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ORIGINAL RESEARCH

How Does Misinformation and Capricious Opinions Impact the Supply Chain - A Study on the Impacts During the Pandemic

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Abstract
Misinformation or fake news has had multifaceted ramifications with the onset of the Covid-19 pandemic, creating widespread panic amongst people. This study investigates the impact of misinformation/ fake news (on internet platforms) on consumer buying behavior, impact of fear (created by fake news) on hoarding of essential products and consumer spending and finally impact of misinformation-induced panic buying on supply chain disruptions. It draws upon the consumer decision theory and the cognitive load theory for explaining the psychological and behavioral responses of consumers. The study follows an inductive approach towards theory building using a multi-method approach. Initially, a qualitative research method based on interviews followed by text-mining has been used followed by analysis using python for topic modelling using Latent Dirichlet Allocation (LDA). The findings revealed several prominent themes like consumer shift to online buying, two contrasting spending intentions namely financial security and compensatory consumptions, irrational panic buying, uncertainty/ambiguity of government protocol and norms, social media fraudulent practices and misinformation dissemination, personalized buying experience, reduced trust on news and marketers, logistics and transportation bottlenecks, labor shortage due to migration and plant closures, and bullwhip effect in supply chains.

Keywords Fake news · Consumer buying behavior · Hoarding · Consumer spending · Supply chain disruptions

1 Introduction

The social media revolution has descended upon us and the widespread usage of the internet has facilitated dissemination as well as publication of content, making it more accessible to a wider audience. This has had a multi-pronged impact, with a gravely negative outcome, the proliferation of so-called 'fake news'. Fake news can be explained as deliberately fab-

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ricated false stories that are potentially verifiable (Allcott & Gentzkow, 2017; Fulgoni & Lipsman, 2017; Lazer et al., 2018). Hardly any entry barriers exist, hence producers of fake news can easily post such content, for underlying economic incentives. Sensational online headlines tend to generate clicks and traffic, which in turn increases advertising volume and consequentially fake news (Ormond et al., 2016). At the center of the growing controversy on online misinformation are tabloid websites, which are using falsified news to bait for clicks on commercial ads (Nicas, 2016; Blom & Hansen, 2015). This is usually the result of algorithm-driven product advertisements, which choose target sources with the highest probability of reaching their audience. Hence this also results in established brands being inadvertently associated with fake news (Fulgoni & Lipsman, 2017; Allcott & Gentzkow, 2017). As the internet progresses on its path to replace traditional media like television and print media, this situation will proliferate further; and individuals are also on the path of altering their media preferences (Geyskens et al., 2002; Gentzkow, 2007; Xu et al., 2014).

Misinformation or fake news has had widespread ramifications with the onset of the Covid-19 pandemic. There is an overarching cloud of panic looming large on people. One outcome of this widespread panic was the negative impact on consumers and retail services. Consumers were displaying abnormal purchase behavior with reference to retail products like hoarding food items and toilet paper globally. This kind of unusual purchase behavior was recorded during March 2020 with the onset of the pandemic and often this was attributed towards information availability on formal media platforms (Wang et al., 2020; Miri et al., 2020). Some of the presumable causes were quarantine risk, self-health threat, and the fear of stoppage of production of essential items due to the pandemic led to mass anxiety induced irrational behaviour. This would consequentially result in worldwide disruption in supply chains. The initial anxiety-driven rush for some products created a shortage for some and a surplus of some others. However academic research deep diving into this phenomenon was not undertaken to the best of our knowledge.

There was a sharp decline in the consumption of retail and entertainment services globally after March 2020, due to the pandemic (Google's 2020 COVID-19 community mobility report). This unusual consumer behavior had a multifaceted impact on grocery and convenience stores, restaurants, and cafeterias as well as their suppliers. There has been a predictable impact on consumer purchasing activity, instigated by the economic uncertainty brought about by a global pandemic. There are several areas of concern related to financial security Vis a Vis "compensatory consumption" during an exigency, which often impacts spending as a result (Laato et al., 2020).

It is however the impact of fake news that this study aims to demystify which has not been explored till now. It aims to highlight and identify how fake news or misinformation during the current pandemic creates psychological distress among the general public/ consumers, which further creates panic among them and they start pilling stock of products for future consumption. In addition, because of this panic buying, there is increased demand and limited supply which leads to disruptions in the supply chain.

If consumers are more conscientious and aware of these contrasting desires to save money (for financial security) as well as spend more due to a feeling of uncertainty, it would nudge them towards more responsible spending, involving a combination of saving as well as spending, as the need arises. The uncertainty and ambiguity surrounding the pandemic combined with circulation of misinformation have compelled consumers to indulge themselves with shopping as well as go in for saving.

The motivation for the current study was drawn from some cardinal questions confronting both academicians and practitioners surrounding the impact of misinformation/ fake news (on internet platforms) on consumer buying behavior resulting in the creation of an echo chamber effect. This echo chamber effect increased the impact of fear (created by fake news) and led towards hoarding of essential products and consumer spending and finally this impact of misinformation-induced panic buying leading to supply chain disruptions. This leads us to the research questions that the current study aims to address:

RQ1. How does the circulation of misinformation/fake news on social media platforms during the Covid-19 pandemic impact consumer buying behavior?

RQ2. Why did the fear created by the circulation of misinformation/fake news on social media lead to the hoarding of products by the consumers? What were the other impacts?

RQ3. How does fear created by the circulation of misinformation/fake news on social media platforms impact consumer spending?

RQ4. How does misinformation-induced panic buying by consumers create disruption in the supply chain of various products?

This study aims to provide elucidative responses to these questions, so as to prepare for a more comprehensive response to similar exigencies in the future, develop responsive and resilient supply chains and gain an insight into effectively transition to the emerging status quo of various consumer-related retail services, once the pandemic has been curbed.

The remaining paper is structured as follows: the next section (i.e., Sect. 2) presents the literature review followed by the framework development in Sect. 3. Subsequently, Sect. 4 discusses the research methodology followed by presenting results based on data analysis in Sect. 5. Thereafter, Sect. 6 discusses the results and highlights the key implications for theory and practice, limitations, and directions for future research. Finally, Sect. 7 provides the conclusive remarks.

