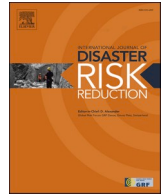




Contents lists available at ScienceDirect

## International Journal of Disaster Risk Reduction

journal homepage: [www.elsevier.com/locate/ijdr](http://www.elsevier.com/locate/ijdr)

# What influences panic buying behaviour? A model based on dual-system theory and stimulus-organism-response framework

Xue Li<sup>a</sup>, Yusheng Zhou<sup>a</sup>, Yiik Diew Wong<sup>a</sup>, Xueqin Wang<sup>b</sup>, Kum Fai Yuen<sup>a,\*</sup>

<sup>a</sup> School of Civil and Environmental Engineering, Nanyang Technological University, Singapore

<sup>b</sup> Department of International Logistics, Chung-Ang University, Seoul, 06974, South Korea

## ARTICLE INFO

## Keywords:

Panic buying  
Consumer behaviour  
Dual-system theory  
Stimulus-organism-response framework  
Health belief model  
Structural equation modelling

## ABSTRACT

Panic buying has been observed across many regions during the COVID-19 pandemic which greatly disrupts supply chains and market economies. The determinants of panic buying, upon being identified, can be applied to control the escalation of panic buying behaviour that is highly detrimental to societies. This research aims to synthesise the dual-system theory and stimulus-organism-response framework to investigate into the causes of panic buying. Structural equation modelling is employed to analyse data collected from 508 residents in Singapore. The results reveal that panic buying can be explained as a response to both environmental stimuli and reflective thinking. Specifically, perceived susceptibility and perceived severity of a pandemic event as well as social influence and social norm can stimulate consumers' perceptions of scarcity and affective response, which in turn leads to the impulsive decision of panic buying; meanwhile, a rational reflection which is operationalised by perceived lack of control also influences panic buying. Furthermore, the perceived lack of control positively moderates the effect of affective response on panic buying. Theoretically, this research provides a unique explanation of panic buying. The findings also provide managerial implications on dealing with panic buying in response to disasters such as a health crisis.

## 1. Introduction

The ongoing COVID-19 pandemic is severely affecting global commerce and re-shaping consumer behaviour [1]. One overt consumer behaviour change is panic buying, which refers to unusual stockpiling of a certain product or a broad range of goods fuelled by the fear of stock-out or price increase. This behaviour can remain for a short while or persist for a long time [2,3]. Panic buying has been witnessed and studied during previous disasters [4]. However, the unique COVID-19 pandemic (with long-term influence and unpredictable scaling) which spawns worldwide booming demand for sanitisers, masks, medicines, food and toilet paper have engendered adverse impacts of hoarding behaviour, leading to consumer stress, and price and supply chain disruptions [90]. This provides strong motivations for researchers to re-visit consumer panic buying behaviour [5,6].

During the COVID-19 pandemic, panic buying has been observed in more than ninety countries [7]. Considering the panic buying's negative impacts on global supply chains and commodity prices [7], the investigation of panic buying from various perspectives can be useful for involved stakeholders such as policy makers [8]. Understanding the

causes and effects of panic buying during COVID-19 shall be instrumental towards mitigating negative influences, controlling escalation and ensuring preparedness against future herd behaviour. However, research on this stream of literature remains inadequate [2]. Herein, researchers have been investigating the psychological causes of panic buying using various theories and methodologies. For example, Chua et al. [9] found that health belief model and anticipated regret can contribute to the understanding of panic buying behaviour; perceived severity and perceived susceptibility of the pandemic, outcome expectation of panic buying, cues from social media and self-efficacy can indirectly lead to panic buying via the mediation of perceived scarcity and anticipated regret. Yuen et al. [10] used Maslow's hierarchy of needs and survival psychology to explain panic buying behaviour. They argued that physiological needs, safety needs, social needs and esteem needs can explain responsible factors of panic buying. Arafat et al. [11] identified contributory factors of panic buying through the analysis of media reports. They found that perceived scarcity of products, growing demands, the necessity of products, and anticipated price surge are most frequently mentioned attributes of panic buying in online reports. Other theories and models that have been discussed in prior research include

\* Corresponding author.

E-mail address: [kumfai.yuen@ntu.edu.sg](mailto:kumfai.yuen@ntu.edu.sg) (K.F. Yuen).

<https://doi.org/10.1016/j.ijdr.2021.102484>

Received 23 May 2021; Received in revised form 21 July 2021; Accepted 21 July 2021

Available online 24 July 2021

2212-4209/© 2021 Elsevier Ltd. All rights reserved.

the theory of planned behaviour, animal foraging theory and social network theory [12–14]. Overall, the factors contributing to panic buying include perceptions and personality psychological factors (i.e. perceived scarcity, anxiety, fear of unavailability, and self-control) and social psychological factors (i.e. observational learning, normative influence, and trust) [3].

It has been observed that panic buying can be explained as a peculiar behaviour that is triggered by external environmental factors, and through the internalisation of these factors, results in stockpiling behaviour. Herein, the objective of this study is to provide a better understanding on various factors that impact panic buying behaviour by anchoring on the integration of dual-system theory and stimulus-organism-response (SOR) framework. The SOR framework examines how environmental cues (i.e. pandemic) affect individuals’ cognitive and emotional thoughts, which would consequently affect behavioural reactions. This framework has been widely applied in consumer behaviour studies [15]. Meanwhile, the dual-system theory (DST) proposes that human behaviour is attributed by two distinct systems: an automatic, impulsive system and a controlled, analytical and reflective system [16]. DST has been applied to investigate behaviour patterns due to its versatility [17,18]. The synthesis of the two theories is fitting in this research because panic buying can be considered as a behaviour triggered not only by stimuli from the pandemic and associated impulsive thoughts such as anxiety but also controlled by personal reflective thoughts [19]. Specifically, environmental stimuli (i.e. pandemic) can trigger consumers’ internal emotional and cognitive process (i.e. perceived scarcity), and such internal process can subsequently result in panic buying response. Moreover, a rational reflection on self-control over the current situation can influence consumers’ decisions on panic buying as well. A perceived loss of control can result in remedial behaviour to gain a sense of security [20]. Therefore, the synthesis of the two theories shall provide a coherent, fitting explanatory model for panic buying.

This research contributes to the literature on panic buying by conceptualising DST and SOR framework to explore how the dual-system systems work together to affect panic buying behaviour. Laato et al. [15] has conducted a valuable study on consumers’ unusual shopping behaviour during the pandemic using the SOR framework. This research takes a step further by arguing that panic buying can be considered as more than a response to environmental stimuli. It is rationalised that for the impulsive system, pandemic and societal stimulus can trigger perceived anxiety and affective response which in turn leads to panic

buying. For the controlled system, perceived lack-of-control directly accounts for panic buying. This research also investigates the interaction between the impulsive and reflective systems by examining the moderation effect of perceived lack of control on the relationships between the impulsive system and panic buying. To achieve the research objective, a questionnaire survey is conducted to collect representative data from residents in Singapore. Then, structural equation modelling is employed to analyse data because observable variables and latent variables are involved in the analysis.

The rest of this paper is as follows. The theoretical model and research hypotheses are introduced in Section Two. Research methods are explained in Section Three. Analysis results are analysed in Section Four. Finally, conclusions and recommendations are provided in Section Five.

## 2. Literature review

### 2.1. Theoretical model

The theoretical model of this research is depicted in Fig. 1. To investigate the determinants of panic buying behaviour, the SOR framework and DST are integrated. The adopted theories and fourteen proposed hypotheses are introduced in detail in the following parts.

