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COVID-19, consumer behavior, technology, and society: A literature review and bibliometric analysis

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ABSTRACT

The COVID-19 crisis is among the most disruptive events in recent decades. Its profound consequences have garnered the interest of many studies in various disciplines, including consumer behavior, thereby warranting an effort to review and systematize the literature. Thus, this study systematizes the knowledge generated by 70 COVID-19 and consumer behavior studies in the Scopus database. It employs descriptive analysis, highlighting the importance of using quantitative methods and China and the US as research settings. Co-occurrence analysis further identified various thematic clusters among the studies. The input-process-output consumer behavior model guided the systematic review, covering several psychological characteristics and consumer behaviors. Accordingly, measures adopted by governments, technology, and social media stand out as external factors. However, revised marketing strategies have been oriented toward counteracting various consumer risks. Hence, given that technological and digital formats mark consumer behavior, firms must incorporate digital transformations in their process.

1. Introduction

The COVID-19 pandemic is among the most relevant events of recent decades. Its social and economic consequences on a global level are enormous. At the social level, the World Health Organization (WHO) has reported over four million global deaths due to COVID-19 (WHO, 2021a). Economies have also been severely affected (Donthu and Gustafsson, 2020). The International Monetary Fund (IMF) predicts that the gross domestic product, worldwide, will plummet to about 4.9% in 2020 (IMF, 2020). These remarkable social and economic implications of the pandemic and its unique features have inspired many studies from various disciplines, including consumer behavior. The crisis scenario has profoundly shifted consumer behavior toward one based on technology (Sheth, 2020).

In prior pandemics, social and behavioral science research focused heavily on preventive and health behavior, while consumer behavior received less attention (Laato et al., 2020). The situation has been different for the COVID-19 pandemic; COVID-19 and consumer behavior studies proliferate the literature. Reasonably, such rapidly accumulating bodies of knowledge require organization and systematization, lest such knowledge produced in fast-growing fields remains fragmented (Snyder, 2019). Thus, this study fulfills this need by identifying knowledge generated by 70 relevant studies in the Scopus database, indexed up to January 5, 2021, for systematic processing.

Prior theoretical efforts created a global and general perspective of consumer behavior during the COVID-19 pandemic. Such efforts have sought to propose possible stages in behavior, comparing old and new consumption habits, or explain behaviors based on similarities with other crises and disruptive events, such as other pandemics, wars, or natural disasters (e.g., Kirk and Rifkin, 2020; Sheth, 2020; Zwanka and Buff, 2020). However, this study is evidently among the first to review the literature on COVID-19 and consumer behavior. The study is necessary because, beyond its similarities with other disruptive events, the COVID-19 crisis has several fundamental differences. First, it is truly

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global (Brem et al., 2020). Second, it coincides with the rapid advance of various disruptive technologies, the confluence of which has been called "digital transformation" (Abdel-Basset et al., 2021).

First, the study conducts descriptive and bibliometric analyses of the 70 selected COVID-19 and consumer behavior articles. Second, an input-process-output consumer behavior model is used to systematize the existing literature. The model, adapted by Cruz-Cárdenas and Arévalo-Chávez (2018) from Schiffman and Wisenblit (2015) for systematic reviews, furnished a comprehensive understanding of the pandemic-era consumer behavior via macro-environmental, micro-environmental, and internal-consumer-factor integration.

Accordingly, government regulations and technology stand out as fundamental forces at the macro level. At the micro-level, specific technological applications like social media and business platforms, social group and family pressure, and marketing strategies stand out. Meanwhile, many personal and psychological characteristics help us to understand how consumers process external influences and make decisions at the consumer level. Finally, regarding purchasing behaviors, the use and adoption of technologies like e-commerce platforms have had a prominent place in consumer behavior during the pandemic.

The remainder of this paper is organized as follows. Section 2 presents the construction of a theoretical framework on consumer behavior and disruptive events. The method is explained in Section 3. Section 4 presents the descriptive and co-occurrence bibliometric technique results of generating an understanding of the literature interrelationships and characteristics. Section 5 documents the systematization and grouping of the knowledge generated based on an input-process-output model of consumer behavior. Finally, Section 6 concludes with the main implications and scope for future research.

2. Consumer behavior and disruptive events

Many consumer and human behavior studies in the context of disruptive events precede the COVID-19 pandemic. The term "disruptive event" is a situation that leads to profound changes regarding the unit analyzed (Dahlhamer and Tierney, 1998). Thus, it can apply to individual consumers, organizations, industries, or society. Disruptive events can also be classified by their nature (e.g., pandemic, war, natural disaster, and personal calamity).

At the personal level, prior studies establish that in the aftermath of calamities or unfavorable events, such as the death of loved ones, divorces, and illness, consumers get rid of products that remind them of difficult times and, thus, buy new products (Cruz-Cárdenas and Arévalo-Chávez, 2018). Although such disruption studies are interesting, they fail to shed enough light on consumer behavior during the COVID-19 crisis. On a larger scale, past disruptive events—such as other pandemics, natural disasters, or extreme social violence and terrorism—can contribute to understanding the pandemic-induced consumer behavior, because they affect a greater number of consumers simultaneously and in similar fashion.

Natural disasters like earthquakes, floods, hurricanes, and typhoons are frequent. They cause damage to infrastructure, economy, and human lives, thereby creating a permanent field of consumer behavior studies. Some natural disasters are carefully monitored, and their arrival and intensity can be anticipated (e.g., hurricanes). The anticipation of such events induces a behavior of stockpiling basic necessities (Pan et al., 2020). Others cannot be anticipated in the short term (e.g., earthquakes). In both types of natural disasters, consumers may lose possessions and loved ones. The feeling of loss induces impulsive, therapeutic, and replacement purchases (Delorme et al., 2004; Sneath et al., 2009). Natural disasters are primarily noted for their destructiveness and scope, which can reach regional levels.

Extreme social violence and so-called terrorism constitute another category of disruptive events affecting a country or region. Terrorism comprises violent actions by a group with less power that seeks to destabilize a government or a dominant organization (Bates and LaBrecque, 2019). Such violent actions often impact human lives and negatively affect the economy and physical infrastructure. Moreover, their intensity and frequency in society are highly variable.

Table 1
Disruptive events, their characteristics, and effects on the consumer.

Disruptive event type	Features and impact	Effects on consumer behavior
Natural disasters	Some may be anticipated; others may not. They have a variable scope (local, national, or regional). They destroy physical infrastructure, damage the economy, and induce the loss of human life.	Impulsive, therapeutic, replacement (Delorme et al., 2004; Sneath et al., 2009), and stockpile (Pan et al., 2020) purchases
Terrorism	It has a variable influence (local to national). It causes deliberate destruction of physical infrastructure, damage to the economy, and loss of human life.	Short-term effects and avoidance behavior (choosing an alternative or substitute consumption) (Herzenstein et al., 2015)
Disease outbreaks prior to the COVID-19 pandemic	They have a variable scope (local, national, or regional); they negatively impact the economy and human life. They do not cause damage to the infrastructure.	Collecting essential, protective, and hygiene products (Goodwin et al., 2009); Change in consumption patterns of leisure activities (Wen et al., 2005)

Although terrorist actions significantly affect the economy and infrastructure, the impact on consumer behavior is in the short term (Baumert et al., 2020; Crawford, 2012), which induces an avoidant behavior, due to certain consumption options they consider to be of greater risk; that is, consumers choose an alternative option rather than give up their plans or consumption (Herzenstein et al., 2015) (e.g., the choice between air and land travel or a destination change for tourism). The selection of consumption alternatives hinges on past events and anticipated threats (Baumert et al., 2020).

Prior outbreaks from recent decades like SARS, Influenza A, and H1N1 present another type of disruptive event, which consumer behavior scholars have largely ignored (Laato et al., 2020). Current knowledge on human behavior during disease outbreaks stems from other social and human sciences. Thus, two consumption-behavior types have been noted: purchasing necessities and protective equipment, and curbing leisure outside the home. For example, Goodwin et al. (2009) find that the purchase of protective items (e.g., masks and personal hygiene items) and food rose significantly during the influenza A, and H1N1 outbreaks, as people engaged in stockpiling. However, regarding SARS in China, Wen et al. (2005) found that people altered their leisure activities, modes of transportation, and the places they visited. Table 1 summarizes the features of prior disruptive events and the relevant knowledge regarding consumer behavior therein.

The COVID-19 pandemic, like other prior disruptive events, has significantly impacted the economy and human life (IMF, 2020; WHO, 2021a). However, unlike natural disasters and terrorism, it (similar to prior disease outbreaks) does not damage physical infrastructure. Further, it is characterized by its persistence (the current pandemic has continued for a year and a half). Even so, the COVID-19 pandemic is unique in its global scope (WHO, 2021b). Moreover, it occurs within the context of significant technological advancement, known in the business and organizational world as "digital transformation" (Abdel-Basset et al., 2021).

Against this comparison, prior to the systematic review, consumer behaviors reported in other disruptive events probably occurred on a large scale. However, the scope of the COVID-19 pandemic and technological advancement is expected to provide a distinctive character to consumer behavior, caught between the unique confluences of the two.

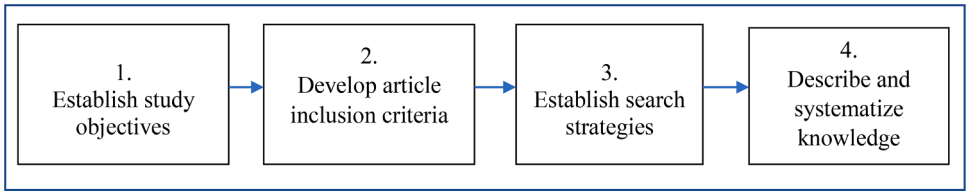


Fig. 1. Stages of this study.