2 Literature Review

Some researchers have attempted to explore the impact of fake news in the past as well. There has been a study on fake news being perceived as real, which consequentially results in an indirect positive impact of exposure to fake news in fostering feelings of alienation, inefficacy, and cynicism with a realistic perception of fake news, mediating the relationship (Balmas, 2014). Then Allcott & Gentzkow (2017) have investigated the impact of fake news on the 2016 US presidential election. Their findings suggest that if one fake news article had the same persuasion ability as one TV campaign ad, the impact (of the fake news) on the changed vote shares would be up to hundredths of a percentage point.

There is an area of grave concern for academic researchers, policymakers, and managers, over the role discharged by social media in the dissemination of misinformation, widely described as ‘Fake News’. In the current scenario, social media is a key platform for communication and there is a perceptible gap in our perception of falsified news from a consumer’s perspective. (Di Domenico et al., 2020, 2021) In their systematic literature review highlighted that fake news is an upcoming domain of research in the field of marketing and business, with a knowledge gap for want of theoretical development, bringing to the fore the importance of fake news.

There have been other studies exploring the role and impact of fake news. For instance, Di Domenico et al. (2020) conducted an experimental study and their findings revealed that fake news presented in a format (with the source being revealed upfront) reduces the sharing tendency of users due to lack of trust and a perception of an ulterior motive (of the source). Thereafter Kim et al., (2019) conducted another experimental study on social media users' believability in the articles and the impact of source ratings and their rating mechanisms. In case of low ratings (identifying fake news), the users focused more on the rating mechanism. Their findings also revealed a second-order effect, where sources with ratings resulted users in being more skeptical than sources which had no ratings. There also existed a prominent confirmation bias, with users having a tendency to believe as well as engage with those articles that are in sync with their beliefs.

There have been some controversial studies pertaining to fake news as well. It is now a greater threat than ever before, especially with the widespread dissemination on social media platforms (Chakraborty, 2020; Gimpel et al., 2021) have tried to investigate the impact of social norms on social media users' decisions to report fake news. Although their study found no significant effect, however misplaced social norms can result in even real news being reported as fake news.

There is notable information overload, which results in an increased probability of fake news sharing, due to an increased psychological strain on consumers (AON, 2020). Furthermore, it is the consumers' resilience, which tends to mitigate these drastically negative effects by inhibiting the various process components (Bermes, 2021). Taking this further, researcher have investigated different kinds of users' have varied susceptibility to misinformation, so as to provide a guiding path to brand managers for adapting their branding strategies to be deployed on social media accordingly (Borges et al., 2020). Thus in order to satiate academic as well managerial queries, it is vital to decipher the impact of misinformation on the consumer buying behavior and spending patterns.

"Fake news", sadly, has become a major global theme in the political as well as media domain. In the past three decades, content creation as well as dissemination has undergone a sea change, greatly increasing with a large number of people accessing information online, with barely any control on content distribution. The follow-up to hit the audience will be that of machine-generated content. Artificial Intelligence will be able to detect counterfeit reality with ease and efficiency. Unfortunately, AI is also deployed for creating counterfeit reality at a much faster pace, whereas deploying AI for the detection of counterfeit reality is far behind the use of AI to create it (Wigand, 2020).

It has been established that collaborative planning technologies (CPFR) are improving customer service by eradicating established hindrances in the form of poor information availability. Omnipresent sensing technology has aided product tracking, thus resulting in improving efficiency as well as safety. There is a new global corporate mandate i.e. sustainability. However, its implementation is driven primarily by technology or by making the supply chain "green". There is a ubiquitous presence of big data and artificial intelligence (AI) and these technologies are influencing every facet of how organizations design their supply chains and positively impact sustainability (Sanders et al., 2019; Wang et al., 2016).

Multifaceted research pertaining to supply chains is being conducted globally. Boone et al., (2019), have attempted to explore the impact of customer analytics (drawn from big data and other technologies) on sales forecasting in the supply chain. Finally, customer experiences and supply chains have both evolved with the passage of time, making the integration

of big data technologies with conventional SOP processes difficult. Another facet gaining in importance is social media analytics, which is becoming a critical aspect in modern supply chain operations management (SCOM). Researchers have attempted to investigate the deployment of 'blockchain technology supported social' media platforms for enhanced usage of these analytics for SCOM (Chaudhuri et al., 2021; Kamble et al., 2021). Several problems like data accuracy (due to fake data), data security and user privacy, and so on, however, exist in using social media analytics for SCOM (Choi et al., 2020).

In the current business environment, natural as well as manmade disasters like the recent pandemic have caught the attention of researchers and practitioners with reference vulnerabilities in the supply chain. Researchers have attempted to identify and prioritize these vulnerability factors. Some critical ones are, critical suppliers; the geographical location of the supplier; lead times of extended supply chains; fixing process owners, and misaligned incentivization. Vulnerabilities in the supply chain are consequences of cumbersome supply chains and related practices. If these factors are evaluated relatively, professionals can deploy appropriate preventive strategies resulting in more robust supply chains (Sharma et al., 2021; Ivanov, 2020; Giannakis et al., 2019).

The current pandemic has highlighted the need to restructure and strengthen supply chain networks at a global level. The supply chains need to be responsive, dynamic, and interconnected to an organization's processes as well as an ecosystem (Dubey et al., 2016). There are emergent supply chain technologies, that are dramatically improving end-to-end supply chain visibility, building organizational ability to resist such shocks. The traditionally prevalent linear supply chain model is transforming into digitally driven supply networks, destroying functional silos and connecting organizations to their complete supply network. This enables end-to-end visibility, agility, collaboration, and optimization (Deloitte report). This entails the need for transparency, real-time information flow, and fast-paced decisions in exigencies (IBM report).