#### 2.1.1. Stimulus-organism-response framework

SOR is an extensively applied framework to understand human behaviour. It consists of three stages: stimulus, organism and response. Stimulus refers to social environments or environmental cues that could arouse individuals’ psychological and behavioural responses or changes [21]. Since this research is conducted in the context of COVID-19 and panic buying behaviour is observed during the pandemic, the threats from COVID-19 are considered as important environmental stimuli. Two factors from the health belief model are extracted and applied to operationalise the stimuli from the ongoing pandemic, namely, perceived severity and perceived susceptibility. The two factors are suitable because they could measure the degree of adverse outcomes and likelihood of contracting the pandemic. Moreover, social influence and social norm are also used to operationalise stimulus because these social constructs have been shown to exert major influence on consumer behaviour and decisions during a pandemic [22,23].

Organism refers to intervening internal decision process that stands between a stimulus and response [24]. Prior research has shown that an

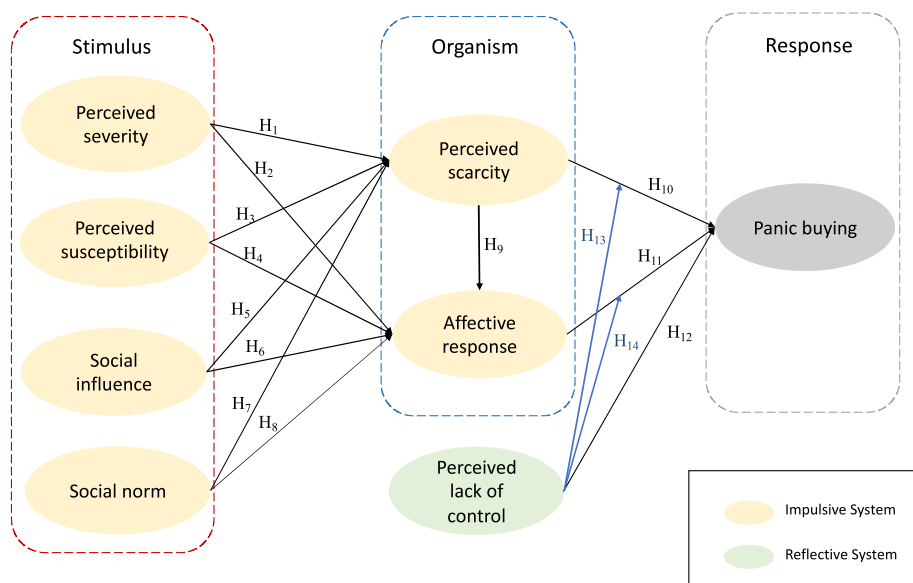


Fig. 1. The theoretical model.

organism's decision process includes both cognitive and emotional processes [25]. Cognition concerns the formation of perceptive images due to the environment stimulus while emotion concerns individuals' feelings triggered by external environments, such as pleasure, arousal or dominance [26]. Some 'organism' factors that have been studied in consumer behaviours research include attitude, satisfaction, and perceived value. This research takes both cognitive and affective processing into consideration. Accordingly, the cognitive and emotional mechanism are operationalised by perceived scarcity and affective response. Perceived scarcity refers to individuals' perception on the degree of product unavailability during COVID-19 whereas affective response is defined as an individual's anxiety and fear towards the shortage of products. Both cognitive and emotional factors are proposed to be internal processes that mediate the effect of environmental cues on panic buying.

Response refers to intentions, decisions or behavioural changes caused by stimulus and 'organism' factors. The current study defines the response as panic buying behaviour. Based on the SOR framework, social factors or external environments could stimulate individuals' internal cognitive and emotional mechanisms which in turn influence a response such as panic buying [26,27].

### 2.1.2. Dual-system theory

DST suggests that individuals' behaviour is regulated by two parallel systems: the impulsive system which is intuitive, fast and unconscious and the reflective system which is controlled, slow and conscious [28]. The impulsive system would trigger an impulse to conduct an unplanned behaviour while the controlled system would consider the long-term value of the behaviour prior to its conduct [28].

This research synthesises the two psychological tenets (DST and SOR framework) to investigate the determinants of panic buying. Based on the SOR framework, the prospect of a specific stimulus triggering a cognitive and then, an emotional reaction, can cause irrational behaviour such as panic buying. Therefore, this process could be considered as an impulsive system. In the previous literature, the most commonly used reflective system factor is self-regulation or self-control [29,30]. Self-control process is considered a reflective system because it concerns the deliberate evaluation of individuals' capabilities, current situation, and long-term goals [31]. High self-control can prevent consumers from succumbing to short-term impulses [31]. Individuals perceiving a lack of control shall more likely lead to a decision to panic buy. Therefore, perceived lack of control is considered as a reflective system in this research.

## 2.2. The effects of health and social stimulus on emotional organism ( $H_1$ to $H_8$ )

The effects of the stimuli created by the pandemic and society on individuals' perceived scarcity ( $H_1$  to  $H_4$ ) as well as affective responses such as fear and anxiety ( $H_5$  to  $H_8$ ) are discussed in the following.

Perceived susceptibility is defined as individuals' perceptions of the likelihood of contracting COVID-19. It is an essential component of the health belief model to explain how health concerns impact consumer behaviour. When the chances of contracting COVID-19 is high, a more strict restriction on social activities and freight transportation is emplaced [9]. Supply chains are vulnerable to disasters. When vehicle movements and goods movements are restricted to control the propagation of the pandemic [32], it takes a longer lead time for retailers to replenish their inventories while a lack of product inventory is more likely to occur due to the shortage of labour, lockdowns and border control. Therefore, consumers can expect a higher level of product limitation and unavailability. Further, the vulnerability raises emotional anxiety because of anticipation of frequent product shortage. Therefore, the following hypotheses are proposed:

**H1.** : Perceived susceptibility has a positive influence on perceived

scarcity.

**H2.** : Perceived susceptibility has a positive influence on affective response.

Perceived severity is defined as the consequence of the adverse effect that COVID-19 poses on an individual's well-being, such as job security and economic conditions, family relationship and psychological health. Research has shown that the pandemic is associated with mental health issues such as depression, loneliness and suicide [33,34]. COVID-19 also triggers economic recession; many factories are forced to close and many job positions are retrenched due to sluggish economy [35]. When individuals perceive a severe negative outcome associated with the pandemic such as a long-term compulsive social distancing, more factory shutdowns, supply chain collapse, they tend to lose confidence in the future recovery of the pandemic and the replenishment of supply chain, and correspondingly, shall expect more restricted productivity and increasing unavailability of products. In addition, the worsened expectation on product supply lower consumers' confidence in acquiring goods and therefore, brings about emotional anxiety. Therefore, the following hypotheses are proposed:

**H3.** : Perceived severity has a positive influence on perceived scarcity.

**H4.** : Perceived severity has a positive influence on affective response.

Social influence refers to how external information and environmental cues impact the individuals' thoughts and decisions [36]. It is an important determinant in the field of psychology as influencing human emotions and behavioural changes [37]. Social influence can be classified into informative influence and normative influence [38]. Informative influence elicits conformity based on the information provided by others such as social media whereas normative influence elicits conformity to fulfil the expectation and cues of important people, such as friends or families [39]. Social influence can also be derived from coercive influence which elicits compliance to avoid punishment or obtain rewards, and non-coercive influence which represents proactive attitude change due to external information [40]. Social influence influences an individual's emotions and attitude because individuals are engaged in complex social relationships [41]. As a part of social reciprocal networks, individuals show compliance to surrounding influences [42].