3. Method

This study was developed in a series of stages, common to systematic literature reviews (Balaid et al., 2016; Cruz-Cárdenas and Arévalo-Chávez, 2018: Osobajo and Moore, 2017) (see Fig. 1).

3.1 Study objectives

Regarding Stage 1, this study primarily describes and systematizes the existing literature on consumer behavior during the COVID-19 pandemic. This objective can be broken down into three specific objectives. Thus, this study aims

- O1: To describe the characteristics and interrelationships of relevant studies
- O2: To generate a structured systematization of their contents and results
- O3: To establish the limitations and gaps in existing knowledge, thereby ascertaining the scope for future lines of research

Accordingly, recognizing the multidisciplinary nature of consumer behavior, researchers from marketing, business administration, psychology, and economics teamed up to bring together experts in diverse research methodologies, such as machine learning and big data techniques. The study commenced when COVID-19 became a pandemic in March 2020.

3.2 Criteria for inclusion of articles

The study developed several article-inclusion criteria. Importantly, studies must address COVID-19 only from the perspective of consumer behavior. Thus, it was important to differentiate consumer behavior from other types of human behavior in the COVID-19 framework. Consumer behavior encompasses people's behavior in their search, purchase, usage, and disposal of goods and services (Schiffman and Wisenblit, 2015). Further, articles must have an acceptable quality level, be written only in English, and have no time restriction on the date of their publication.

3.3 Search strategies

The search strategies were then developed, operationalizing the inclusion criteria. The study drew from the Scopus database, which offers a good balance between quality and coverage (Singh et al., 2020). The search terms aimed to extract two central contents simultaneously: the COVID-19 pandemic and consumer behavior. The search process was initiated with the following terms: Covid AND (consum* AND behav*). The asterisk in the terms allowed for including variants of the keywords such as: consumer, consumers, consumption behavior, and behavior. Additionally, the search scanned the titles, abstracts, and keywords of the documents.

As the search process progressed, other terms were added, because they were also used significantly by relevant articles; this was particularly important because there was no consensus regarding the name for the pandemic at its inception. Hence, regarding the pandemic, alternative terms included "Covid-19," "Sars-Cov-2," "Pandemic," and "Coronavirus." Similarly, regarding consumer behavior, "marketing," "purchasing," "shopping," and "buying" were the alternative terms.

The search process involved reading the titles and abstracts of the outputs generated for an initial and main debugging. A second purification was then conducted. Among the biggest search challenges was that, although some articles addressed consumer behavior and included "Covid" or its synonyms in their titles, keywords, and abstracts, as well as their topic incorporation, they were unclear. The situation is attributed to a temporal coincidence with the COVID-19 crisis, rather than a deliberate intention of studying its effects on consumer behavior. From the start of the study to its culmination on January 5, 2021, 347 articles were reviewed, of which 70 relevant articles were selected after

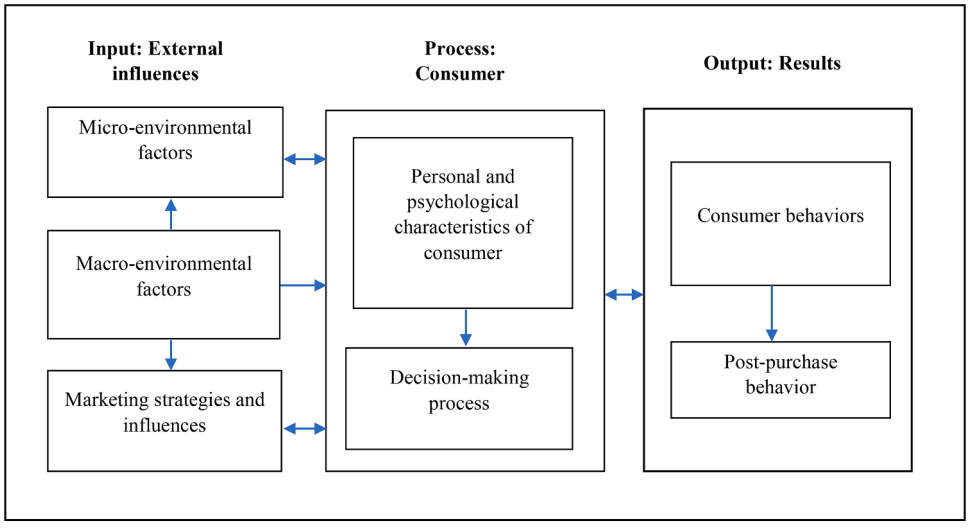


Fig. 2. Generic model of consumer behavior. Adapted from Schiffman and Wisenblit (2015) and Cruz-Cárdenas and Arévalo-Chávez (2018).

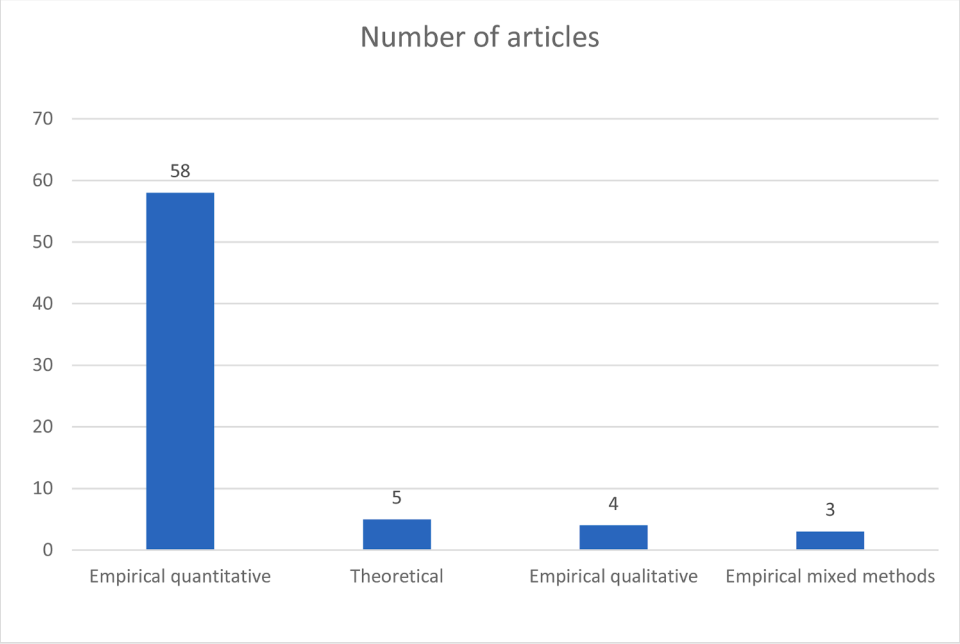


Fig. 3. Number of articles according to their methodology.

satisfying the inclusion and search criteria.

3.4 Method describing and systematizing the literature

The study employed various bibliometric and literature systematization techniques, to describe the characteristics and interrelationships of the 70 articles and systematize their content. Bibliometric techniques estimated the main descriptive statistics of the relevant body of knowledge. Further, a visual analysis of co-occurrence was performed.

The study used content analyses of the generated knowledge and findings to systematize the literature (Kaur et al., 2021), seeking a knowledge organization structure. The search focused on identifying a widely accepted model of consumer behavior. Thus, the selected model was the input-process-output model of Schiffman and Wisenblit (2015), modified by Cruz-Cárdenas and Arévalo-Chávez (2018) to apply to literature reviews on consumer behavior topics. This model is employed in empirical research (e.g., Ting et al., 2019).

Fig. 2 presents the generic model. The left of the model presents the external influences or stimuli, processed and interpreted as per the personal and psychological characteristics of the consumer at the center of the model. The consumer also follows a decision-making process. Finally, the right of the model yields the results or outputs: the purchase and post-purchase behaviors. Furthermore, this study incorporates arrows connecting macro-environmental to micro-environmental forces, marketing strategies, and the consumer. It highlights that the macro-environment spans the entire model (Kotler and Keller, 2016).

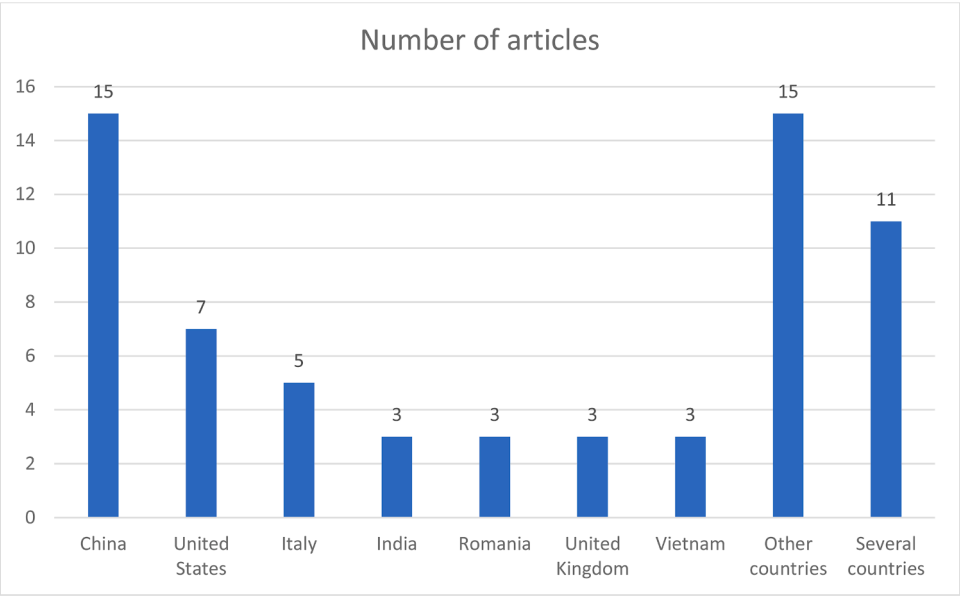


Fig. 4. Number of empirical articles according to their study setting.