3 Framework Development

The current study draws upon the Consumer Decision theory (Engel-Blackwell-Miniard Model; Engel et al., 1968) as an overarching theory. Researchers have used this framework for understanding the internal as well external variables, having an impact on behavior. According to this theory, the consumer buying process is influenced by internal stimuli and external variables in the form of environmental influences or individual differences. The internal stimuli may be constituted by previous knowledge, self-efficacy, and thinking skills of the consumers, which may influence their behavioral responses (Attiq et al., 2017).

In the Covid 19 context, predominant external variables or stimuli are comprised of the fake news (regarding the pandemic) circulating on social media as well as traditional media. This fake news has instigated fear psychosis amongst consumers. There is widespread circulation of misinformation pertaining to the pandemic, causing an information overload (Dhir et al., 2018, 2019; Malik et al., 2020; Whelan et al., 2020). The consumer decision theory explains both individual as well as external variables influencing consumer behavior. Furthermore, the study also uses cognitive load theory (Sweller, 2011) for establishing causality between the variables and explaining the psychological and behavioral responses. This theory attempts to explain that the human brain suffers from cognitive overload (when

bombarded with excessive information), due to its limited cognitive capacity. This overload leads to stress in human beings, which in turn may result in cognitive processing such that it instigates adverse or irrational behavioral responses (Dhir et al., 2018, 2019; Laato et al., 2020; Whelan et al., 2020; Malik et al., 2020). The internal and the external stimuli may push the consumers towards certain reactions, however, herd mentality may prevail and group characteristics and behavior may further enhance panic buying (amongst consumers) as well as hoarding of products.

For the research questions, the study draws upon the consumer decision-making model, for the internal as well as the external stimuli, which influence the behavior patterns of consumers, while perceiving an environmental threat from the COVID-19 pandemic. It also takes into cognizance the cognitive load theory for incorporating the cognitive overload due to excessive circulation of fake news related to the pandemic. This mental overload consummates not only in stress but an irrational display of buying behavior by the consumers.

Prior research on individuals' behavior during pandemics and outbreaks has usually attributed unusual behavioral display to either personal motivations or policy level decisions enforced by the government, however, both these factors are error-prone as well bias prone in ambiguous situations (Weinstein, 1988). Information sources have been the major drivers of consumer behavior during the pandemic (Laato et al., 2020). The greater the ambiguity and unpredictability of the situation, the greater the risk mitigation by individuals and safer their actions (Brug et al., 2009; Laato et al., 2020) has also attempted to explore the strange purchasing behavior during the onset of the COVID-19 pandemic, using the stimulus-organism-response approach. Their findings revealed that sources of online information led to explosive information overload and cyberchondria. Perceived severity of the situation and cyberchondria significantly influenced people's intention to make unusual purchases while voluntarily self-isolating. The wide access to user-created content on various social media platforms facilitates aggregation of public opinion around common interests, narratives and worldviews. However, it also fosters widespread diffusion of unverified rumors. Information about distinct narratives tends to generate homogeneous and polarized communities (i.e., echo chambers) which display similar consumption patterns for information. This type of selective exposure to content is the primary driving force of content diffusion, resulting in formation of homogeneous clusters, i.e., "echo chambers (Del Vicario et al., 2016). Thus, drawing from extant literature, the current study aims to address the following crucial questions, how does the circulation of misinformation/fake news on internet platforms during the Covid- 19 pandemic impact consumer buying behavior? How does fear created by the circulation of misinformation/fake news on the internet lead to hoarding of products by the consumers? How does this fear impact consumer spending?

Global research with reference to supply chains is being conducted. Researchers have delved into customer analytics for sales forecasting in the supply chain (Boone et al., 2019). There is also research on the deployment of 'blockchain technology-supported social media platforms for using these analytics for SCOM. There are several hindrances like data accuracy (due to fake data), data security, and user privacy in using social media analytics for SCOM (Choi et al., 2020). Extreme circumstances like the pandemic have revealed several vulnerability factors in existing supply chains like critical suppliers; the geographical location of the supplier; fixing process owners, and misaligned incentivization. (Elluru et al., 2019; Kaur & Singh 2019). Vulnerabilities in the supply chain are consequences of cumbersome supply chains and related practices. If these factors are evaluated relatively, profes-

Table 1 Profile of the respondents

Academic qualification		Work experience		Seniority in the organization	
Bachelors in technology	22	0–3 years	11	Senior management	31
Graduate(General)	8	3–6 years	7	Middle management	39
MBA	37	6–9 years	14	Lower management	12
Master (Technology)	15	9–12 years	35		
		12 years and more	15		
n = 82					

sionals can deploy appropriate preventive strategies resulting in more robust supply chains (Sharma et al., 2021; Fahimnia et al., 2017; Belhadi et al., 2021; Dennehy et al., 2021). Hence evidence from extant literature prods us to address another pertinent research question, how does misinformation-induced panic buying by consumers create disruption in the supply chain of various products?

4 Research Methodology

This study follows an inductive approach towards theory building using a multi-method approach. Multimethod approached for complex research questions are often more effective in the areas where not much work has been done and not much literature is available. When the researcher is exploring and moving towards confirmatory results or research with the help of inductive mechanism of theory building (Borrego et al., 2009), these approaches are useful in inductive theory formation where the content and context are not explored much in existing literature. Inductive approach for theory building is used either when the context of examination is new or there is theoretical saturation in a field. The pandemic being an unprecedented challenge that firms and consumers globally faced, the firms did not have an adequate mechanism for governance and were severely challenged in terms of coping with drastic changes. This disruption was at a global level, forcing firms and governments to adopt drastic coping strategies. Therefore inductive theory building approach was thought to be suitable and appropriate for addressing the research questions revolving around disruptive changes, calling for exploration and theory building from the perspective of practitioners who are in midst of the dynamic and evolving situations, facing everyday challenges and disruptions.

The study first uses a qualitative research methodology based on interviews followed by text-mining to investigate the responses gathered from 82 professionals having experience of working with MNCs. These respondents were from different professional and academic backgrounds and were selected with the help of purposive sampling (Table 1). From a total of 82 respondents, 60 were male respondents and the remaining were female professionals employed in direct to consumer retail industry. The average work experience is 7 years. Semi-structured interviews were conducted with the respondents to understand the impact of fake news on panic buying and different kinds of behavior exhibited by consumers during this crisis and further explore its impact on supply chain disruption.