The current research defines social influence as the influence from the information that consumers gather from various social media platforms. With widespread application of smartphones and other mobile devices, it is becoming easier for individuals to obtain information. The information sourced from different channels has been shown to impact consumer psychological states [43,44]. Media coverage of the pandemic severity or empty shelves can result in psychological discomfort and stress [45,46]. Further, wrong information or contamination information can exacerbate people's anxiety and hopelessness [45]. Information on supply chain disruption and the hoarding behaviour of others enhance individuals' belief in product limitation and trigger fear on stock-out of essential products. Therefore, the following hypotheses are proposed:

**H5.** : Social influence has a positive influence on perceived scarcity.

**H6.** : Social influence has a positive influence on affective response.

Social norm refers to "rules and standards that are understood by members of a group, and that guide or constrain social behaviours without the force of law" [47]. Social norm is acknowledged to be an important explanatory factor of human psychology that works explicitly and implicitly [48]. The expectation, cues and behaviour of other social members influence an individual because individuals tend to comply with social norms to pursue a sense of belonging and social identification [49,50].

The current study defines social norm as the acceptance of stockpiling products by community members. Usually, rational consumers purchase only needed products. However, the threat from COVID-19 has

triggered a non-conventional, emerging norm to purchase more products than needed. Based on emergent norm theory, such panic buying behaviour is interpreted as a collective reaction to the fear of the pandemic [51]. Such behavioural change is affected by the information that product shortage is likely to happen due to the pandemic, and conveys the information that product unavailability might possibly affect normal life. Therefore, the perception of product scarcity is thus formed and enhanced. Higher social acceptance of hoarding makes purchasing products more difficult than usual, and increases anxiety and worry about failing to get the required products. Therefore, the following hypotheses are proposed:

**H7.** : Social norm has a positive influence on perceived scarcity.

**H8.** : Social norm has a positive influence on affective response.

### 2.3. The effects of perceived scarcity on affective response

Perceived scarcity has certain effects on affective responses ( $H_9$ ). Perception can be understood as the formation of perceptive pictures through the organisation of received environmental stimulus and this study proposes that perception precedes the emotional process [25]. Existing literature has found that perceived scarcity produces a series of affective responses. Guo et al. [52] posited that limited-quantity scarcity which refers to the restriction on the quantity and limited-time scarcity in the provision of products within only a certain period causes consumers' pressure and competitive arousal to obtain the product before others. Scarcity also triggers other negative emotions such as grief, agitation and sadness [53]. When consumers fail to obtain the desired item, they are likely to feel sad about not getting the product and blame the retailers [53].

The current study proposes that the perception of stock-out can result in fear and anxiety [54]. Products such as sanitisers are necessary not only for daily life but also have utility as protective measures against the pandemic. Therefore, the shortage of supply coupled with high demand, and the unknown about the future, lead to the fear of the inability to purchase those products. Therefore, the following hypothesis is proposed:

**H9.** : Perceived scarcity has a positive influence on affective response.

### 2.4. The effects of perceived scarcity and affective response on panic buying

There exists positive relationship between individuals' cognitive and affective processes and panic buying behaviour ( $H_{10}$  to  $H_{11}$ ). Previous literature has demonstrated that perceived scarcity influences consumer behaviour [55,56]. From the principles of economics, scarcity could come from both supply and demand side [57]. The ongoing pandemic leads to reduced productivity and decreases expected supply, while consumer's high demand for certain products exacerbates the shortage of products. Based on the reactance theory, such scarcity causes reduced perceived freedom [58]. The sense of losing freedom to engage in a behaviour causes individuals to possess a stronger desire to regain freedom. Individuals tend to have higher motivations to perform the behaviour once it becomes accessible. Therefore, individuals are more likely to exhibit panic buying behaviour driven by the fear of resource scarcity. When individuals perceive possible unavailability of certain products, they would be motivated to obtain more products than what is needed when it is still available to safeguard their freedom [9]. Correspondingly, the following hypothesis is proposed:

**H10.** : Perceived scarcity has a positive influence on panic buying.

Affect, a subjective emotional state, is an important determinant of human behaviour [59]. Positive emotions or negative emotions can encourage or discourage humans from accomplishing a certain behaviour [60]. Affective response refers to individuals' emotions that arise from stimuli [61]. Researchers have investigated the impact of affective response on consumer behaviour. For example, Bitner [62] proposed that affective responses are associated with two kinds of behaviours: approach and avoidance behaviour. Nusairat et al. [63] found that customers' emotions mediate between social cues and consumption behaviour. Chan et al. [64] posited that positive affective responses, such as self-gratification, indicate a higher chance to purchase luxury products.

Affective response is defined in the current study as fear or anxiety caused by the pandemic and social factors. The negative emotions caused by product shortage and price mark-up affect purchasing behaviour. When consumers possess higher fear of product shortage, they tend to purchase more products to overcome the negative emotions which gives them a sense of security. Therefore, the following hypothesis is proposed:

**H11.** : Perceived scarcity has a positive influence on panic buying.

### 2.5. The effects of perceived lack of self-control on panic buying

The individuals' perceived lack of control influences panic buying ( $H_{12}$ ). Self-control process is considered as a controlled, reflective system. Self-control allows an individual to judge if he or she has control over the current situation, and inhibits impulsive responses (i.e. panic buying) to stick to original norms [29]. Existing literature has posited that consumers with lower self-control are more easily influenced and persuaded by external forces than consumers with high self-control [51]. This is because consumers with high self-control tend to commit to established long-term objectives, make rational decisions and avoid being affected or changed by the influence of one specific instance [65]. On the other hand, consumers would try to regain control over the situation if they experience a loss of control [3]. They perform actions that they believe help them return to a better, controlled state [66].

The current study defines perceived lack of self-control as a lack of self-efficacy to achieve goals after a meticulous evaluation. If consumers evaluate that product unavailability is out of their control, and are overwhelmed by the thoughts that the pandemic is going to get worse in the future, they would more likely exhibit panic buying behaviour to regain control. On the contrary, consumers who judge they have high self-control and it is not worthwhile to hoard products would stick to original shopping behaviour. They divert their attention to other activities, for example, adapting to a healthier lifestyle or looking for proper substitute products. Therefore, a perceived lack of control is more likely to lead to a decision to hoard products, and the following hypothesis is proposed:

**H12.** : Perceived lack of control has a positive influence on panic buying.

### 2.6. The moderation effect of perceived lack of self-control

It is rationalised that perceived lack of control has a moderation effect on perceived scarcity and on affective response ( $H_{13}$  to  $H_{14}$ ). Martin and Sloman [67] posited the interaction of the impulsive system and the reflective system, indicating that the two systems function more than parallelly impacting consumer behaviour. The two systems can work jointly during certain stages to influence individuals' decision-making [68]. Self-control has been used as a moderator in human psychology



and behaviour studies [69,70]. Some previous studies on dual-system theories have also tested the moderating effects of self-control or self-regulation [71]. Consumers who consider themselves to lack control over the current situation would perceive scarcity to be more severe and hence, overcompensate in their behaviour by panic buying. On the other side, consumers who judge they have enough control would be more rational, perceive scarcity to be less severe and undercompensate in their behaviour in terms of panic buying. Therefore, it is proposed that perceived lack of control function as a moderator that interacts with the impulsive decision triggered by the organism. The following hypotheses are proposed:

**H13.** : Perceived lack of control enhances the effect of perceived scarcity on panic buying.

**H14.** : Perceived lack of control enhances the effect of affective response on panic buying.

### 3. Methodology

#### 3.1. Constructs and measurement items

The measurement items are basically adopted or adapted from prior research studies. The constructs consist of: four stimuli - perceived susceptibility (SUS), perceived severity (SEV), social influence (INF), social norm (NOR); two organism factors - perceived scarcity (SCA), affective response (AFE); one reflection factor - perceived lack of control (PLC); and one response factor - panic buying behaviour (BUY). Detailed measurement items and sources are listed in Table 1.