Table 2
Journals in which reviewed articles were published.

Journal	Number of articles
Sustainability	7
International Journal of Environmental Research and Public Health	5
Journal of Retailing and Consumer Services	5
British Food Journal	2
Food Security	2
International Journal of Hospitality Management	2
Journal of Business Research	2
Journal of Economic and Social Geography	2
Journal of Integrative Agriculture	2
Nutrients	2
Other Journals	39
Total	70

4. Descriptive and bibliometric analysis

4.1 Descriptive analysis of relevant articles

Table A.1 presents the 70 relevant articles, among which 57 were published in 2020; 12, 2021; and one, in press. Fig. 3 shows the number of articles per their methodology. Most articles (58 articles or 82.9%) employ quantitative empirical approximations, followed by studies with a theoretical approach (five articles or 7.1%). Notably, few studies employed qualitative or mixed methods (5.7% and 4.3%, respectively).

This marginal use is likely for the following reasons. First, societies and funders exert time constraints for fast and conclusive results. Second, there are many studies on consumer behavior and the adoption of technologies before the COVID-19 pandemic. Third, the rise in machine learning methods, particularly natural language processing, allows for processing significant textual social media data using artificial intelligence (Géron, 2019).

Considering only the 65 empirical studies, Fig. 4 presents the main countries where data was collected. China has 15 articles (23.1%), followed by the US, with seven articles (10.8%), and Italy, five articles (7.7%). Next are India, Romania, the UK, and Vietnam, each with three articles (4.6%). Others attracted 15 articles (23.1), and 11 articles (16.9%) had several countries simultaneously as study settings, either because they deliberately chose several countries or studied social media. China's dominance as a study setting can be attributed to its status as the origin of the pandemic. However, it can also be attributed to China's rapid growth in the scientific field.

Table 2 presents the journals in which the articles were published. Most articles appeared in three major journals: *Sustainability* had seven articles (10%), and the *International Journal of Environmental Research and Public Health* and the *Journal of Retailing and Consumer Services* each had five articles (7.1%), respectively. Notably, several journals not traditionally linked to consumer studies or marketing are represented, probably because of the multidisciplinary character of consumer studies (Schiffman and Wisenblit, 2015).

While the selected articles examined various products, food was the main preference in 29 articles (41.4%). Other products, studied to a lesser extent, included personal hygiene items, hotels, and the banking sector. Further, the studies widely employed two theories: the theory of planned behavior (TPB) (Ajzen, 1991) and the technology acceptance model (TAM) (Davis, 1989).

TPB stems from psychology, and it asserts that attitude toward behavior (personal view on behavior), subjective norm (perceived social pressure to act), and perceived behavioral control (difficulty in acting) determine the intention of a person to act out a behavior. This behavioral intention then determines whether the behavior occurs (Ajzen, 1991). TAM stems from Information Technology and draws from TPB; it indicates that a user's acceptance of new technology is determined by the perceived usefulness and ease of use (Davis, 1989). TPB and TAM are general theories that allow for much flexibility in application. The two theories and their many variants are widely used in consumer behavior research and, particularly, cases of a new product, service, and technology acceptance (Lin and Chang, 2011; Schmidthuber et al., 2020).

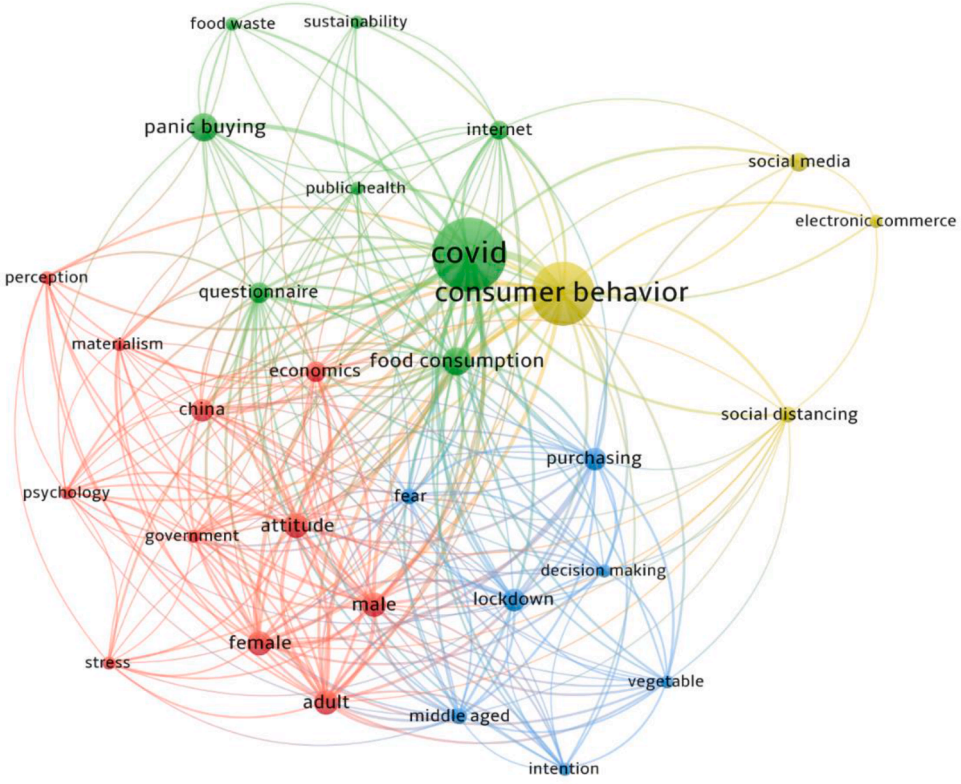


Fig. 5. Co-occurrence network of articles based on keywords.

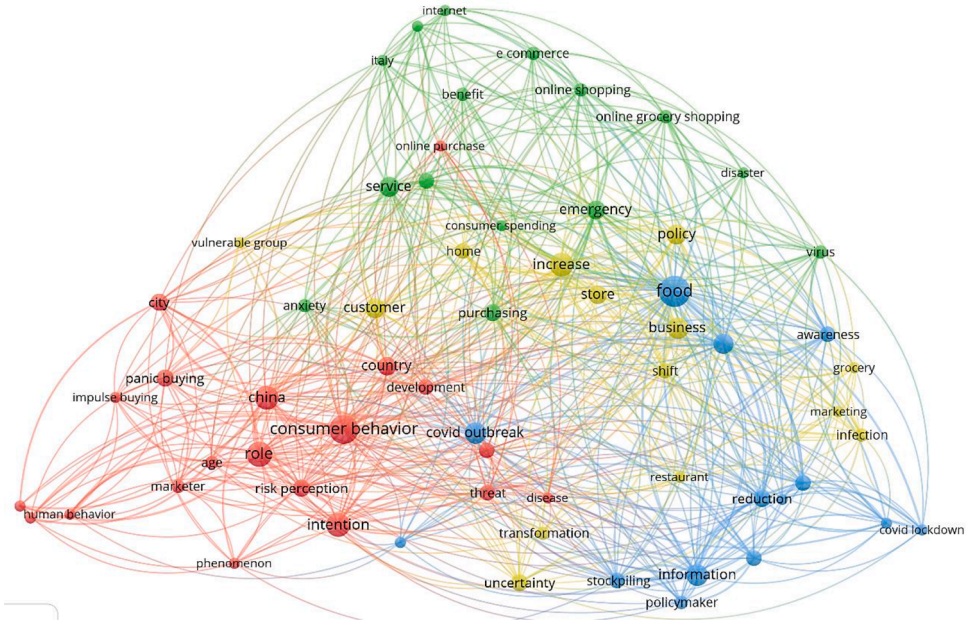


Fig. 6. Co-occurrence network of articles based on titles and abstracts.

Considering the prevalence of TPB and TAM, and their variants in consumer studies prior to COVID-19 (particularly regarding technologies) coupled with the massive popularity of technologies during the pandemic (Baicu et al., 2020: Sheth, 2020), the dominance of the two theories in this study is not surprising. Furthermore, they also explain the popularity of quantitative methods in the selected studies, and by specifying a set of directional relationships, they allow for testing the proposed models via structural equation modeling (Kline, 2016). The studies reviewed largely model consumer purchasing behaviors in technological environments and include fear or concern about COVID-19 as an additional variable, either in an exogenous or moderating variable role.

4.2 Analysis of the co-occurrence

The study employed co-occurrence analysis to establish the topics of interest in the set of articles on COVID-19 and consumer behavior. The analysis was performed in two ways to obtain more reliable results: keyword-based and title- and abstract-based.

First, we sought to identify the clusters formed based on the co-occurrence of keywords in the set of articles (Singh et al., 2020). We employed VOSviewer 1.6.15 (VanEck and Waltman, 2010) for this analysis. VOSviewer suggests, by default, a minimum number of five occurrences for a term to be considered. However, we set this number to three, given the relatively small number of articles. Generic terms like "article" and "study" were removed during the data cleanup. Additionally, similar terms were grouped into a single term (van Eck and Waltman, 2010, 2020), such as "Covid-19," "Covid," and "pandemic." Fig. 5 shows the obtained clusters. The nodes represent keywords or concepts, while their size corresponds with their frequency (van Eck and Waltman, 2010, 2020). VOSviewer represents each cluster of keywords or concepts with a different color.

Cluster 1 (yellow) has "consumer behavior" as a prominent node and groups together other keywords such as "social distance," "social media," and "electronic commerce." Thus, the cluster is related to purchasing behavior during the COVID-19 pandemic, which is strongly marked by technology use. Cluster 2 (green) has the term "COVID-19″ as its central node. It gathers terms such as "public health," "food waste," "food consumption," "sustainability," and "panic buying." Hence, this cluster regards the consumption and handling of food during the COVID-19 pandemic. Cluster 3 (blue) has no central node. However, "fear," "decision making," and "purchasing" suggest a cluster focused on the purchase decision process. Finally, Cluster 4 (red), while without a prominent node, is the most prevalent. Terms such as "materialism," "adult," "attitude," and "psychology," "government," and "economics" suggest that this cluster is mainly about macro, micro, and internal influences on the consumer.