All the protocols were followed while conducting the interviews to minimize biases of internal and external validity. The questions were provided across multiple rounds and respondents were not allowed to interact with each other to minimize the biases of groupthink. This mechanism of control ensures greater internal validity without losing external validity when the respondents are heterogeneous in terms of work profile and yet have similarities in terms of focus with experience within a single industry. The interviews were conducted across 82 respondents till the time theoretical saturation was achieved. The interviews were translated into a transcript by organizing the responses into individual files for all four RQs distinctly. These files were further collated by data processing to exclude all the spaces, special characters, and other numeric values present in the files. Uniformity of cases was conducted followed by identification of stop words. Once all these steps were complete the final version of transcripts was used for analyzing and coding into themes using NVivo. Inter-coder reliability was addressed while creating the codebook for mapping the responses with the themes developing from the transcripts. Group consensus-based approach was used to establish face validity of the themes identified from the topics elicited after text summarization. Extraction of main content from the analysis was done with the help of word cloud. Feature of autocode was used for performing the thematic and sentiment analysis.

We have further used python for topic modelling using Latent Dirichlet Allocation (LDA). "Topic modelling is a probabilistic approach towards clustering of documents" (Kushwaha et al., 2020, p. 317). Topic modelling is an approach within text mining and is used to analyze large volumes of text data to reduce them to differentiable and distinct dominant themes so that the core themes can be summarized based on a cluster of representative words (Kumar et al., 2021). This approach helps in determining or extracting topics or themes from the transcripts (raw data). And this process of extracting themes or topics from raw data is called inference in the topic model. LDA is a type of topic model that creates topics/themes based on the frequency of words from a document.

The outputs of topic modeling were also visually represented using word clouds so that thematic coherence is understood about the dominant themes emerging within the responses. To ensure that the themes are not representative of similar themes, inter-topic correlation analysis was undertaken whereby it was ensured that the inter-topic correlation is between -0.7 to $+0.7$.

Then the outputs of NVivo and Topic Modeling were evaluated to assess the confluence of themes for convergence of outcome and developing thematic validity (Kar & Dwivedi, 2020). This mix of qualitative content analysis and text mining was employed to make the thematic convergence evident from the collected data. For demonstrating the nomological network of the topics and how they connect among the different research questions to form a broader theme, a network analysis was undertaken (Barabasi, 2013). This analysis of checking the connection among the different themes with a network can help to check, if all the themes are related to a larger theme, which in this case is represented by the words like misinformation, pandemic, covid, fake news, and consumers. The minimum cutoff for words to appear in this network was twice among the topics across research questions. Since there was no cluster that was segregated from the core network, the themes identified were closely mapped with the larger nomological network (Kar & Dwivedi, 2020; Kushwaha et al., 2021). This helps in bringing out a larger conceptual framework of assessing the context based on divergent views emerging from the collective intelligence of all the respondents in the interview process.

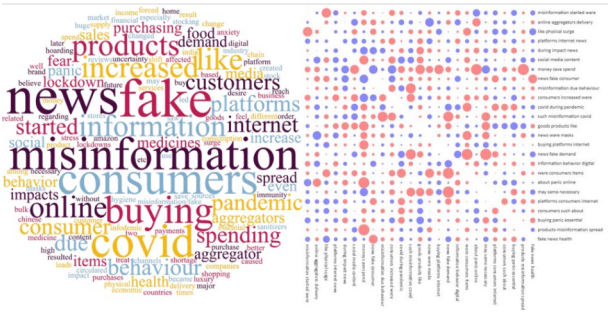

Fig. 1 Word cloud and correlation heat map among the topics for RQ1

The methodological triangulation approach has also been deployed to demonstrate objectiveness of findings and interpretation through the convergence of methods to develop a comprehensive understanding of phenomena (Berente et al., 2019). While there were only 82 respondents, the corpus of text generated in the interviews were significantly large after transcribing the text. This approach of combining methods for capturing collective intelligence of different stakeholders helped us to view the phenomenon of misinformation during covid and its impacts, through the lens of consumer decision theory, but from different analysis of data so that findings have greater objectivity. Further this creates greater generalizability of findings as the text mining based theory building has greater objectivity while interview based examination and manual coding has better internal validity as well as explainability. However coding manually a large set of samples may lead to researcher's own biases creeping in based on proximity to the context, which was avoided by the text mining methods. Because of the large sample size on the interviews that were undertaken, external validity was ensured, but mining them thematically needed text mining as the desired methodology to avoid interpretations based on researcher's own biases.

5 Results

The analysis of the data collected from the in-depth interviews and from Twitter revealed the following information – the circulation of fake news/misinformation had a great impact on the buying behavior of the customers during this pandemic. These impacts can be categories under different headings like a great increase in the demand for essential goods as customers wanted to hoard the essential items and medicines.

RQ1.*Impact of circulation of misinformation/fake news on consumer buying behavior*.

The word cloud in Fig. 1 for RQ1 depicts that "news" is the word which is highlighted the most by the respondents followed by fake, misinformation, consumer, buying, online, covid, spending, like, social, due, and fear, etc. these words were used for forming the themes while taking assistance of thematic analysis. The correlation among the themes emerging is also shown in Fig. 1. The major themes which emerged under RQ1 are a shift to online buying (18%), two contrasting spending intentions namely financial security, and compensatory consumptions (16%), and Irrational panic buying (12%). Circulation of misinformation or fake news was at its peak which further created a panic among the consumers. Due to Government restrictions, consumers shifted towards buying online and had two contrasting intentions.

Table 2 Themes for RQ1

S. No.	Themes	Percentage
1.1	Shift to online buying	18%
1.2	Contrasting spending intentions	16%
1.3	Irrational panic buying	12%

Fig. 2 Word cloud and correlation heat map among the topics for RQ2

Quoted below are some instances from the respondents' answers-.