#### 3.2. Survey design and sampling process

A questionnaire survey is conducted to collect the data. The designed questionnaire is composed of three sections. A short introduction of the research background (i.e. COVID-19 and panic buying) and research purpose, as well as the guarantee of confidentiality are provided in the

**Table 1**  
Measurement items.

Construct	ID	Measurement Item	Source
Perceived susceptibility	SUS1	My chance of contracting COVID-19 is greater than others	Becker and Maiman [72]; Huang et al. [73]
	SUS2	Due to my physical health, I would more probably contract COVID-19	
	SUS3	I feel that my probability of contracting COVID-19 in the future is high	
Perceived severity	SEV1	The thought of contracting COVID-19 scares me	Huang et al. [73]
	SEV2	If I had COVID-19, my career would be endangered	
	SEV3	If I had COVID-19, my relationships with my family and friends will be affected	
Social influence	INF1	The media portrays public fear for the volatility of product prices and supply shortage during COVID-19	Sheu and Kuo [74]
	INF2	The media portrays the public frequently rush into a panic buying for products during COVID-19	
Social norm	NOR1	My friends find it acceptable to stockpile products	Gong et al. [75]
	NOR2	My family members find it acceptable to stockpile products	
	NOR3	My colleagues/classmates find it acceptable to stockpile products	
Perceived scarcity	SCA1	The products that I feel I want to buy will be very limited during COVID-19	Byun and Sternquist [76]
	SCA2	The brand availability for a product will be very limited during COVID-19	
	SCA3	The sizes of a product will be very limited during COVID-19	
	SCA4	The types of products will be very limited during COVID-19	
Affective response	AFE1	I am anxious about the volatility of product prices during COVID-19	Sheu and Kuo [74]
	AFE2	I have a great fear of supply shortage of products during COVID-19	
	AFE3	I am usually seized with panic due to the perceived phenomenon of products shortage during COVID-19	
Perceived lack of control	PLC1	I felt that I could not control what was happening	Kemp et al. [77]
	PLC2	I felt that the situation was out of my hands	
	PLC3	I was nervous and confused	
Panic buying	BUY1	I had the urge to grab products immediately	Byun and Sternquist [76]; Sheu and Kuo [74]
	BUY2	I snapped things up during the shopping trip in this shop	
	BUY3	When I took a product, I did not want to place it down even though I was not certain if I would purchase it or not	

first section. The guarantee basically states that the collected data will only be used for academic purpose and any private information will not be disclosed to any third party, therefore, the respondents would thereby be encouraged to give honest answers. The demographic information of participants is enquired in the second section, including gender, age, household income and housing type. In the third section, respondents are asked to rate the level of agreement on the measurement items in Table 1 between “1 = extremely low” to “7 = extremely high” based on a seven-point Likert Scale.

A professional survey company, Qualtrics is engaged to administer the online survey. To ensure the validity of the responses, attention checkers are built into certain questions. For instance, respondents are asked to select ‘4’ for a question. Responses who failed to select the assigned answer correctly are disqualified and deleted from the sample. The samples are collected for 17 days from June to July 2020. A total of 508 valid questionnaires are collected. A lump sum contract price is paid to Qualtrics, being inclusive of the rewards to participants who completed the questionnaire.

#### 3.3. Responses bias test

Since the survey uses a self-administrated method whereby the independent variables and dependent variables are obtained from the same sample, non-response bias and common method bias might weaken the result validity. To test non-response bias, the responses are divided into two equal groups based on the completion time [78]. A simple *t*-test is conducted to examine the mean difference between the two groups. The result shows that there is no significant difference between the two groups. Therefore, non-response bias is not of concern in this research.

To test the common method bias, Harman’s single factor test is applied and all observable items are loaded into one single factor. The total variance of the single factor model is 34.8 % which is below the critical value of 50 % recommended by Podsakoff et al. [79]. Therefore, common method bias is not a major issue for this research.

**Table 2**  
Confirmatory factor analysis results.

Construct	Item	$\lambda$	AVE	CR
Perceived susceptibility	SUS1	0.816	0.741	0.896
	SUS2	0.912		
	SUS3	0.852		
Perceived severity	SEV1	0.676	0.533	0.772
	SEV2	0.836		
	SEV3	0.666		
Social influence	INF1	0.888	0.612	0.756
	INF2	0.661		
Social norm	NOR1	0.880	0.785	0.916
	NOR2	0.874		
	NOR3	0.904		
Perceived scarcity	SCA1	0.799	0.731	0.916
	SCA2	0.875		
	SCA3	0.880		
	SCA4	0.865		
Affective response	AFE1	0.668	0.584	0.807
	AFE2	0.837		
	AFE3	0.779		
Perceived lack of control	PLC1	0.764	0.598	0.817
	PLC2	0.807		
	PLC3	0.749		
Panic buying	BUY1	0.842	0.666	0.857
	BUY2	0.790		
	BUY3	0.816		

Model fit indices:  $\chi^2/df = 1.94$ , ( $p < 0.05$ ); CFI = 0.970; TLI = 0.963; RMSEA = 0.043; SRMR = 0.050.

### 3.4. Demographic characteristics

For the collected 508 responses, the proportion of male is around 51 % and the proportion of females is around 49 %. This gender distribution is rather close to Singapore residents' gender ratio of 51.1 %:48.9 %.<sup>1</sup> Furthermore, respondents ageing between 16 and 34 years account for 49 % of the total sample. About 38 % of the sample fall between age 35–49 years and 13 % of the respondents are older than 50 years old. The median of the age distribution falls between 35 and 49 years which is consistent with the median age of the whole Singapore's population of 42.4 years.<sup>2</sup> Moreover, 45 % of the respondents have higher than SGD8000 household monthly income and the remaining 55 % respondents receive lower than SGD 8000 household monthly income. Around 78 % of the participants' housing type is public housing which is close to the average ratio of Singapore's whole resident population (80 %).<sup>3</sup> The collected sample is therefore considered representative of Singapore's resident population.

## 4. Results and discussion

A two-step process is performed for data analysis. Firstly, confirmatory factor analysis is performed to examine the reliability, validity and model fit of the measurement model. Thereafter, structural equation modelling is performed to examine the relationships among constructs in order to test the proposed research hypotheses.

### 4.1. Measurement model analysis

The results of confirmatory factor analysis are illustrated in Table 2. Comparative fit index (CFI) and Tucker-Lewis index (TLI) values are above 0.95 [80]. Root mean square error of approximation (RMESA) is

<sup>1</sup> <https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Pages/Singapore-Demographic-Sex-Ratio-Males-to-Females.aspx>.

<sup>2</sup> <https://www.worldometers.info/world-population/singapore-population/>.