Further, to allow for greater context richness, the second analysis was based on the titles and abstracts of selected articles (VanEck and Waltman, 2010). Similar to the procedure based on keywords and with the same criteria, the minimum number of occurrences of words was set to three. The data was also cleaned by elimination or grouping (VanEck and Waltman, 2010). For example, generic or irrelevant words, such as "article," "item," "author," and "study," were eliminated. However, similar terms were grouped together, as in the case of "covid," "covid-19," and "pandemic." Fig. 6 shows the results of the co-occurrence analysis based on titles and abstracts.

The analysis generated four clusters. Cluster 1 (red) had "consumer behavior" as a prominent node and included other terms like "risk perception," "threat," "panic buying," "impulsive buying," and "China." Thus, this cluster is related to consumer panic buying. Cluster 2 (green) had as prominent nodes "service," "emergency," "purchasing," and technology-related actions, such as "online shopping," "e-commerce," and "internet." Hence, it regards consumer behavior and the use of technology in purchases. Cluster 3 (blue) featured "food" as a prominent node and included other terms like "stockpiling," "covid lockdown," "covid outbreak," and "policymaker." Therefore, this cluster focused on consumer behavior in the purchase and handling of food under lockdown conditions. Cluster 4 (yellow) did not have particularly prominent nodes. It included customer," "infection," "policy," "home," "uncertainty," "business," and "reduction," showing that this cluster refers to the consumer subject to macro, micro, and internal influences.

The analysis of co-occurrence of keywords is similar to that of titles and abstracts in the dominance of the reviewed studies on Covid-19 and consumer behavior, thus increasing the confidence in the results. Accordingly, three fundamental areas can be identified: consumer behavior and technology use; purchasing and handling basic necessities, particularly food; and consumer subject to internal and external (micro and macro) forces. A possible fourth area may induce a discrepancy, putting the keyword analysis emphasis on the decision-making process

and the analysis of titles and abstracts in panic purchases.

5. Systematization of the relevant literature

This section presents the analysis and systematization of the 70 relevant studies. The authors used content analysis techniques to identify the main findings from the literature (Kaur et al., 2021). The relevant content is organized using the structure of the consumer behavior model in Fig. 2.

5.1 Macro-environmental factors

Macro-environmental factors affect the entire analytical micro-environment (Kotler and Keller, 2016). In this study, the micro-environment is built around the consumer, the center of the analysis. The consumer micro-environment is formed by organizations and groups of people close to the consumer (e.g., companies, the media, family, and friends).

Regarding COVID-19 and consumer behavior, five macro forces are fundamental: the COVID-19 pandemic and the technological, political-legal, economic, and socio-cultural environments. High importance is attached to COVID-19, the technological environment, and the politico-legal environment. Various studies indicate how the COVID-19 and available technology confluence has induced consumers to massively and rapidly adopt technologies and increase their consumption of highly digital business formats (Baicu et al., 2020: Sheth, 2020). Specifically, e-commerce and business platform formats solved possible shortage problems and allowed consumers to accumulate products (Hao et al., 2020; Pillai et al., 2020). Further, the technology allowed social lives to thrive amidst the pandemic, reflecting the increased use of social media platforms (Pillai et al., 2020).

The political-legal environment is strongly intertwined with economic performance. Significant legal regulations by many governments were enforced during quarantines, lockdowns, social distancing, and educational service closure (Yoo and Managi, 2020). However, not all governments resorted to lockdown measures. Regardless, economies fell in many areas because of consumer decisions (Sheridan et al., 2020). However, food and hygiene item purchases increased. In non-lockdown (lockdown) countries, consumers were guided by caution (anxiety and fear were) (Anastasiadou et al., 2020; Prentice et al., 2020).

Another very important aspect derived from the political-legal environment is trust in government institutions. Increased confidence in governments and their actions made consumers less likely to experience fear of food shortages and engage in panic buying (Dammeyer, 2020; Jeżewska-Zychowicz et al., 2020). Effective public announcements moderated the effects of negative feelings, such as anxiety and a sense of losing control in terms of panic buying (Barnes et al., 2021).

A diagnosis of the state of knowledge on macro-environmental factors allows for seeing a significant amount of research on political-legal and technological factors. However, the COVID-19 crisis is dynamic. Currently, many governments have halted lockdown measures, betting more on social distancing as a new mass vaccination phase emerges, which is worthy of exploration. Further, few studies address cultural issues during the COVID-19 crisis, even though culture is another determining force in consumer behavior.

5.2 Micro-environmental factors

As noted, the political-legal macro-environment of the COVID-19 pandemic is marked by lockdown and social distancing measures, while the digital transformation process marks the technological macro-environment. A logical consequence of their interaction is that the micro-environment (family, friends, acquaintances, society, the media, and companies) interacts with consumers through technology and digital media. Section 5.3 will discuss consumer interaction with businesses and companies.

During the COVID-19 crisis, consumers use information as a valuable factor in decision-making, as they actively or passively seek it. Social media is a common source of information. Popular topics regard food acquisition and storage, health issues, social distancing, and economic issues (Laguna et al., 2020). However, social media also induces panic buying, especially during lockdowns. Advice from associates, product shortage perceptions, the COVID-19 spread, official announcements, and global news inspired this behavior (Ahmend et al., 2020; Grashuis et al., 2020; (Jeżewska-Zychowicz et al., 2020); Naeem, 2021a). Further, the news, social media, and associates also influence technology use in purchases on company pages, platforms, or apps (Koch et al., 2020; Troise et al., 2021).

Therefore, despite contributing to panic buying, the mainstream news media and social media have also curbed the spread of COVID-19 (Liu et al., 2021). The extensive knowledge on the micro-environmental effects on consumer behavior was generated primarily due to previous non-relevant studies that focused on social media; they created a solid base of departure.

5.3 Marketing strategies and influences

Marketing influences are in the consumer's micro-environment. They are vital, because they are tools that companies can design and control. Thus, consumer behavior models usually consider them separately from other influences, such as those discussed in the preceding section. The main marketing tool is the product or service. Others are prices, distribution, and communication strategies.

Two key elements of marketing strategies during the pandemic are reducing various risks and increasing benefits perceived by the consumer. Two central risks marketing strategies must address are the risks of coinfection and conducting online transactions. Further, the reviewed studies address the forms of action regarding the two types of risks. Thus, while the perceived COVID-19 risk increases the probability of online purchases, the perceived risk of online purchases moderates this relationship (Gao et al., 2020).

Accordingly, using technology to digitize processes or products, and reduce physical contact with employees or other consumers, has encouraged consumer purchases during the COVID-19 pandemic. For example, technology that allows consumers to make reservations via smartphones or kiosks reduces the perceived health risk, thereby increasing the probability of hotel reservations (Shin and Kang, 2020). Moreover, state-of-the-art cleaning technology moderates the negative effect of staff interaction on service use intentions (Shin and Kang, 2020). Thus, technology guarantees cleanliness and minimal contact for the consumer. Further, the perceived risk of online transactions involves the possible misuse of personal information and financial fraud (Tran, 2021). Marketing strategies to reduce this risk have focused on building trust and image (Lv et al., 2020; Troise et al., 2021). Regarding the strategy duration, other recommended marketing strategies for e-commerce sites and platforms with less renown are increasing profits or reducing prices (Lv et al., 2020; Tran, 2021).

During the lockdowns in most countries, consumer demand centered on food products, personal hygiene, and disinfection. Thus, implementing or increasing promotions of non-priority items is a recommended strategy (Anastasiadou et al., 2020). Finally, regarding small businesses that use technology less intensively, the speed of adaptation and digital transformation are vital, even at basic levels. Many small businesses have survived by adopting elementary digital transformation strategies in the form of a mix of social media sales and home delivery services (Butu et al., 2020).

Hence, although there are interesting results, the transcendental importance of studies on marketing strategies within the framework of consumer studies deserves more research. Further, since the pandemic is dynamic, companies must adapt their strategies constantly. Notably, few studies employ case studies or experimental methodologies, which are appropriate for studying the effects of marketing strategies.

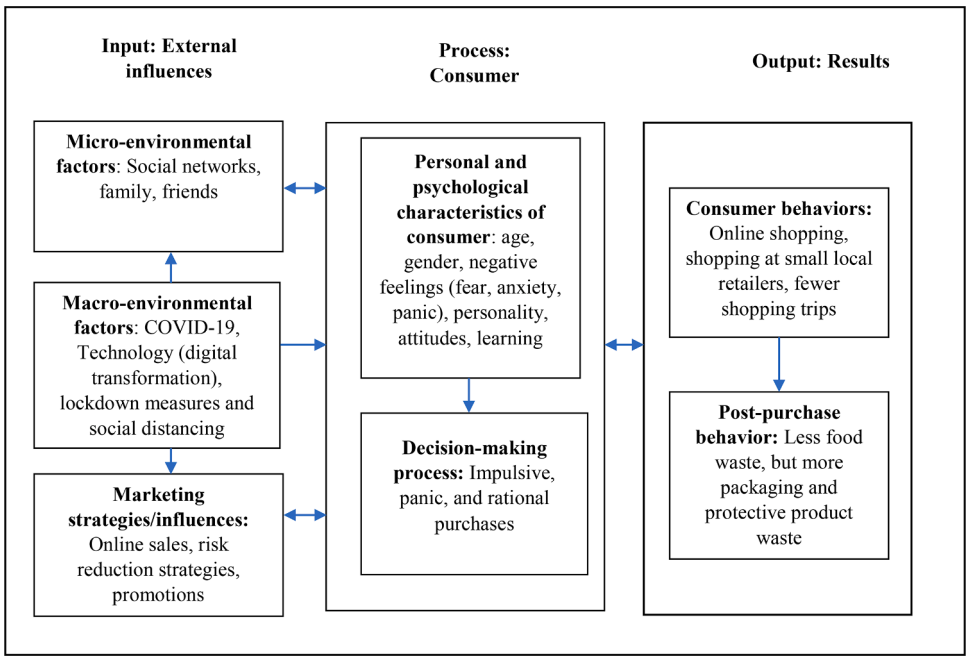


Fig. 7. Model of consumer behavior during the COVID-19 crisis.