Respondent 4: *"During the Covid times' consumers had two opposing spending intentions: the desire to save money and the desire to spend it on things in order to feel better. This led to irrational panic buying. Misinformation regarding the shortage of essential goods, the extension of lockdown, closure of shops, etc., led to irrational buying from aggregator platforms which in terms had a severe effect on the distributor, manufacturer, etc."*

Respondent 16: "Consumer purchasing activity is impacted by the economic uncertainty created during a global pandemic. Concerns about long-term financial security versus 'live it while it last' during times of crisis are expected and often impact spending as a result. An individual's exposure to fake news impacts their consumer buying behavior during a crisis."

Table 2 shows the themes for RQ1.

RQ2.*Fear created by the circulation of misinformation/fake news created hoarding of products by the consumers.*

The word cloud in Fig. 2 for RQ2 depicts that "consumers" is the word which is highlighted the most by the respondents followed by hoarding, misinformation, fear, buying, products, fake, panic, fear, Covid, news, essential, and pandemic, etc. these words were used for forming the themes while taking assistance of thematic analysis. The correlation among the themes emerging is also shown in Fig. 2. The major themes which emerged under RQ2 are excessive buying and hoarding (herd mentality) (21%), uncertainty/ambiguity of government protocol and norms (19%), and social media fraudulent practices and misinformation (17%). Circulation of misinformation or fake news created a fear among the consumers. Due to Government protocols and norms, consumers were forced to hoard the essential items and medicines thereby creating an increase in the demand for the essential goods.

Quoted below are some instances from the respondents' answers-.

Respondent 4: "*Fear creates stress in people, and they are unsure when they can expect things to be normal. They feared complete lockdown in the country anytime which leads to hoarding of products. In a pandemic, there were chances of lockdowns, and it was administered by the local operating body so, misinformation was spread among people through social media; consumers started thinking that the essential goods would vanish from the*

Table 3 Themes for RQ2

S. No.	Themes	Percentage
2.1	Excessive buying and hoarding (herd mentality)	21%
2.2	Uncertainty/ambiguity of government protocol and norms	19%
2.3	Social media fraudulent practices	17%

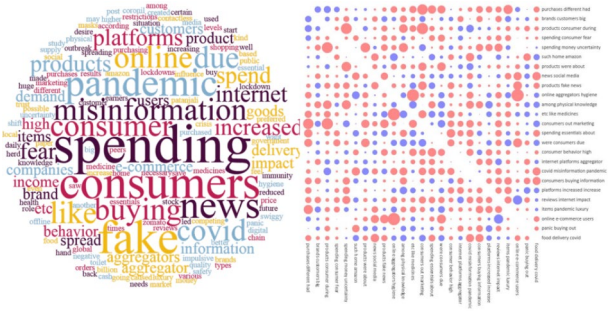

Fig. 3 Word cloud and correlation heat map among the topics for RQ3

stores. In covid medical illness, fear and anxiety were at peak among people due to the fear consumers tend to panic buying, hoarding, and stockpiling".

Respondent 16: "*Panic is a common reaction to societal crises like disasters (in this case, the Covid pandemic) and riots, and it shows itself at various levels in individuals and institutions. Excessive fear and worry can lead to hoarding and stockpiling of basic necessities or specific objects."*

Table 3 shows the themes for RQ2.

RQ3.*Impact of fear created by the circulation of misinformation/fake news on consumer spending.*

The word cloud in Fig. 3 for RQ3 depicts that "spending" is the word which is highlighted the most by the respondents followed by consumers, misinformation, buying, news, fake, pandemic, online, due, fear, increase, time, and social, etc. these words were used for forming the themes while taking assistance of thematic analysis. The correlation among the themes emerging is also shown in Fig. 3. The major themes which emerged under RQ3 are compensatory consumptions (20%), personalized buying experience (17%), and decrease in the trust level (16%).

Quoted below are some instances from the respondents' answers-.

Respondent 4: "*Fake news has resulted in making the consumer smarter, and they are more skeptical regarding the information reliability, and there is an emphasis on creating a unique and personalized buying experience for the consumer, and that is when consumers are willing to spend. Widespread fake news can also damage the brand name, which will reduce the trust levels consumer has in the brand and ultimately will result in a decline in the consumer spending pattern on internet aggregator platforms. For example, considering there is a circulation of fake news regarding a food brand, there are chances that this would affect consumers' trust levels, and it might create a perception that the product is unfit for human consumption, which would, in turn, decrease the consumer spending".*

Table 4 Themes for RQ3

S. No.	Themes	Percentage
3.1	Compensatory consumptions	20%
3.2	Personalized buying experience	17%
3.3	Decrease in the trust level	16%

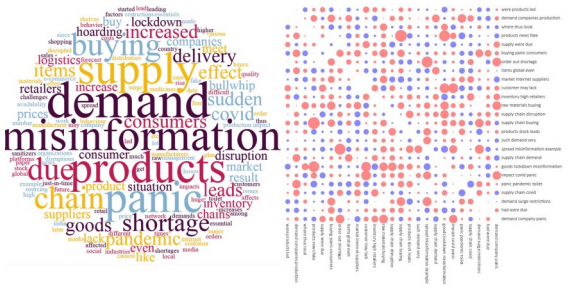

Fig. 4 Word cloud and correlation heat map among the topics for RQ4

Respondent 16: "*Over time, such misinformation has made the end consumer skeptical regarding the information reliability. The brands are now emphasizing creating a unique and personalized buying experience for the consumer to stand out in the competition of panic hygienic consumer spending."*

Table 4 shows the themes for RQ3.

RQ4.*Misinformation-induced panic buying by consumers creates disruption in the supply chain of products.*

The word cloud in Fig. 4 for RQ4 depicts that "demand" is the word which is highlighted the most by the respondents followed by misinformation, supply, products, panic, buying, chain, shortage, and goods, etc. these words were used for forming the themes while taking assistance of thematic analysis. The correlation among the themes emerging is also shown in Fig. 4. The major themes which emerged under RQ4 are logistics and transportation bottleneck (21%), fear-induced panic buying (18%), labor shortage due to migration and plant closures (17%), and bullwhip effect in supply chains (15%).