<sup>3</sup> <https://www.hdb.gov.sg/cs/infoweb/about-us/our-role/public-housing-a-singapore-icon#:~:text=The%20flats%20spell%20home%20for,optimal%20living%20environment%20for%20residents.>

below the threshold of 0.8 and standardised root mean square residual (SRMR) is below 0.10 [80]. The results indicate acceptable model fits. Moreover, all factor loadings are greater than 0.60 and composite reliabilities are greater than 0.70, suggesting that the measurement items are reliable [81]. The measurement items are valid as well. The average variance extracted (AVE) values are all greater than 0.50, suggesting good convergent validity [81]. Therefore, the latent constructs are well reflected by their corresponding items. As shown in Table 3, the correlation between any two constructs is smaller than the respective squared root of AVE values. Therefore, discriminant validity is supported.

### 4.2. Structural model analysis

The results of structural equation modelling are presented in Fig. 2. The results suggest acceptable model fit ( $\chi^2/df = 2.10$ ,  $p < 0.05$ ); CFI = 0.951; TLI = 0.943; IFI = 0.951; RMSEA = 0.050; SRMR = 0.055). Additionally, the squared multiple correlation ( $R^2$ ) of perceived scarcity is 0.276. The  $R^2$  of affective response and panic buying are 0.588 and 0.433, respectively. The values indicate acceptable explanatory power [82].

Age, gender and income are used as controlling variables in this study because they could possibly influence consumer behaviour. The coefficients of "age" "gender" "income" are  $-0.052$ ,  $0.048$  and  $0.113$ , respectively. Only the effect of income on panic buying is significant. The significant impact of income on panic buying behaviour is expected because income is positively associated with consumption. Higher household income indicates a higher disposable income and therefore, a relatively stronger purchasing power to stock up on the products. On the contrary, lower household income indicates higher budget restrictions and relatively lower purchasing power. Furthermore, although age is shown to have a negative influence on panic buying, the effect is not significant. One possible explanation is that the COVID-19 has affected humans' lives regardless of age. People of different ages have the motivation to hoard products such as sanitisers to protect themselves from the pandemic. Therefore, although it can be argued that younger generations might perceive they are less vulnerable to diseases and would take fewer protective measures, the result does not support such argument. Moreover, gender is not found to have a significant effect on panic buying as well. This result is consistent with some previous studies [83,84]. Despite possible behavioural heterogeneity caused by different gender characteristics, demands and lifestyles [85], panic buying response does not display difference between males and females.

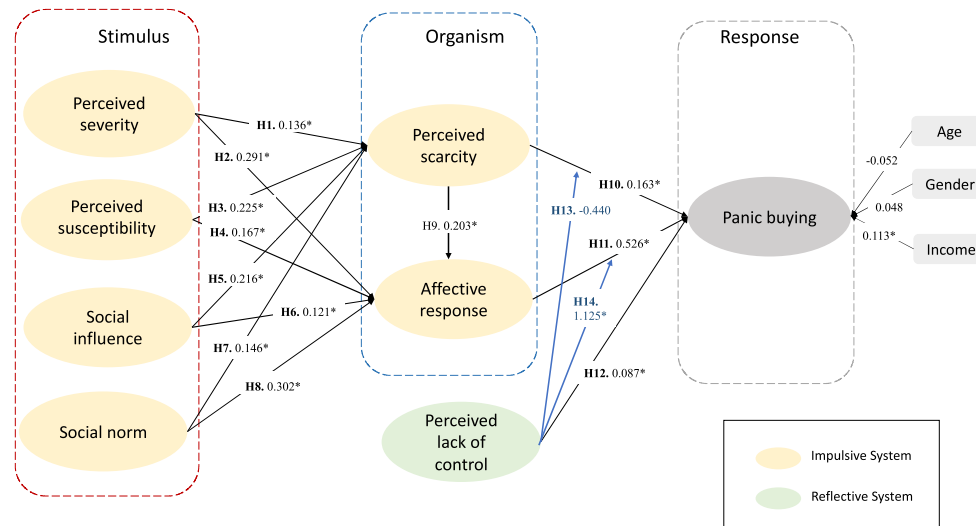
After taking into account the effects of controlling variables, all hypotheses are found to be supported in this study as indicated in Fig. 2. Perceived susceptibility and perceived severity have significant positive effects on perceived scarcity and affective response, supporting H<sub>1</sub> to H<sub>4</sub>. The results show that the two health belief factors impact consumers' emotions and cognitions. When consumers perceive a less severe outcome or lower likelihood of contracting COVID-19, they tend to expect less strict limitations on social distancing and cargo movements, higher productivity in production and availability of products. Therefore, they shall be less concerned about scarcity or develop negative emotions.

Social influence is shown to have significant positive effects on perceived scarcity and affective response, confirming H<sub>5</sub> and H<sub>6</sub>. The results support the influential power of various media platforms on consumers' perception of scarcity and emotional changes. The advancement of technologies has simplified humans' lifestyle. Humans are able to access greater amount of information. However, the reported information might be exaggerated or targeted to attract attention. Consumer who cannot well distinguish the information may be misguided. Furthermore, information carried by media platforms can shape individuals' perceptions. For example, continuous reports on supply chain disruptions during the pandemic can enhance consumers' expectation of product shortage. Coverage on stockpiling behaviour in other regions further strengthens consumers' beliefs in a stock-out and

**Table 3**  
Squared root of AVE and correlations of constructs.

	SUS	SEV	INF	NOR	SCA	AFE	PLC	BUY
SUS	0.861 <sup>a</sup>							
SEV	0.502 <sup>b</sup>	0.730						
INF	0.216	0.361	0.782					
NOR	0.271	0.400	0.366	0.886				
SCA	0.372	0.392	0.352	0.334	0.855			
AFE	0.448	0.605	0.458	0.536	0.513	0.764		
PLC	0.036	0.175	0.297	0.115	0.313	0.212	0.773	
BUY	0.459	0.448	0.237	0.521	0.464	0.578	0.254	0.816

<sup>a</sup> Squared root of AVE values are along the main diagonal.  
<sup>b</sup> Correlations between constructs are below the main diagonal.



Fit indices:  $\chi^2/df = 2.10, p < 0.05; CFI = 0.951; TLI = 0.943; IFI = 0.950; RMSEA = 0.050;$   
 SRMR = 0.060.

Note: \* indicates a significant effect

**Fig. 2.** Structural modelling result.

Fit indices:  $\chi^2/df = 2.10, p < 0.05; CFI = 0.951; TLI = 0.943; IFI = 0.950; RMSEA = 0.050; SRMR = 0.060.$  Note: \* indicates a significant effect

triggers fear of not being able to obtain sufficient products. Therefore, the influence from social media must not be overlooked.

Social norms are shown to exert a significant positive effect on perceived scarcity and affective response as well. Thus, H<sub>7</sub> and H<sub>8</sub> are supported. The results reveal that social norms are important instruments that influence consumers' attitudes and perceptions. The collapse of restrained buying behaviour and the emergence of panic buying due to the pandemic cause consumers to form the perception of scarcity because as more people are accustomed to panic buying, perceived scarcity is expected to escalate due to competition. Furthermore, consumers tend to be more anxious as it becomes increasingly difficult to purchase necessary products.

Perceived scarcity has a significant positive effect on affective response, thus, H<sub>9</sub> is supported. The result empirically supports the hypothesis proposed by Arafat et al. [20], that perception of scarcity can lead to panic buying. The result further ascertains that affective response is influenced not only by external stimuli but also by cognitive perceptions that involve analysing and interpreting external surroundings. Scarcity indicates fewer resources are available and more efforts are required to obtain needed products. For instance, when consumers perceive lower scarcity, they are less bothered by the woe, fear and anxiety for not being able to obtain enough resources for survival. Therefore, getting rid of the perception of scarcity is essential to reduce emotional stress.