5.4 Personal and psychological characteristics and decision-making

Most of the reviewed studies stemmed from this area. The personal characteristics of consumers (e.g., age, gender, income, and educational level) and their psychological characteristics (e.g., motivation, perception, and attitudes) determine how they interpret stimuli (Schiffman and Wisenblit, 2015).

For instance, many studies address gender. There is no consensus about which gender makes the most panic purchases. A study carried from Brazil reports that men tend to make the most panic purchases (Lins and Aquino, 2020), while a study in China (Wang et al., 2020a) attributes this behavior to women. However, another study in several European countries found gender differences irrelevant in the tendency to make extra purchases (Dammeyer, 2020). The inconsistency may be attributable to cultural issues; however, the methodology may also have a bearing on the conflicting results. For example, while the study by Lins and Aquino (2020) asked respondents about purchasing products in general, Wang et al. (2020a) focused on food, and Dammeyer (2020) on food, medicine, and hygiene items. The same discrepancy in gender issues and panic purchases extends to the age variable. Some studies found that age is negatively related to the tendency to panic buy (Lins and Aquino, 2020), while other studies found no relationship at all (e.g., Dammeyer, 2020).

Many studies also examine the pandemic-induced negative psychological states and feelings. The perceived risk and information overload regarding COVID-19, led to sadness, anxiety, and cognitive dissonance (Song et al., 2020b). The perceived severity of the pandemic leads to self-isolation (Laato et al., 2020). The negative psychological states that the consumer experiences, are associated with hoarding behavior. Excessive concern regarding health leads to excessive purchasing and stockpiling of food and hygiene items (Laato et al., 2020). While negative emotions encourage excessive purchases, particularly the purchasing of necessities, they also discourage them from consuming services that involve contact. For example, the fear of contracting COVID-19 has been central to avoiding air transport during the pandemic (Lamb et al., 2020).

Consumer personality traits were also critical to understanding consumer behavior during the COVID-19 crisis. Extraversion (conscientiousness) and neuroticism (openness to experience) were positively (negatively) associated with extra purchases (Dammeyer, 2020). Another personality trait, such as agreeableness (sympathetic or considerate), led to the renunciation of consumption. Consumers with high scores on this trait gave up consumption that could negatively affect third parties (Lamb et al., 2020).

The pandemic has also encouraged favorable attitudes among consumers, be they pro-environmental or pro-health attitudes. The fear of COVID-19 and the uncertainty it brings has a positive effect on people's pro-environmental attitudes, which, in turn, increase trust in green brands (Jian et al., 2020). However, while consumers gave less importance to the nutritional value of food during the first months of the crisis (Ellison et al., 2021), there was an increase in health awareness in later months (Čvirik, 2020).

Despite great interest in consumers' personal and psychological processes, the purchase decision-making process garnered less attention. Studies note three types of decision-making processes: impulse (e.g., Ahmed et al., 2020; Islam et al., 2020), panic (e.g., Prentice et al., 2020), and rational (Wang and Hao, 2020) purchases.

In summary, consumer behavior, as it relates to consumers' personal and psychological characteristics, has been widely studied, especially in its relationship with the first phases of COVID-19, characterized by lockdown and social distancing. The broad base of prior knowledge on consumer psychology and the adoption and use of technologies facilitates such studies. Here too, given the dynamic pandemic and its entry into new stages involving vaccination and social distancing, future studies must extend the discussion on personal and psychological processes. In addition, more research should be conducted on purchase decision-making processes during the COVID-19 crisis.

5.5 Purchasing behaviors

In consumer behavior models, purchasing behavior is the output of the model. This output is generated by selecting products and places or points of purchase. During the pandemic, these two behaviors were central to consumers' strategies to ensure their own well-being.

The imposition lockdowns led to an increase in the purchase of food, beverages, hygiene items, and medicines, inducing frequent stockpiling. This behavior occurred before and during the measures and has been widely confirmed worldwide (e.g., Antonides and van Leeuwen, 2020;

Prentice et al., 2020; Seiler, 2020;). After the lockdown and the transition to social distancing, moderate stockpiling may be expected (Anastasiadou et al., 2020). Meanwhile, the consumption of goods and services in industries such as entertainment, dining, travel, and tourism decreased (Antonides and van Leeuwen, 2020; Ellison et al., 2021; Seiler, 2020; Skare et al., 2021). Another essential aspect is the selection of the purchase method. Various purchase methods were implemented to reduce the risk of infection, among which consumers favored online purchases while making changes in their selection of physical retailers.

The lockdown and later, social distancing, inspired many consumers to rapidly adopt purchasing behaviors mediated by technology (e.g., online shopping) (Butu et al., 2020), creating an "online awareness" among populations (Zwanka and Buff, 2020). A digital means of purchase was extended to categories which did not have a strong online presence previously. Thus, online purchases of food, beverages, and cleaning supplies grew (Antoides and van Leeuwen, 2020; Ellison et al., 2020; Hassen et al., 2020; Li et al., 2020b; Wang et al., 2020b). However, there was also an increase in the use of technology for entertainment. For example, there has been an increase in users and streaming hours on services such as Netflix and Spotify (Madnani et al., 2020). Another change in consumer purchasing behavior regarded the physical point of sale. This change occurred as consumers aimed to decrease the number of trips they made to physical stores (purchase frequency) (Laguna et al., 2020; Principato et al., 2020, in press; Wang et al., 2020a). In some countries and cities, consumers stopped buying from large retailers and places that could be crowded, preferring small local retailers instead (Li et al., 2020b).

Hence, there is a solid global consolidation of technology in purchasing (i.e., online shopping) and the strengthening of small local retailers. Given the dynamic nature of the COVID-19 crisis, future studies can evaluate the changes in the next stages of the pandemic.

5.6 Post-purchase behavior

Another key behavior is disposal, of which results are very interesting. During the lockdown, there is less food waste, more likely for future supply than ecological reasons (Amicarelli and Bux, 2021; Jribi et al., 2020). However, dire health precautions increased the usage of disposable protective items, and more electronic commerce transactions increased waste created by packaging material (Vanapalli et al., 2021). Thus, from a social and environmental perspective, the effects of the pandemic on product waste are mixed.

Future studies can examine product disposition and the new stages of the COVID-19 crisis. Moreover, consumer satisfaction with purchases has garnered less attention in the literature. Fig. 7 presents the model of consumer behavior during the COVID-19 crisis, summarizing the systematization of the literature.

5.7 Consumer behavior model under COVID-19: the near future

This subsection seeks to use the model (Figs. 2 and 7) to anticipate consumer behaviors, given the ongoing, dynamic development of the pandemic (WHO, 2021b). Accordingly, the crisis thus far has induced intense consumer learning, particularly in the use of technologies (personal and psychological factors). Moreover, although technologies can satisfy both hedonic and utilitarian needs (Cruz-Cárdenas et al., 2021), some consumer needs remain unsatisfied, particularly social needs (personal and psychological factors) (Sheth, 2020). However, public vaccination campaigns (macro-environmental factor) and their protective effects on the population can reduce people's fear and avoidance behavior regarding certain products and services (personal and psychological factors). Further, consumers can have a greater range of consumption options (decision-making process), given their decreased fear, and due to the relaxation of restrictions on mobility and the congregation of people (macro-environmental factor). However, the trajectory of the COVID-19 pandemic (macro-environmental factor) will not be a linear process, given the appearance of new waves of infections and strains (WHO, 2021b).

Therefore, the new consumer behavior (output or results) will not embark on a gradual return to pre-pandemic conditions. Rather, consumer learning about technologies, attenuated avoidance behavior, and unsatisfied needs mark consumer practices that tend to combine pre-COVID-19 behaviors (some intensified by the level of unsatisfied needs) with new technology-based behaviors (e.g., use of electronic banking, e-learning, e-commerce, and social media). However, this combination of old and new consumer behaviors will likely be dynamic (in varying proportions) and creative, as consumers will have to go through new stages of the pandemic marked by uncertainty.

6. Discussion, implications, and limitations

6.1 The COVID-19 pandemic versus other disruptive events: differences and similarities in their nature and consumer behavior

The COVID-19 pandemic in the context of disruptive events affecting humanity shares traits with other disruptive events and has unique characteristics. Like any disruptive event, it has profoundly impacted societies (Dahlhamer and Tierney, 1998). Among its unique characteristics are its truly global scope and occurrence within the context of the "digital transformation" technological advancement (Abdel-Basset et al., 2021).

Regarding consumer behavior, comparing the study findings to behaviors observed in other disruptive events yield interesting conclusions. Impulsive and panic buying seems to be common to all disruptive events. Therapeutic purchases seem to be more linked to natural disasters, where physical possessions suffer damages. The avoidance behavior of certain products and services appears to be more linked to terrorism and pandemics. However, despite these similarities, the role of technology in shopping has induced a unique consumer behavior under COVID-19. Indeed, technology has been transversal to the different consumer behaviors under COVID-19.