Quoted below are some instances from the respondents' answers-.

Respondent 4: "*Due to the misinformation and panic buying, different segments of food supply chains, affecting the farm production, food processing, transports and logistics, and final demand. All the sectors were not affected and different portfolios of products experienced disruption at different stages of the supply chain. Labors working in these sectors were under the influence of fake news from various sectors, and they left their work and the companies found it difficult to meet the high demand from the consumers' Seasonal food like Mushroom, were not having sufficient leader to meet the demands. Fruits and vegetables were rotting down due to the bottlenecks in the logistics. Import and export of the products were hampered due to the rules imposed in transportation".*

Respondent 16: *"Even if the manufacturers were able to produce the goods the lead time for getting the orders on selves was not good enough to meet the high demand due to logistics incapability. The high demand for improved logistics gave rise to new 3PL players that collaborated with organizations to deliver the products on time".*

Table 5 shows the themes for RQ4.

Figure 5 represents the nomological network of association of topics across the research questions. Topic summarization was undertaken separately on the interviews for each ques-

Table 5 Themes for RQ4

S. No.	Themes	Percentage
4.1	Logistics and transportation bottleneck	21%
4.2	Fear induced panic buying	18%
4.3	Labor shortage due to migration and plant closures	17%
4.4	Bullwhip effect in supply chains	15%

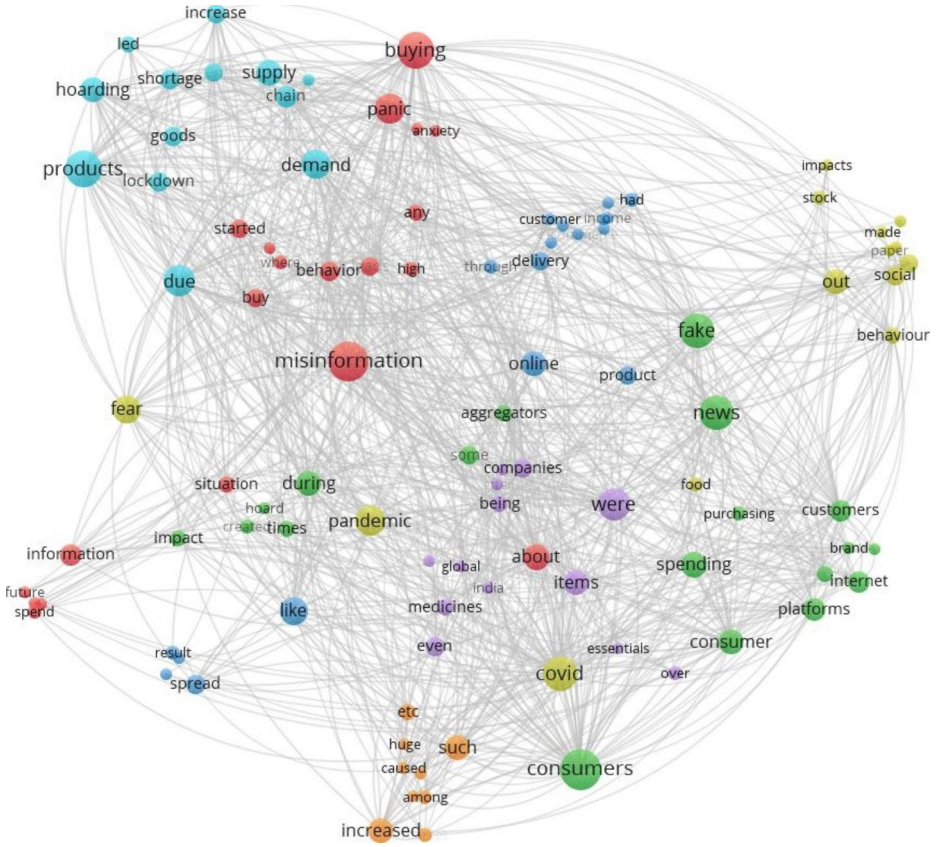

Fig. 5 Nomological network of association of topics across RQs

tion and based on the topic summarization and topics were identified using LDA. After identifying the topics with LDA, connect among the topics were explored using the network diagram based on the association (among the topics). The network demonstrates association of various topics across the themes which were analyzed. Some of the clusters which emerged are represented by different colors in the nomological network. Our analysis demonstrates that we had synthesis among the cluster of topics i.e., association among the topics and the themes that we identified from our analysis. This helped in identifying major themes from the topic modelling using the LDA, which further helped in extracting the core focus of the transcripts. The nomological network of the words associated with the elicited topics

indicate that the themes are closely related and there is connect among the themes. There are no themes which are cut off from the main network and the themes appear strongly clustered.

Further methodological triangulation has been used to test validity through the convergence of information from the experts. The inter-topic association connects the topics generated from the different research questions based on text summarization. How the topics form a cohesive network of discussions and they are coupled with a central theme of misinformation is visible from the above network analysis among the topics. So this presents a thematic ynthesis of how panic buying was related to misinformation (which forms a centroid) and how fake news led to over spending on specific commodities like over the counter medicines.

The research questions have been answered and addressed by analyzing them in Nvivo as well as text mining using Python / Orange for topic extraction and inter-topic association. A mix of qualitative content analysis and text mining was employed to make the thematic convergence evident from the collected data. This was further supported by evidence present in grey literature, validating our findings from interviews.

6 Discussion

In subsequent subsection we provide a detailed discussion surrounding the contribution of our study.