Both perceived scarcity and affective response have significant positive effects on panic buying, supporting H<sub>10</sub> and H<sub>11</sub>. The significant effect of perceived scarcity is in line with the reactance theory. When consumers perceive abundant resources, they have more freedom to choose from available goods and are less motivated to stockpile. Enough inventory to satisfy demands indicates a lower possibility of price increase caused by surplus demand. Therefore, perceived scarcity drives panic buying behaviour. Moreover, the significant effect of affective response corroborates the importance of emotions, feeling and thoughts on influencing consumer behaviour.

Further, perceived lack of control is demonstrated to be positively associated with panic buying behaviour, supporting H<sub>12</sub>. This is in line with the dual-system theory that panic buying behaviour is influenced by impulsive responses from external stimuli and rational reflection on self-control ability. When consumers judge that they have enough control over the current situation, they are more likely to stick to normal shopping behaviour. However, when consumers evaluate that the current situation is out of their control and they would suffer more in the future if they do not stockpile, they shall panic buy to regain control.

The testing of moderation effect is based on the indicant product approach proposed by Ping Jr [86]. The basic logic is to use cross-product of measurement items to examine if the interaction of latent variables has a significant effect on the exogenous variable. To illustrate, the indicators of perceived lack of control and affective

response are mean-centred before performing cross-product to overcome multicollinearity issues. Thereafter, the measurement items of perceived lack of control and affective response are summed, respectively. The two summed values are multiplied to create a single indicator of the latent interaction factor. The significance of the interaction factor is tested by running the model. It is found that the moderating effect is significant, supporting H<sub>14</sub>. However, the effect of perceived lack of control on the path between perceived scarcity and panic buying is not significant; therefore, H<sub>13</sub> is not supported. A possible explanation is that reflective system has more influence on emotional processing while interacts less with consumers' cognitive processing. The effects of reflective system on cognitive responses could be studied further in the future. The results suggest that consumers who exhibit low control are more anxious about the situation and more likely to exhibit panic buying than consumers who have greater control.

4.3. Direct, indirect and total effects

The influences of the exogenous variables on endogenous variables are presented in Table 4. For the direct effects, the main determinants of perceived scarcity are perceived susceptibility ( $a_{21} = 0.225$ , social influence ( $a_{31} = 0.216$ ), social norms ( $a_{41} = 0.146$ ), and perceived severity ( $a_{11} = 0.136$ ). For affective response, in descending order of importance, the determinants are normative social norms ( $a_{42} = 0.302$ ), perceived severity ( $a_{12} = 0.291$ ), perceived susceptibility ( $a_{22} = 0.167$ ), and social influence ( $a_{32} = 0.121$ ).

As for the indirect effects, in descending order of importance, the drivers of affective response are perceived susceptibility ( $b_{22} = 0.045$ ), social influence ( $b_{32} = 0.044$ ), social norms ( $b_{42} = 0.029$ ), and perceived severity ( $b_{12} = 0.028$ ).

For the total effects, affective response has the largest effect on panic buying ( $c_{73} = 0.526$ ). This is followed by perceived scarcity ( $c_{63} = 0.269$ ), social norms ( $c_{43} = 0.198$ ), perceived severity ( $c_{13} = 0.190$ ), perceived susceptibility ( $c_{23} = 0.148$ ), social influence ( $c_{33} = 0.122$ ), and perceived lack of control ( $c_{53} = 0.087$ ).

**Table 4**  
Direct, indirect and total effects.

Exogenous (i)	Endogenous (j)		
	Perceived scarcity	Affective response	Panic buying
<i>Direct effects (a<sub>ij</sub>) of ...</i>			
Perceived severity	0.136	0.291	-
Perceived susceptibility	0.225	0.167	-
Social influence	0.216	0.121	-
Social norms	0.146	0.302	-
Perceived lack of control	-	-	0.087
Perceived scarcity	-	0.203	0.163
Affective response	-	-	0.526
<i>Indirect effects (b<sub>ij</sub>) of ...</i>			
Perceived severity	-	0.028	0.190
Perceived susceptibility	-	0.045	0.148
Social influence	-	0.044	0.122
Social norms	-	0.029	0.198
Perceived lack of control	-	-	-
Perceived scarcity	-	-	0.106
Affective response	-	-	-
<i>Total effects (c<sub>ij</sub>) of ...</i>			
Perceived severity	0.136	0.319	0.190
Perceived susceptibility	0.225	0.212	0.148
Social influence	0.216	0.165	0.122
Social norms	0.146	0.332	0.198
Perceived lack of control	-	-	0.087
Perceived scarcity	-	0.203	0.269
Affective response	-	-	0.526

5. Conclusion

The objective of this research study is to provide a holistic explanation for panic buying during the COVID-19 pandemic from a psychological perspective. Anchoring on the stimulus-organism-response framework and dual-system theory, this study proposes a theoretical model to explain the drivers of panic buying. An online questionnaire survey is conducted that involves 508 respondents. Then, confirmatory factor analysis and structural equation modelling are employed to analyse the data. The results indicate that environmental stimuli which includes perceived scarcity and affective response trigger the internal organism. Further, perceived scarcity, affective response and perceived lack of control could directly shape panic buying.

5.1. Theoretical contributions

This research makes theoretical contributions in the field of consumer behaviour and consumer psychology. Firstly, limited research has been conducted on panic buying during the COVID-19 focusing from the external (i.e. stimulus) and internal (i.e. psychological cognition) lens. This topic subject matter is well worthy of investigation because a better understanding of panic buying behaviour is critical for establishing suitable policies to manage the escalation of panic buying and promoting the recovery of supply chain networks. This research enriches the stream of literature by examining impulsive organism factors (i.e. perceived scarcity and affective response), which are induced by health concerns and social factors, and rational reflection (i.e. lack of control) that influence panic buy. Secondly, this research extends the SOR framework and dual-system theory to the area of panic buying behaviour. This research has identified the following determinants of panic buying: perceived severity, perceived susceptibility, social influence, social norms, perceived scarcity, affective response, perceived lack-of-control. Thirdly, this research models the interaction of impulsive system and reflective system with the moderating effect of perceived lack of control. The moderating effect of lack of control on the influence of affective response on panic buying provides empirical evidence on the interaction of the two systems. This suggests that panic buying behaviour is linearly as well as jointly influenced by the impulsive and reflective system. Yet, the impulsive system plays the more dominant role in the decisions to panic buying.

5.2. Policy implications

The research findings provide a basic understanding of panic buying behaviour for policymakers and businesses. This study also provides implications for policymakers on the control of panic buying under COVID-19 as well as improve preparedness against future health crisis.

Firstly, considering the impacts of the COVID-19 threats on consumers' perceived scarcity and affective responses, strict measures can be taken to combat the spread of the pandemic and reduce the likelihood of contracting COVID-19. For example, compulsory social distancing and mask-wearing, strict position tracing can be continued and adjusted according to the development of the pandemic. Promotion of hygiene habits and appropriate support on job safety or job shift should be considered to reduce the severity of COVID-19.