Consumer behavior and COVID-19 studies are characterized by three thematic areas: consumer behavior and technology use; purchase and handling of essential, hygiene, and protective products; and internal and external influences on consumers. Notably, the current pandemic is an ongoing event that follows a non-linear trajectory (WHO, 221b). Hence, the study priorities will surely change, marked by the new stages of the pandemic. For example, in light of the vaccination campaigns, the interest of future studies in the purchase and handling of basic necessities and protection products will decline. Further, given the decreased avoidance behavior, interest in the study of fun and leisure behaviors will increase. However, the use of technologies in consumption will remain at a high profile throughout the pandemic.

6.2 The nature of consumer behavior studies under the COVID-19 pandemic

Studies examining consumer behavior under the COVID-19 pandemic exhibit unique characteristics. Prior studies on consumer behavior and other disruptive events had a significant presence of qualitative studies, given their ability to explore and thoroughly understand how certain phenomena profoundly affect people's lives (Delorme et al., 2004). However, in studies on consumer behavior and COVID-19, their presence is modest, where quantitative studies dominate.

Various factors can explain the preeminence of quantitative studies; however, this subsection addresses the key factor of technology. Specifically, the confluence of intensive use of technologies by consumers during COVID-19, and the body of knowledge accumulated before the pandemic on consumer behavior and the use and adoption of technologies. Hence, this body of knowledge created a solid foundation for quantitatively oriented consumer studies. However, the existing

knowledge about consumer behavior and disruptive events did not provide a solid foundation since its extension is rather modest. (Laato et al., 2020).

6.3 Reassessment of pre-COVID-19 knowledge on key topics of consumer behavior and recommendation for future studies

A crucial consequence of the COVID-19 pandemic is the massive rise in the learning and use of technologies (Baicu et al., 2020: Sheth, 2020), which is unprecedented considering the global scale of the pandemic and its sustained duration. This massive and extensive learning of the use of technologies will have consequences in the validity of knowledge developed before the pandemic in key consumer behavior topics and technology use. Although there are various topics, this subsection will focus on two: Consumer segments in the use of technologies and the digital divide.

Before the pandemic, many studies in different countries apply various scales, including the technology readiness index scale (Parasuraman and Colby, 2015), to gage consumer segments in technology markets. The studies yielded strong results on consumer segments and their sizes. Thus, considering the rapid adoption of technologies during the COVID-19 pandemic, an obvious question is how current this knowledge is. Hence, future studies can determine how the COVID-19 pandemic reconfigured consumer segments in the use of technologies, how they changed regarding their importance, and whether a revision of existing measuring instruments (scales) is necessary.

Moreover, the digital divide (i.e., the gaps in the access and use of technologies between different societal sectors) has also been extensively studied before COVID-19. For example, older and lower-income people used technology-based services to a much lesser degree (Cruz-Cárdenas et al., 2019). The information is useful to design profitable and social marketing strategies. However, the pandemic-induced massive learning of technologies may leave out a part of society. Ultimately, future studies can focus on determining what happened to the digital gaps between social groups as an effect of the pandemic.

6.4 COVID-19 and the future: recommendations for practice and future studies

The review and systematization of the literature leave important recommendations for firms and organizations. Primarily, firms must incorporate rapid digital transformation in their processes. For example, although social media was already significant in societies before the COVID-19 crisis, its role has now been enhanced (Naeem, 2021b). The most diverse companies can find a profitable channel of communication and promotion in social networks. Smaller companies can utilize social media to sell products coupled with home delivery (Butu et al., 2020), thereby beginning their digital transformation process. For larger companies, digital social networks can help build communities around their brands, especially during times of uncertainty and increased user traffic.

Second, companies and businesses must consider how to address the risk perceived by consumers. This risk has been articulated as two fundamental types: the risks of infection, and fraud and misuse of data in e-commerce transactions. The perceived risk of infection is expected to diminish with massive vaccination campaigns (Shin and Kang, 2020). However, companies can address the perceived risk of fraud in online transactions via security protocols, incorporation and combination of technologies, and communication and promotion tools. In the latter, the best strategy will be to use the business image to generate consumer confidence (Troise et al., 2021; Lv et al., 2020). Further, for an undecided consumer regarding online transactions, promotions aimed at reducing prices and increasing benefits proved useful during the pandemic (Lv et al., 2020; Tran, 2021).

Finally, given the non-linear and uncertain trajectory of the pandemic, consumer behavior across the stages of the pandemic is a dynamic combination of old and new behaviors, highlighting the

Table A.1
Reviewed articles.

Setting/Type	Articles
China	Gao et al., 2020
	Hao et al., 2020
	Jin et al., 2020
	Li et al., 2020a
	Li et al., 2020b
	Liu et al., 2021
	Lv et al., 2020
	Min et al., 2020
	Qi et al., 2020
	Song et al., 2020a
	Song et al., 2020b
	Wang and Hao, 2020
	Wang et al., 2020a
	Yang et al., 2020
	Yang, 2021
United States	(Ahmed et al., 2020)
	Campbell et al., 2020
	Ellison et al., 2021
	Goolsbee and Syverson, 2020
	Lamb et al., 2020
	Soule et al., 2020
	Wang et al., 2020b
Italy	Alaimo et al., 2020
	Amicarelli and Bux, 2021
	Barnes et al., 2021
	(Principato et al., 2020)
	Troise et al., 2021
India	Madnani et al., 2020
	Mehta et al., 2020
	Pillai et al., 2020
Romania	Baicu et al., 2020
	Butu et al., 2020
	Petrescu-Mag et al., 2020
United Kingdom	Foroudi et al., 2021
	Naeem, 2021a
	Naeem, 2021b
Vietnam	Long and Khoi, 2020
	Pham et al., 2020
	Tran, 2021
Other countries	Antonides and van Leeuwen, 2020
	Čvirik, 2020
	Hall et al., 2020
	Hassen et al., 2020
	Jaman et al., 2020
	(Jeżewska-Zychowicz et al., 2020)
	(Jribi et al., 2020)
	Koch et al., 2020
	Laato et al., 2020
	Laguna et al., 2020
	Lins and Aquino, 2020
	Prentice et al., 2020
	Romeo-Arroyo et al., 2020
	Seiler, 2020
	Sidor and Rzymski, 2020
Several countries	Anastasiadou et al., 2020
	Bahmanyar et al., 2020
	Dammeyer, 2020
	Grashuis et al., 2020
	Islam et al., 2020
	Jian et al., 2020
	Kim et al., 2020
	Safara, 2020
	Sheridan et al., 2020
	Shin and Kang 2020
	Szymkowiak et al., 2021
Theoretical studies (without empirical work)	(Kirk and Rifkin, 2020)
	Oana, 2020
	Sheth, 2020
	Vanapalli et al., 2021
	Zwanka and Buff, 2020

necessity for companies to incorporate flexibility and agility into their culture and operations, and fully align with digital transformation initiatives.

6.5 Limitations

This study has some limitations. Though the article search was performed in the Scopus database, which presents a good balance between quality and coverage (Singh et al., 2020), several articles were not captured in the Scopus index, which could indicate that their quality is heterogeneous. However, this decision was necessary to systematize the literature in a reasonable amount of time.

Author statement

Jorge Cruz-Cárdenas: Writing

CRediT authorship contribution statement

Jorge Cruz-Cárdenas: Conceptualization, Methodology, Formal analysis, Writing – review & editing. **Ekaterina Zabelina:** Conceptualization, Methodology, Formal analysis, Visualization. **Jorge Guadalupe-Lanas:** Resources, Investigation. **Andrés Palacio-Fierro:** Resources, Investigation. **Carlos Ramos-Galarza:** Methodology, Formal analysis, Visualization.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.techfore.2021.121179.

Appendix: Articles included in the review according to the study setting

[*Insert* Table A.1 *here*]

References

Abdel-Basset, M., Chang, V., Nabeeh, N.A., 2021. An intelligent framework using disruptive technologies for COVID-19-19 analysis. Technol. Forecast. Soc. Change. 163, 120431, 10.1016/j.techfore.2020.120431.

Ahmed, R.R., Streimikiene, D., Rolle, J.-.A., Pham, D., 2020. The COVID-19 pandemic and the antecedants for the impulse buying behavior of US citizens. J. Compet. 12 (3), 5–27.

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50 (2), 179–211.

Alaimo, L.S., Fiore, M., Galati, A., 2020. How the Covid-19 pandemic is changing online food shopping human behaviour in Italy. Sustainability 12 (22), 9594.

Amicarelli, V., Bux, C., 2021. Food waste in Italian households during the Covid-19 pandemic: a self-reporting approach. J. Food Secur. 13, 25–37.

Anastasiadou, E., Chrissos Anestis, M., Karantza, I., Vlachakis, S., 2020. The coronavirus' effects on consumer behavior and supermarket activities: insights from Greece and Sweden. Int. J. Sociol. Soc. Pol. 40 (9/10), 893–907.

Antonides, G., van Leeuwen, E., 2020. Covid-19 crisis in the Netherlands: "only together we can control Corona. Mind Soc. https://doi.org/10.1007/s11299-020-00257-x.

Bahmanyar, A., Estebsari, A., Ernst, D., 2020. The impact of different COVID-19 containment measures on electricity consumption in. Europe. Energy Res. Soc. Sci 68, 101683.

Baicu, C.G., Petronela, G.G., Gardan, D.A., Epuran, G., 2020. The impact of COVID-19 on consumer behavior in retail banking: evidence from Romania. Manag. Mark: Challeng. Knowl. Soc. 15 (s1), 534–556.

Balaid, A., Rozan, Abd, M., Z., Hikmi, S.N., Memon, J., 2016. Knowledge maps: a systematic literature review and directions for future research. Int. J. Inf. Manag. 36 (3), 451–475.

Barnes, S.J., Diaz, M., Arnaboldi, M., 2021. Understanding panic buying during COVID-19: a text analytics approach. Expert. Syst. Appl. 169, 114360.