6.1 Contributions to literature

The first three RQ attempt to delve deep into multifarious impacts of circulation of fake news on consumer buying behavior, fear-induced product hoarding (by consumers), and irrational consumer spending. Covid 19 can easily be termed as the first pandemic in the age of information overload and due to the dire need for virality and sensationalization of information, fake news donned the avatar of the second epidemic (infodemic) of 2020. It had far-reaching ramifications on consumer buying behavior. The major themes which emerged for RQ1 are a shift to online buying, two contrasting spending intentions namely financial security, and compensatory consumptions, and irrational panic buying. Consumer purchasing activity is bound to be affected by the uncertain economic scenario created by the global pandemic. There were concerns about long-term financial security Vis a Vis the 'live it while it lasts' attitude. The consumers were consequentially displaying two contrasting spending intentions, the desire to save money and the desire to overindulge and spend on things looking for a 'feel good' factor. The over-purchasing and hoarding of necessities are common consumer responses in a crisis situation based on collective wisdom generated from social interactions. This panic situation results in the breakdown of the social order and consequential hoarding in anticipation of supply-side scarcity. This can be observed as a rational survival strategy. This behavior can be termed as 'panic buying' culminating in temporary shortages and price rise of essentials like toilet paper and non-Covid medicines like Hydroxychloroquine. Another notable impact on consumer buying behavior was the shift towards e-commerce sites. There was a sudden spurt in online shopping. There were also some negative behavioral manifestations like there was misinformation about the origin of

the virus from China, which reinforced inherent biases in people resulting in xenophobia against Chinese people and products. These themes are in sync with evidence in the extant literature, for instance, findings by Balmas (2014) and Laato et al., (2020). Then Wen et al., (2020) and Weinstein (1988) have also investigated individuals' unusual behavior during pandemics and outbreaks. The extent of ambiguity of the situation determines the extent of risk mitigation by individuals (Brug et al., 2009; Laato et al., 2020) have also purported that online information sources led to increased information overload and cyberchondria, influencing people's intention to make unusual purchases while voluntarily self-isolating.

The major themes which emerged for RQ2 are herd mentality induced excessive buying, uncertainty/ambiguity of government protocol and norms, and social media fraudulent practices and misinformation dissemination. Hoarding has emerged as a psychiatric condition during the pandemic. As a consequence of social learning, rational consumers also joined the panic buying frenzy. Fear-induced negative perception, dread of the unknown, coping behavior, and social psychology are the underlying causes for excessive buying. There was a huge quantum of fake news in circulation on various social media platforms, and this news was spreading like wildfire (Ramanathan et al., 2017). This dissemination of fake news resulted in a perceived scarcity of essential as well as hygiene-related products. This perception further instigated consumers with a hedonic mindset, who tend to seek gratification in ownership of scarce or unique products. Excessive buying also helped consumers to relieve their fear-linked anxiety. There was also a lot of misinformation being circulated about false remedies for Covid-19 and the harmful side effects of vaccines. Herd mentality was also instrumental in instigating excessive buying, due to a collective social concern. There was massive information asymmetry related to ambiguous government protocols. There were abrupt lockdown announcements creating psychological uncertainty and panic amongst people who resorted to panic buying on online platforms. The loss aversion psychology of people came to the fore in light of sensational fake news propagation and the prevalence of uncertainty in government norms and policies. These themes find support in literature as well, in the form of research findings by Wen et al., (2020), Weinstein (1988), Brug et al., (2009) and Laato et al., (2020). Also, these findings further buttress conclusions drawn from experimental studies by Di Domenico et al. (2020) and Kim et al., (2019).

The noteworthy themes for RQ3 were compensatory consumption, personalized buying experience, and overall reduced trust in news and marketers. The consumer buying patterns on eCommerce platforms can be justified as a compensatory response process for easing fear and anxiety instigated by external events like fake news circulation. Hence, on one hand, there was a tendency to save due to a plethora of insecurities and uncertainty, and on the other, there was a desire to occasionally indulge oneself with certain luxury items, which can be termed as compensatory consumption. The rampant misuse of news platforms and unethical business practices during the pandemic created an atmosphere of lack of trust and belief. Also, consumers became increasingly discerning and started seeking personalized buying experiences. These themes find support in extant literature in studies by Balmas (2014), Laato et al., (2020), and Brug et al., (2009).

All the emergent themes for RQ1, RQ2, and RQ3 are aligned with the consumer decision theory and further the cognitive load theory (Sweller, 2011), in terms of explaining the psychological and behavioral responses displayed by the consumers. In sync with the tenets of this theory, the respondents in the current study display an array of irrational behavioral responses like hoarding of essential products, compensatory consumption, herd mentality,

excessive panic buying. This theory also states that the human brain suffers from cognitive overload (when bombarded with excessive information), due to its limited cognitive capacity. This overload leads to stress in human beings, which in turn may result in cognitive processing such that it instigates adverse or irrational behavioral responses. The internal and the external stimuli (consumer decision theory) may push the consumers towards certain reactions, however, herd mentality may prevail and group characteristics and behavior may further enhance panic buying (amongst consumers) as well as hoarding of products.

The prominent themes for RQ4 were logistics and transportation bottleneck, labor shortage due to migration and plant closures, and bullwhip effect in supply chains. The misinformation-induced panic buying by consumers created major supply chain disruptions. This instigated a chain reaction leading further to panic buying, due to shortage of scarcity perception. This further upset the demand-supply equilibrium, caused largely by lockdowns, disruptions in manufacturing processes, and shortage of labor forces. Labor shortages and plant closures hampered processing. Then there were major bottlenecks in transportation and logistics, creating sourcing issues and constraints in inventory management and replenishment. There was major uncertainty brewing in the supply chains of a large number of products (essential and otherwise). This uncertainty created a bullwhip effect, which is a consequence of minor fluctuations in retail demand levels, which progressively result in bigger demand fluctuations at the level of distributor, wholesaler, manufacturer, and suppliers of raw material. Supply chains are forecast-driven, any change occurring even in anyone link along the supply chain will result in a multiplier effect in the remainder of the supply chain. There are several contributing factors causing a bullwhip effect in supply chain management. In the current business environment, disasters like the recent pandemic have caught the attention of researchers as well as practitioners with reference to vulnerabilities in the supply chain. Researchers have attempted to identify and prioritize these factors. If these vulnerabilities can be evaluated rationally, it helps professionals to devise effective mitigation strategies for increasing the robustness of supply chains (Chaudhuri et al., 2021; Sharma et al., 2021; Sanders et al., 2019; Choi et al., 2020; Kamble et al., 2021). The entire phenomenon has been conceptually represented in Fig. 6.