Secondly, as media has an important role in conveying external information and shaping consumers' perceptions, the exaggeration or manipulation of coverage should be curtailed to the greatest extent. The media should be aware of their responsibility in nullifying rumours and presenting useful information to the public [87]. Moreover, since a lack of trust in government's control ability can increase the likelihood of panic buying [20], government agencies can take advantage of various media platforms such as televisions and social media to distribute necessary information on how to properly protect oneself from contracting COVID-19 and update on the real-time development as well as effective control measures to effectively combat the pandemic and gain



public faith [88]. They shall endeavour to pass positive news to the public to allay public's fear and anxiety. For example, retailers' efforts to replenish inventory, the government's support on creating a safe working environment and effective measures to combat the pandemic can build public's confidence in the resilience of supply chains.

In addition to the utilisation of social media to convey positive information, appropriate limits on products that can be purchased can serve to minimise stock-out situations. This is consistent with Arafat et al. [88] 's suggestions to put a bar on product purchasing and provide assistance to people with special needs. This can effectively reduce consumers' perception of scarcity and fear due to large purchases of products. Additionally, businesses should also enhance their resilience towards disasters. Government as well as upstream and downstream businesses should cooperate to combat supply chain collapse. Advanced technologies such as blockchain-based tracing and big data analysis can be applied to collect real-time demand information of customers so that businesses have a clearer command on which product should deserve more attention and require more inventories. Automating production process and strict monitoring of labour's health conditions contribute towards creating a safer and more efficient working environment so that basic production requirements can be met even in the pandemic. In summary, efforts on rebuilding supply chains and the acknowledgement of those endeavours to the public play a crucial role in reducing consumers' perceptions of scarcity, which in turn limits panic buying behaviour.

Furthermore, as consumers who have low self-control are more prone to panic buying, measures should be applied to enhance consumers' sense of control. Since public sensitisation is helpful for coping with panic buying [89], psychological education programmes aiming at helping consumers to improve the ability to have rational judgment and restoring self-control can be established.

### 5.3. Limitations and recommendations

This study has several limitations. Firstly, this study is conducted in Singapore which has its own unique demographic characteristics. Strict social distancing measures are vigorously put into practice in Singapore. Additionally, Singapore relies heavily on imports. Therefore, the result would not be directly generalisable to other countries. Future research should be conducted in other countries or cultural backgrounds to cross-validate the analysis results. Secondly, this study synthesises two tenets and identifies environmental stimuli from the health belief model and social factors. Future study shall consider incorporating other suitable theories and factors to improve the explanatory power of the model. Thirdly, the moderation effects of demographic factors should be studied further. Fourthly, this study examines panic buying based on a single point in time. Longitudinal observation and assessment shall be undertaken to detect changes in the effects of the determinants across different periods of the COVID-19 pandemic.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### References

- [1] S. Billore, T. Anisimova, Panic buying research: a systematic literature review and future research agenda, *Int. J. Consum. Stud.* (2021).
- [2] S.K. Kar, V. Menon, S.Y. Arafat, Online group cognitive behavioral therapy for panic buying: understanding the usefulness in COVID-19 context, *Indian J. Psychiatr.* 62 (5) (2020) 607.
- [3] K.F. Yuen, X. Wang, F. Ma, K.X. Li, The psychological causes of panic buying following a health crisis, *Int. J. Environ. Res. Publ. Health* 17 (10) (2020) 3513.
- [4] J. Preston, C. Chadderton, K. Kitagawa, C. Edmonds, Community response in disasters: an ecological learning framework, *Int. J. Lifelong Educ.* 34 (6) (2015) 727–753.
- [5] D. Ivanov, Predicting the impacts of epidemic outbreaks on global supply chains: a simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case, *Transport. Res. E Logist. Transport. Rev.* 136 (2020) 101922.
- [6] A. Yap, C. Chen, The Psychology behind Coronavirus Panic Buying, *Insead Knowledge*, 2020, pp. 1–2.
- [7] S.M.Y. Arafat, K.F. Yuen, V. Menon, S. Shoib, A.R. Ahmad, Panic buying in Bangladesh: an exploration of media reports, *Front. Psychiatr.* 11 (2020).
- [8] S.M.Y. Arafat, S.K. Kar, R. Kabir, Editorial: panic buying: human psychology and environmental influence, *Frontiers Pub. Health* 9 (589) (2021).
- [9] G. Chua, K.F. Yuen, X. Wang, Y.D. Wong, The determinants of panic buying during COVID-19, *Int. J. Environ. Res. Publ. Health* 18 (6) (2021) 1–28.
- [10] K.F. Yuen, J. Leong, Y.D. Wong, X. Wang, Panic buying during COVID-19: survival Psychology and needs perspectives in deprived environments, *Int. J. Disaster Risk Reduc.* 62 (2021) 102421.
- [11] S.M.Y. Arafat, S.K. Kar, V. Menon, A. Alradie-Mohamed, S. Mukherjee, C. Kaliamoorthy, R. Kabir, Responsible factors of panic buying: an observation from online media reports, *Frontiers Pub. Health* 8 (747) (2020).
- [12] R.P. Bentall, A. Lloyd, K. Bennett, R. McKay, L. Mason, J. Murphy, O. McBride, T. K. Hartman, J. Gibson-Miller, L. Levita, Pandemic buying: testing a psychological model of over-purchasing and panic buying using data from the United Kingdom and the Republic of Ireland during the early phase of the COVID-19 pandemic, *PLoS One* 16 (1) (2021) e0246339.
- [13] M. Lehberger, A.K. Kleih, K. Sparke, Panic Buying in Times of Coronavirus (COVID-19): Extending the Theory of Planned Behavior to Understand the Stockpiling of Nonperishable Food in Germany, *Appetite*, 2021, p. 161.
- [14] S.E. Li, Toilet paper thrones and heated tweets: applying moral panic and social network theory to responses over panic buying during COVID-19, *Int. J. Soc. Sci. Humanit.* 11 (2) (2021).
- [15] S. Laato, A.N. Islam, A. Farooq, A. Dhir, Unusual purchasing behavior during the early stages of the COVID-19 pandemic: the stimulus-organism-response approach, *J. Retailing Consum. Serv.* 57 (2020) 102224.
- [16] K.E. Stanovich, R.F. West, Individual differences in reasoning: implications for the rationality debate? *Behav. Brain Sci.* 23 (5) (2000) 645–665.
- [17] O. Turel, H. Qahri-Saremi, Problematic use of social networking sites: antecedents and consequence from a dual-system theory perspective, *J. Manag. Inf. Syst.* 33 (4) (2016) 1087–1116.
- [18] O. Turel, H. Qahri-Saremi, Explaining unplanned online media behaviors: dual system theory models of impulsive use and swearing on social networking sites, *New Media Soc.* 20 (8) (2018) 3050–3067.
- [19] D.-H. Park, J. Lee, eWOM overload and its effect on consumer behavioral intention depending on consumer involvement, *Electron. Commer. Res. Appl.* 7 (4) (2008) 386–398.
- [20] S.M.Y. Arafat, S.K. Kar, M. Marthoenis, P. Sharma, E. Hoque Apu, R. Kabir, Psychological underpinning of panic buying during pandemic (COVID-19), *Psychiatr. Res.* 289 (2020) 113061.
- [21] S. Eroglu, K. Machleit, L. Davis, Empirical testing of a model of online store atmospherics and shopper responses, *Psychol. Market.* 20 (2003) 139–150.
- [22] K. Borg, J. Curtis, J. Lindsay, Social norms and plastic avoidance: testing the theory of normative social behaviour on an environmental behaviour, *J. Consum. Behav.* 19 (6) (2020) 594–607.
- [23] S. Youn, S.V. Jin, Reconnecting with the past in social media: the moderating role of social influence in nostalgia marketing on Pinterest, *J. Consum. Behav.* 16 (6) (2017) 565–576.
- [24] S. Loureiro, L. Ribeiro, The Effect of Atmosphere on Emotions and Online Shopping Intention: Age Differentiation, Australian and New Zealand Marketing Academy Conference, Perth, Australia, 2011.
- [25] I.Y. Lin, Evaluating a servicescape: the effect of cognition and emotion, *Int. J. Hospit. Manag.* 23 (2) (2004) 163–178.
- [26] A. Mehrabian, J.A. Russell, The basic emotional impact of environments, *Percept. Mot. Skills* 38 (1) (1974) 283–301.
- [27] D. Robert, R. John, Store atmosphere: an environmental psychology approach, *J. Retailing* 58 (1) (1982) 34–57.
- [28] A. Samson, B.G. Voyer, Two minds, three ways: dual system and dual process models in consumer psychology, *AMS Review* 2 (2–4) (2012) 48–71.
- [29] A.A. Soror, B.I. Hammer, Z.R. Steelman, F.D. Davis, M.M. Limayem, Good habits gone bad: explaining negative consequences associated with the use of mobile phones from a dual-systems perspective, *Inf. Syst. J.* 25 (4) (2015) 403–427.
- [30] H. Xu, K.Z. Zhang, S.J. Zhao, A Dual Systems Model of Online Impulse Buying, *Industrial Management & Data Systems*, 2020.
- [31] W. Hofmann, M. Friese, F. Strack, Impulse and self-control from a dual-systems perspective, *Perspect. Psychol. Sci.* 4 (2) (2009) 162–176.
- [32] D. Ivanov, A. Das, Coronavirus (COVID-19/SARS-CoV-2) and supply chain resilience: a research note, *Int. J. Integrated Supply Manag.* 13 (1) (2020) 90–102.
- [33] S. Botchway, S. Fazel, Remaining vigilant about COVID-19 and suicide, *The Lancet Psychiatry* 8 (7) (2021) 552–553.
- [34] S. Shoib, S.Y. Arafat, COVID-19 and the communication blackouts in Kashmir, India, *The Lancet Psychiatry* 7 (9) (2020) 738.
- [35] S. Barua, Understanding coronanomics: the economic implications of the coronavirus (COVID-19) pandemic, 2020.
- [36] J.R. Smith, W.R. Louis, P.W. Schultz, Introduction: social influence in action, *Group Process. Intergr. Relat.* 14 (5) (2011) 599–603.
- [37] W.A. Mason, F.R. Conroy, E.R. Smith, Situating social influence processes: dynamic, multidirectional flows of influence within social networks, *Pers. Soc. Psychol. Rev.* 11 (3) (2007) 279–300.
- [38] R.E. Burnkrant, A. Cousineau, Informational and normative social influence in buyer behavior, *J. Consum. Res.* 2 (3) (1975) 206–215.

