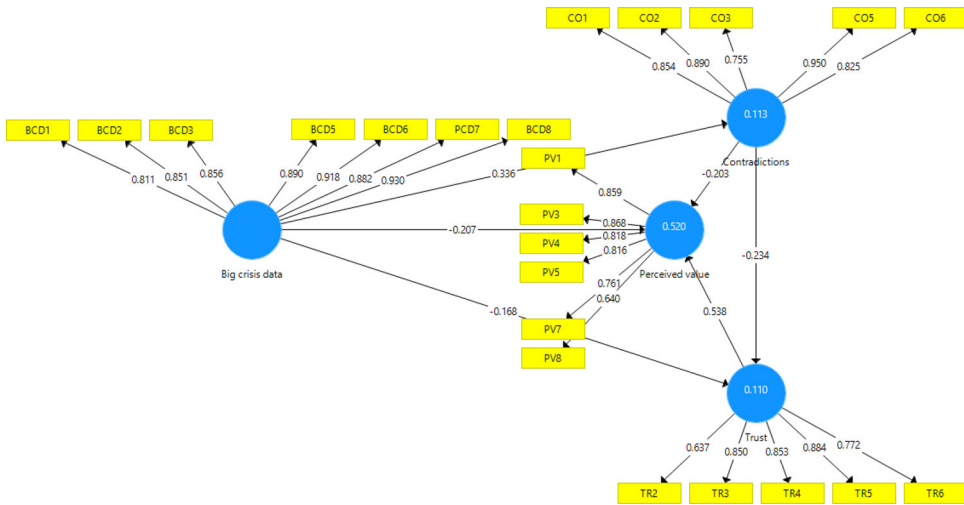


Figure 2. Path coefficient analysis. Source: The authors.

Table 6. Results of hypothesis testing.

H	β	t value	Sig.	Results
1	0.336	4.892	0.000	Supported
2	-0.168	1.435	0.152	Not supported
3	-0.207	2.309	0.021	Supported
4	0.234	2.464	0.014	Supported
5	-0.203	2.491	0.013	Supported
6	0.538	7.482	0.000	Supported

media crowdsourcing represent one of the biggest challenges in public health crises and pandemics.

The results reveal that big crisis data on pandemics has a significant impact on the perceived value of social media crowdsourcing. These findings are consistent with the literature (e.g. Schimak et al., 2015; Kaufhold et al., 2020), which shows that perceived risks may adversely affect the perceived value of social media crowdsourcing. They also support the call by the WHO (2020) to minimise listening, watching or reading information and news reports about COVID-19 because they lead individuals to feel frustrated or anxious. Gao et al. (2020) confirmed that the diverse and repetitive media exposure to big data during the COVID-19 outbreak has directly influenced and fragmented social responses and has hampered governments’ efforts to contain the disease.

The findings indicate that contradictions have a significant impact on trust and the perceived value of social media crowdsourcing during pandemics. These findings are consistent with recent studies (e.g. Huang et al., 2020; La et al., 2020; Rodríguez et al., 2020), which have shown that social media contradictions have a critical impact on levels of trust, creating fertile ground for a wide range of rumours and conspiracy theories about the origin and spread of COVID-19. Contradictions embedded in social media crowdsourcing might harm crisis management efforts, threatening people’s lives and safety. Notably many previous studies (e.g. Brainard & Hunter, 2020; Guidry et al., 2017; La et al., 2020) have confirmed the negative impact of social

media contradictions on population health outcomes and on the willingness of people to take the recommended medical countermeasures during infectious disease outbreaks, thus harming crisis management efforts.

The findings support the evidence of a significant impact of trust on the perceived value of social media crowdsourcing. These findings are in line with many previous studies (e.g. Sharma et al., 2019; Wang & Wang, 2019), which have shown that the perceived value of social media crowdsourcing depends on the extent to which participants trust it.