The occurrence of the echo chamber effect is instigated by a harmonious group of individuals, who amalgamate and develop a narrow vision. Discussions on social media can culminate into an echo chamber, a situation where a particular set of beliefs are amplified by ongoing communication and repetition, without encountering any opposing views. This may potentially result in a confirmation bias. During the pandemic, consumers constrained within their houses (due to the lockdown) engaged in active online discussions and found their opinions and views constantly echoed back to them. This echo reinforced their individual belief systems, since there were no contrasting views. Also there was a large amount of fake news being circulated on various media platforms. These misplaced belief systems thereafter culminated into a confirmation bias regarding the pandemic and the associated uncertainty and ambiguity. This consequentially set off a chain reaction leading to shifting consumer preferences to online buying, irrational panic buying and hoarding, contrasting spending intentions, compensatory consumption, decreasing trust, demand for personalized buying experience, logistics and transportation bottlenecks, labor shortage and the bullwhip effect in supply chains (Tornberg, 2018; Cinelli et al., 2021).

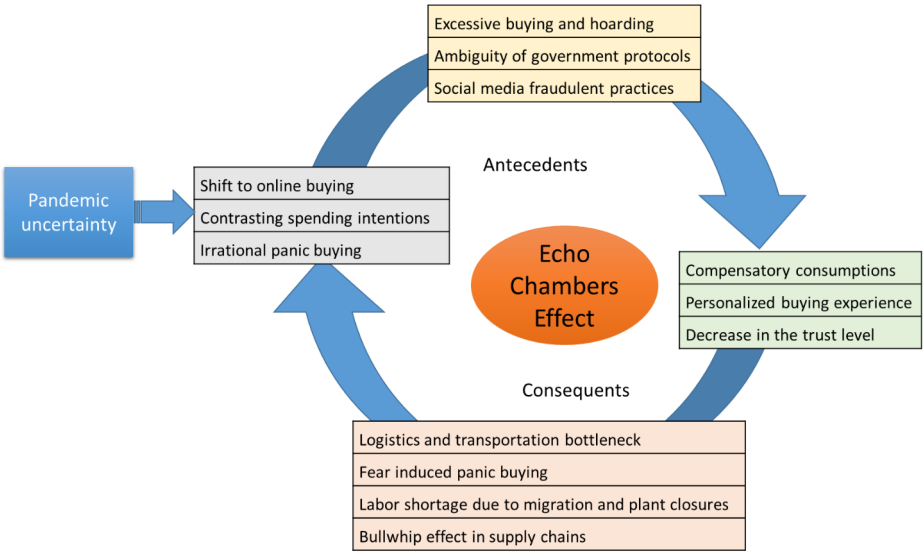

Fig. 6 Cyclical echo chamber's effect

6.2 Managerial implications

As the global economic situation is in a state of evolution, the economic and societal costs will be huge. The pandemic has brought forth vulnerabilities in global supply chains across most sectors and industries. Most organizational supply chains are designed on the premise that there will be a smooth flow of materials. The pandemic has however shattered this premise and has resulted in widespread disruptions in supply chain performance. The majority of the organizations are in a reactive mode, with their prime focus being on maintaining supply and customer need satisfaction through hands-on rigor. However, a retrospective analysis will be required at some point in order to better prepare for tomorrow. A strategy needs to be devised to avoid perpetual reaction to future "black swan" situations. There needs to be preparedness for future readiness to meet unpredictable, yet inevitable, disruptions (Zhang et al., 2022; Mahmud et al., 2020).

The practitioners need to build resilience in their supply chains. The pandemic has greatly emphasized the need to not only strengthen global supply chains and networks but also work towards long-term resilience. Supply chains should be dynamic, responsive, and interconnected to an organization's processes as well as ecosystem. This enhanced agility and the ability to rapidly redeploy strategy can help dissipate disruptions caused by unanticipated events. Supply chain processes can be transformed into intelligent workflows, enabling new levels of responsiveness and uncovering efficiencies across a network of partners and processes. This requires real-time insights, complete transparency, and decisive actions—particularly in crisis situations.

Exponential technology interventions are the need of the hour and can help organizations build smarter supply chains and reduce vulnerabilities in unforeseen circumstances. Deploying AI as input for smart supply chains can leverage technological power helping organizations maintain business continuity amid disruption and uncertainty (Belhadi et al.,

2021; Ghosh & Sanyal, 2021; Grover et al., 2020). Augmentation as a result of technology interventions along with new smart supply chain workflows, supported by business platforms is capable of delivering exceptional outcomes (Deepu & Ravi, 2021). Process transformation can be deployed across the value chain, from planning the demand and executing the manufacturing process to orchestrating the order and fulfillment. Smart workflows will redesign the intersection of people, technology, and processes, thus enabling these supply chain professionals to carry out their tasks more effectively and efficiently, even as the environment remains in a state of flux, constantly making strategies obsolete and redundant.

6.3 Limitations and Future Research directions

The study has few limitations based on the approach and context, since this is undertaken based on interviews with stakeholders. The stickiness of the economy where the interview protocol was administered is present in our findings. Since the interviews were administered in India, the context and findings are generalizable to countries with similar levels of information diffusion, covid impacts and supply chain maturity. In general, therefore these findings can be thought to be generalizable to the BRICS nations where these contexts occurred at comparable scale. However future research may explore to reinvestigate this in other countries where diffusion of information, social networks and maturity of supply chain systems are different.

7 Conclusion

Social media platforms (Twitter, Facebook, WhatsApp, and YouTube) were major contributors to the widespread dissemination of fake news during the pandemic. This being an unprecedented event whereby such a large scale pandemic happened in an era where information dissemination was so easy with digital media platforms, the impact of misinformation was heavily realized on the supply chain of many firms. In this context, our study uses a qualitative research methodology to identify the antecedents and consequents of misinformation in the supply chains of direct to customer retail industry. A larger conceptual framework has also been proposed based on the study undertaken which helps us to better understand and manage the disruption.

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