Bates, R.A., LaBrecque, B., 2019. Terrorism as economic warfare: america's risky business. J. Public Prof. Sociol. 11 (1), 1–17.

Baumert, T., de Obesso, M.M., Valbuena, E., 2020. How does the terrorist experience alter consumer behaviour? An analysis of the Spanish case. J. Bus. Res. 115, 357–364.

Brem, A., Viardot, E., Nylund, P.A., 2020. Implications of the coronavirus (COVID-19) outbreak for innovation: which technologies will improve our lives? Technol. Forecast. Soc. Change. 163, 120451.

Butu, A., Brumă, I.S., Tanasă, L., Rodino, S., Vasiliu, C.D., Doboș, S., Butu, M., 2020. The impact of COVID-19 crisis upon the consumer buying behavior of fresh vegetables directly from local producers. case study: the quarantined area of Suceava County. Romania. Int. J. Environ. Res. Public Health. 17 (15), 5485.

Campbell, B.L., Rihn, A.L., Campbell, J.H., 2020. Impact of the coronavirus pandemic on plant purchasing in Southeastern United States. Agribusiness 37 (1), 160–170.

Crawford, D., 2012. Recovering from terror: the Egyptian and Balinese experiences worldwide hospitality and tourism themes. 14(1), 91–97.

Cruz-Cárdenas, J., Arévalo-Chávez, P., 2018. Consumer behavior in the disposal of products: forty years of research. J. Promot. Mang. 24 (5), 617–636.

Cruz-Cárdenas, J., Zabelina, E., Deyneka, O., Guadalupe-Lanas, J., Velín-Fárez, M., 2019. Role of demographic factors, attitudes toward technology, and cultural values in the prediction of technology-based consumer behaviors: a study in developing and emerging countries. Technol. Forecasting Soc. Change 149, 119768.

Cruz-Cárdenas, J., Guadalupe-Lanas, J., Ramos-Galarza, C., Palacio-Fierro, A., 2021. Drivers of technology readiness and motivations for consumption in explaining the tendency of consumers to use technology-based services. J. Bus. Res. 122, 217–225.

Čvirik, M., 2020. Health-conscious consumer behaviour: the impact of a pandemic on the case of Slovakia. Centr. Eur. Bus. Rev. 2020 (4), 45–58.

Dahlhamer, J.M., Tierney, K.J., 1998. Rebounding from disruptive events: business recovery following the Northridge earthquake. Sociol. Spectr. 18 (2), 121–141.

Dammeyer, J., 2020. An explorative study of the individual differences associated with consumer stockpiling during the early stages of the 2020 Coronavirus outbreak in Europe. Pers. Individ. Dif. 167, 110263.

Davis, F.D., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q 13 (3), 319–340.

Delorme, D.E., Zinkhan, G.M., Hagen, S.C., 2004. The process of consumer reactions to possession threats and losses in a natural disaster. Mark. Lett. 15 (4), 185–199.

Donthu, N., Gustafsson, A., 2020. Effects of COVID-19 on business and research. J. Bus. Res. 117, 284–289.

Ellison, B., McFadden, B., Rickard, B.J., Wilson, N.L.W., 2021. Examining food purchase behavior and food values during the COVID-19 pandemic. Appl. Econ. Perspect. Policy. 43 (1), 58–72.

Foroudi, P.H., Tabaghdehi, S.A., Marvi, R., 2021. The gloom of the COVID-19 shock in the hospitality industry: a study of consumer risk perception and adaptive belief in the dark cloud of a pandemic. Int. J. Hospital. Manag. 92, 102717.

Gao, X., Shi, X., Guo, H., Liu, Y., 2020. To buy or not buy food online: the impact of the COVID-19 epidemic on the adoption of e-commerce in China. PLoS ONE 15 (8), e0237900.

Géron, A., 2019. Hands-on Machine Learning With Scikit-Learn, Keras, and TensorFlow. 2nd ed. O'Reilly, Sebastopol, Canada.

Goodwin, R., Haque, S., Neto, F., Myers, L.B., 2009. Initial psychological response of influenza A, H1N1 ("Swine flu"). BMC Infect. Dis. 9 (1), 1–6.

Goolsbee, A., Syverson, Ch., 2020. Fear, lockdown, and diversion: comparing drivers of pandemic economic decline. J. Public Econ. 193, 104311.

Grashuis, J., Skevas, T., Segovia, M.S., 2020. Grocery shopping preferences during the COVID-19 pandemic. Sustainability 12 (13), 5369.

Hall, M.C., Prayag, G., Fieger, P., Dyason, D., 2020. Beyond panic buying: consumption displacement and COVID-19. J. Serv. Manag. 32 (1), 113–128.

Hao, N., Wang, H.H., Zhou, Q., 2020. The impact of online grocery shopping on stockpile behavior in Covid-19. China Agricult. Econ. Rev. 12 (3), 459–470.

Hassen, T.B., El Bilali, H., Allahyari, M.S., 2020. Impact of COVID-19 on food behavior and consumption in Qatar. Sustainability 12 (17), 6973.

Herzenstein, M., Horsky, S., Posavac, S.S, 2015. Living with terrorism or withdrawing in terror: perceived control and consumer avoidance. J. Consumer Behav. 14, 228–236.

International Monetary Fund [IMF] (2020). World economic outlook. Available at https://www.imf.org/en/Publications/WEO/Issues/2020/06/24/.

Islam, T., Pitafi, A.H., Arya, V., Wang, Y., Akhtar, N., Mubarik, S., Xiaobei, L., 2020. Panic buying in the COVID-19 pandemic: a multi-country examination. J. Retail. Consum. Serv. 59, 102357.

Jaman, J.H., Abdulrohman, R., Suharso, A., Sulistiowati, N., Dewi, I.P., 2020. Sentiment analysis on utilizing online transportation of Indonesian customers using tweets in the normal era and the pandemic Covid-19 era with support vector machine. Adv. Sci. Technol. Eng. Syst. J. 5 (5), 389–394.

Jeżewska-Zychowicz, M., Plichta, M., Królak, M., 2020. 2020. Consumers' fears regarding food availability and purchasing behaviors during the COVID-19 pandemic: the importance of trust and perceived stress. Nutrients 12 (9), 2852.

Jian, Y., Yu, I.Y., Yang, M.X., Zeng, K.J., 2020. The impacts of fear and uncertainty of COVID-19 on environmental concerns, brand trust, and behavioral intentions toward green hotels. Sustainability 12 (20), 8688.

Jin, X., Li, J., Song, W., Zhao, T., 2020. The impact of COVID-19 and public health emergencies on consumer purchase of scarce products in China. Front. Public Health 8, 617166.

Jribi, S., Ismail, H.B., Doggui, D., Debbabi, H., 2020. COVID-19 virus outbreak lockdown: what impacts on household food wastage? Environ. Dev. Sustain. 19, 1–17.

Kaur, P., Dhir, A., Tandon, A., Alzeiby, E.A., Abohassan, A.A., 2021. A systematic literature review on cyberstalking: an analysis of past achievements and future promises. Technol. Forecast. Soc. Change. 163, 120426.

Kim, J., Giroux, M., Gonzalez-Jimenez, H., Jang, S., Kim, S., Park, J., Kim, J.-.E., Lee, J. C., Choi, Y.K, 2020. Nudging to reduce the perceived threat of coronavirus and stockpiling intention. J. Advert. 49 (5), 633–647.

Kirk, C.P., Rifkin, L., 2020. I'll trade you diamonds for toilet paper: consumer reacting, coping and adapting behaviors in the COVID-19 pandemic. J. Bus. Res. 117, 124–131.

Kline, R.B., 2016. Principles and Practice of Structural Equation Modeling, 4th ed. Guilford, New York.