The present study makes a valuable contribution to the study of big crisis data and social media crowdsourcing and the knowledge of academics and practitioners in several areas. The world in which big data and social media crowdsourcing appeared has never faced a global health crisis such as that of COVID-19. The present study opens the way for the empirical exploration of big crisis data from the crowd perspective in pandemics.

The results of the present study contribute to the ongoing discussion about the impact of big data, introducing contradictions as a new subject matter to predict the perceived value of social media crowdsourcing during such global crises. Furthermore, no prior research has empirically investigated the impact of big data and contradictions on trust and the perceived value of social media crowdsourcing in responding to global pandemics.

This study contributes to the literature by examining the constructive role of trust in promoting the perceived value of social media crowdsourcing in pandemics. The findings of this study contribute to launching a new discussion of the challenges and opportunities of big crisis data in global crises sweeping the world. This study also considers the importance of perceived value as a performance evaluation measure of big crisis data and social media crowdsourcing in response to the COVID-19 pandemic.

4.2. Managerial implications

Although big data offers a valuable resource in crisis management, the contradictions of social media crowdsourcing embedded in big data might harm crisis management efforts. Such contradictions may exacerbate the spread of infectious diseases, reducing the willingness of individuals to take the recommended medical countermeasures during pandemics. The contradictions of social media crowdsourcing during COVID-19 are revealing numerous ethical, informational and technical issues that must be addressed. The current COVID-19 pandemic is demonstrating that crowds, authorities, international organisations and social media operators share the responsibility of leveraging the value of social media crowdsourcing by eliminating or diminishing contradictions in big crisis data.

Social media providers can create and publish ethical standards, rules, values, codes and philosophies to reinforce the crowd's sense of ethical responsibility in such crises. Local authorities and international public health organisations are responsible for providing trusted, consistent and timely information to prevent the escalation of

public fears and contradictions. Any new information that contradicts previous information on the pandemic must be justified.

The present study suggests technical solutions to leverage the perceived value of social media crowdsourcing in pandemics. Social media providers and, more specifically, social networking sites can generate new platforms of pages or groups in many languages to support the efforts of crowdsourcing in pandemics. Doing so can attract all stakeholders such as health and medical professionals, authorities and crowds. Such platforms can contain information, tips, advice, news and large-scale maps of the spread of the virus based on the national contact tracing systems. These platforms could add new filtering features to evaluate the reliability and credibility of crowd contributions and detect and address rumours, misinformation and redundant information.

4.3. Limitations and future research

This study has some notable limitations that open up new directions for future research. The total sample population invited to participate in this study is only a tiny part of the Facebook user universe, and it is not representative of the entire population of Facebook users. Data were primarily collected from the Arab world. In other words, if this study is carried out in other cultures, it may yield different findings. Future research must focus on a larger sample of Facebook users, countries and regions to verify the results of the study. Although big crisis data is an important determinant, many factors in behavioural theories must be examined in future studies to extend the research model and improve the prediction of the perceived value of social media crowdsourcing in pandemics. Furthermore, the sense of community, the crowd's perception of big crisis data, contradictions, trust and the perceived value of social media crowdsourcing may change over time due to changes in the status of the pandemic or crowd members' greater experience and knowledge. Consequently, a longitudinal study could be beneficial to provide a better understanding of the dynamics of these factors in pandemics.

5. Conclusions

When risks and threats appear, people become thirsty for information to learn as much as they can and receive more details on possible dangers. In global crises such as the COVID-19 pandemic, the public around the world has access to massive volumes of data but rarely knows or understands which information to extract, trust and use. Social media crowds are an important source of data, sharing vast amounts of public data in crises from a large number of data sources (Schimak et al., 2015; Huang et al., 2020). However, the perception of big crisis data effects cannot be understood without understanding a wide range of ambiguities resulting in contradictions derived from the diversity of the crowds that participate in crisis management. The literature lacks empirical studies on the relationships between big data, crowdsourcing contradictions and trust during such crises. Therefore, this study examines

these relationships, exploring their impact on the perceived value of social media in pandemics.

Disclosure statement

No potential conflict of interest was reported by the authors.

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