Koch, J., Frommeyer, B., Schewe, G., 2020. Online shopping motives during the COVID-19 pandemic: lessons from the crisis. Sustainability 12 (24), 10247.
Kotler, P., Keller, K., 2016. Marketing management, 15 Ed. Pearson, London.
Laato, S., Islam, A.K.M.N., Farooq, A., Dhir, A., 2020. Unusual purchasing behavior during the early stages of the COVID-19 pandemic: the stimulus-organism-response approach. J. Retail. Cons. Serv. 57, 102224.
Laguna, L., Fiszman, S., Puerta, P., Chaya, C., Tarrega, A., 2020. The impact of COVID-19 lockdown on food priorities: results from a preliminary study using social media and an online survey with Spanish consumers. Food Qual. Prefer. 86, 104028.
Lamb, T.L., Winter, S.R., Rice, S., Ruskin, K.J., Vaughn, A., 2020. Factors that predict passenger's willingness to fly during and after the COVID-19 pandemic. J. Air Transport Manag. 89, 101897.
Li, M., Zhao, T., Huang, E., Li, J., 2020a. How does a public health emergency motivate people's impulsive consumption? an empirical study during the COVID-19 outbreak in China. Int. J. Environ. Res. Public Health. 17 (14), 5019.
Li, J.X., Hallsworth, A.G., Coca-Stefaniak, J.A., 2020b. Changing grocery shopping behaviours among Chinese consumers at the outset of the COVID-19 outbreak. Tijdschrift Voor Economische en Sociale Geografie 111 (3), 574–583.
Lin, J-S.C., Chang, H.-.C., 2011. The role of technology readiness in self-service technology acceptance. Manag. Serv. Qual. 21 (4), 424–444.
Lins, S., Aquino, S., 2020. Development and initial psychometric properties of a panic buying scale during COVID-19 pandemic. Heliyon 6 (9), e04746.
Liu, N., Chen, Z., Bao, G., 2021. Role of media coverage in mitigating COVID-19 transmission: evidence from China. Technol. Forecast. Soc. Change. 163, 120435.
Long, N.N., Khoi, B.H, 2020. An empirical study about the intention to hoard food during COVID-19 pandemic. EURASIA J. Math. Sci. Tech. Ed. 16 (7), em1857.
Lv, J., Wang, Z., Huang, Yu., Wang, T., Wang, Yu., 2020. How can e-commerce businesses implement discount strategies through social media? Sustainability 12 (18), 7459.
Madnani, D., Fernandes, S., Madnani, N., 2020. Analysing the impact of COVID-19 on over-the-top media platforms in India. Int. J. Pervasive Comp. Comm. 16 (5), 457–475.
Mehta, S., Saxena, T., Purohit, N., 2020. The new consumer behaviour paradigm amid COVID-19: permanent or transient? J. Health Manag. 22 (7), 291–301.
Min, S., Xiang, C., Zhang, X.-.H., 2020. Impacts of the COVID-19 pandemic on consumers' food safety knowledge and behavior in China. J. Integr. Agricult. 19 (12), 2926–2936.
Naeem, M., 2021a. Understanding the customer psychology of impulse buying during COVID-19 pandemic: implications for retailers. Int. J. Retail Distrib. Manag. 49 (3), 377–393.
Naeem, M., 2021b. Do social media platforms develop consumer panic buying during the fear of Covid-19 pandemic. J. Retail. Cons. Serv. 58, 102226.
Oana, D., 2020. The Impact of the current crisis generated by the COVID-19 pandemic on consumer behavior. Stud. Bus. Econ. 15 (2), 85–99.
Osobajo, O.A., Moore, D., 2017. Methodological choices in relationship quality (RQ) research 1987 to 2015: a systematic literature review. J. Relation. Mark. 16 (1), 40–81.
Pan, X., Dresner, M., Mantin, B., 2020. Pre-hurricane consumer stockpiling and post-hurricane product availability: empirical evidence from natural experiments. Prod. Oper. Manag. 29 (10), 2350–2380.
Parasuraman, A., Colby, C.L., 2015. An updated and streamlined technology readiness index: TRI 2.0. J. Serv. Res. 18 (1), 59–74.
Petrescu-Mag, R.M., Vermeir, I., Petrescu, D.C., Crista, F.L., Banatean-Dunea, I., 2020. Traditional foods at the click of a button: the preference for the online purchase of Romanian traditional foods during the COVID-19 pandemic. Sustainability 12 (23), 9956.
Pham, V.K., Thi, T.H.D., Le, T.H.H., 2020. A study on the COVID-19 awareness affecting the consumer perceived benefits of online shopping in Vietnam. Cogent Bus. Manag. 7 (1), 1846882.
Pillai, V., Ambekar, S., Hudnurkar, M., 2020. Implications of COVID-19 on consumer buying behavior. PalArch's. J. Archaeol. Egypt 17 (6), 4336–4354.
Prentice, C., Chen, J., Stantic, B., 2020. Timed intervention in COVID-19 and panic buying. J. Retail. Cons. Serv. 57, 102203.
Principato, L., Secondi, L., Cicatiello, C., Mattia, G., 2020. in press. Caring more about food: the unexpected positive effect of the Covid-19 lockdown on household food management and waste. Socio-Econ Plan. Sci. https://doi.org/10.1016/j.seps.2020.100953.
Qi, X., Yu, H., Ploeger, A., 2020. Exploring influential factors including COVID-19 on green food purchase intentions and the intention–behaviour gap: a qualitative study among consumers in a Chinese context. Int. J. Environ. Res. Public Health. 17 (19), 7106.
Romeo-Arroyo, E., Mora, M., Vázquez-Araújo, L., 2020. Consumer behavior in confinement times: food choice and cooking attitudes in Spain. Int. J. Gastron. Food Sci. 21, 100226.
Safara, F., 2020. A computational model to predict consumer behaviour during COVID-19 pandemic. Comput. Econ. https://doi.org/10.1007/s10614-020-10069-3.
Schiffman, L.G., Wisenblit, J., 2015. Consumer Behavior, 11th ed. Upper Saddle River, NJ, Pearson.
Schmidthuber, L., Maresch, D., Ginner, M., 2020. Disruptive technologies and abundance in the service sector—toward a refined technology acceptance model. Technol. Forecast. Soc. Change. 155, 119328.
Seiler, P., 2020. Weighting bias and inflation in the time of COVID-19: evidence from Swiss transaction data. Swiss. J. Econ. Stat. 156 (1), 13.
Sheridan, A., Andersen, A.L., Hansen, T., Johannesen, N., 2020. Social distancing laws cause only small losses of economic activity during the COVID-19 pandemic in Scandinavia. Proc. Natl Acad. Sci. 117 (34), 20468–20473.
Sheth, J.N., 2020. Impact of Covid-19 on consumer behavior: will the old habits return or die? J. Bus. Res. 117, 280–283.
Shin, H., Kang, J., 2020. Reducing perceived health risk to attract hotel customers in the COVID-19 pandemic era: focused on technology innovation for social distancing and cleanliness. Int. J. Hospital. Manag. 91, 102664.
Sidor, A., Rzymski, P., 2020. Dietary choices and habits during COVID-19 lockdown: experience from Poland. Nutrients 12 (6), 1657.
Singh, S., Dhir, S., Das, V.M., Sharma, A., 2020. Bibliometric overview of the technological forecasting and social change journal: analysis from 1970 to 2018. Technol. Forecast. Soc. Change. 154, 119963.
Skare, M., Riveiro Soriano, D., Porada-Rochón, M., 2021. Impact of COVID-19 on the travel and tourism industry. Technol. Forecast. Soc. Change. 163, 120469.
Sneath, J.Z., Lacey, R., Kennett-Hensel, P.A., 2009. Coping with a natural disaster: losses, emotions, and impulsive and compulsive buying. Market Lett 20 (1), 45–60.
Snyder, H., 2019. Literature review as a research methodology: an overview and guidelines. J. Bus. Res. 104, 333–339.
Song, W., Jin, X., Gao, J., Zhao, T., 2020a. Will buying follow others ease their threat of death? An analysis of consumer data during the Period of COVID-19 in China. Int. J. Environ Res. Public Health. 17 (9), 3215.
Song, Sh., Yao, X., Wen, N., 2020b. What motivates Chinese consumers to avoid information about the COVID-19 pandemic? the perspective of the stimulus-organism-response model. Inf. Process Manag. 58 (1), 102407.
Soule, E.K., Mayne, Sh., Snipes, W., Guy, M.C., Breland, A., Fagan, P., 2020. Impacts of COVID-19 on electronic cigarette purchasing, use and related behaviors. Int. J. Environ. Res. Public Health. 17 (18), 6762.
Szymkowiak, A., Gaczek, P., Jeganathan, K., Kulawik, P., 2021. The impact of emotions on shopping behavior during epidemic: what a business can do to protect customers. J. Cons. Behav. 20 (1), 48–60.
Ting, H., Thaichon, P., Chuah, F., Tan, S.R., 2019. Consumer behaviour and disposition decisions: the why and how of smartphone disposition. J. Retail. Custom. Serv. 51, 212–220.
Tran, L.T.T., 2021. Managing the effectiveness of e-commerce platforms in a pandemic. J. Retail. Cons. Serv. 58, 102287.
Troise, C., O'Driscoll, A., Tani, M., Prisco, A., 2021. Online food delivery services and behavioural intention: a test of an integrated TAM and TPB framework. British Food J 123 (2), 664–683.
Van Eck, N.J., Waltman, L., 2010. Software survey: vOSviewer, a computer program for bibliometric mapping. Scientometrics 84 (2), 523–538.
Van Eck, N.J., Waltman, L., 2020. Manual for Vosviewer version 1.6.15. available at https://www.vosviewer.com/documentation/Manual_VOSviewer_1.6.15.pdf.
Vanapalli, K.R., Sharma, H.B., Ranjan, V.P., Samal, B., Bhattacharya, J., Dubey, B.K., Goel, S., 2021. Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic. Sci. Total Environ. 750, 141514.
Wang, H.H., Hao, N., 2020. Panic buying? food hoarding during the pandemic period with city lockdown. J. Integr. Agric. 19 (12), 2916–2925.
Wang, E.P., An, N., Gao, Z.F., Kiprop, E., Geng, X.H., 2020a. Consumer food stockpiling behavior and willingness to pay for food reserves in COVID-19. Food Secur 12 (4), 739–747.
Wang, Y., Xu, R., Schwartz, M., Ghosh, D., Chen, X., 2020b. COVID-19 and retail grocery management: insights from a broad-based consumer survey. IEEE Eng. Manag. Rev. 48 (3), 202–211.
Wen, Z., Huimin, G., Kavanaugh, R.R, 2005. The impacts of SARS on the consumer behaviour of Chinese domestic tourists. Curr. Issues. Tour. 8 (1), 22–38.
World Health Organization, 2021a. Who coronavirus disease (COVID-19) dashboard. Available at https://covid19.who.int/.
World Health Organization, 2021b. COVID-19 virtual press conference transcript - 25 June 2021. Available at https://www.who.int/publications/m/item/covid-19-virtual-press-conference-transcript—25-june-2021.
Yang, X., 2021. Potential consequences of COVID-19 for sustainable meat consumption: the role of food safety concerns and responsibility attributions. British Food J 123 (2), 455–474.
Yang, Y., Li, O., Peng, X., Wang, L., 2020. Consumption trends during the COVID-19 crisis: how awe, coping, and social norms drive utilitarian purchases. Front. Psychol. 11, 588580.
Yoo, S., Managi, S., 2020. Global benefits of COVID-19 action. Technol. Forecast. Soc. Change. 160, 120231.
Zwanka, R.J., Buff, C., 2020. COVID-19 generation: a conceptual framework of the consumer behavioral shifts to be caused by the COVID-19 pandemic. J. Int. Cons. Mark. 33 (1), 58–67.

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