- [39] K.R. Lord, M.-S. Lee, P. Choong, Differences in Normative and Informational Social Influence, *ACR North American Advances*, 2001.
- [40] G.L. Frazier, R.C. Rody, The use of influence strategies in interfirm relationships in industrial product channels, *J. Market.* 55 (1) (1991) 52–69.
- [41] D.R. Forsyth, Social Influence and Group Behavior, *Handbook of Psychology: Personality and Social Psychology*, second ed., vol. 5, John Wiley & Sons, Inc., Hoboken, NJ, US, 2013, pp. 305–328.
- [42] J.-G. Lee, K.J. Kim, S. Lee, D.-H. Shin, Can autonomous vehicles be safe and trustworthy? Effects of appearance and autonomy of unmanned driving systems, *Int. J. Hum. Comput. Interact.* 31 (10) (2015) 682–691.
- [43] C.V. Dimofte, C.P. Haugtvedt, R.F. Yalch, *Consumer Psychology in a Social Media World*, Routledge, 2015.
- [44] A.C. Scheinbaum, *The Dark Side of Social Media: A Consumer Psychology Perspective*, Routledge, 2017.
- [45] S.M.Y. Arafat, A.R. Ahmad, H.R. Murad, H.M. Kakashekh, Perceived impact of social media on panic buying: an online cross-sectional survey in Iraqi Kurdistan, *Frontiers Pub. Health* 9 (447) (2021).
- [46] G.J. Asmundson, S. Taylor, Coronaphobia: fear and the 2019-nCoV outbreak, *J. Anxiety Disord.* 70 (2020) 102196.
- [47] R.B. Cialdini, M.R. Trost, Social influence: social norms, conformity and compliance, in: fourth ed. *The Handbook of Social Psychology*, vols. 1–2, McGraw-Hill, New York, NY, US, 1998, pp. 151–192.
- [48] R.C. Dempsey, J. McAlaney, B.M. Bewick, A critical appraisal of the social norms approach as an interventional strategy for health-related behavior and attitude change, *Front. Psychol.* 9 (2180) (2018).
- [49] A. Charles, Identity, Norms, and Ideals, *Exchange Entitlement Mapping*, Springer, 2012, pp. 33–52.
- [50] R.B. Cialdini, R.R. Reno, C.A. Kallgren, A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places, *J. Pers. Soc. Psychol.* 58 (6) (1990) 1015.
- [51] R. Turner, L. Killian, *Collective Behavior*, Prentice Hall, 1987.
- [52] J. Guo, L. Xin, Y. Wu, Arousal or not? The effects of scarcity messages on online impulsive purchase, in: F.F.-H. Nah, C.-H. Tan (Eds.), *HCI in Business, Government and Organizations. Supporting Business*, Springer International Publishing, Cham, 2017, pp. 29–40.
- [53] A. Biraglia, B. Usrey, A. Ulqinaku, The downside of scarcity: scarcity appeals can trigger consumer anger and brand switching intentions, *Psychol. Market.* (2021).
- [54] W.A. Ahmed, The concept of scarcity and its implication on human behaviour: searching the Qur'anic perspective, *Review of Islamic Studies* 14 (1) (2010) 147–171.
- [55] S. Gupta, J.W. Gentry, The behavioral responses to perceived scarcity—the case of fast fashion, *Int. Rev. Retail Distrib. Consum. Res.* 26 (3) (2016) 260–271.
- [56] H.H. Ku, C.C. Kuo, T.W. Kuo, The effect of scarcity on the purchase intentions of prevention and promotion motivated consumers, *Psychol. Market.* 29 (8) (2012) 541–548.
- [57] H. Gierl, M. Plantsch, J. Schweidler, Scarcity effects on sales volume in retail, *Int. Rev. Retail Distrib. Consum. Res.* 18 (1) (2008) 45–61.
- [58] G. Lessne, M. Venkatesan, *Reactance theory in consumer research: the past, present and future*, 1989.
- [59] N.H. Frijda, *The Emotions*, Cambridge University Press, 1986.
- [60] D. Gregory-Smith, A. Smith, H. Winkhofer, Emotions and dissonance in 'ethical' consumption choices, *J. Market. Manag.* 29 (11–12) (2013) 1201–1223.
- [61] P. Zhang, The affective response model: a theoretical framework of affective concepts and their relationships in the ICT context, *MIS Q.* (2013) 247–274.
- [62] M.J. Bitner, Servicescapes: the impact of physical surroundings on customers and employees, *J. Market.* 56 (2) (1992) 57–71.
- [63] N.M. Nusairat, A.H.O. Akhorshaidh, T. Rashid, S. Sahadev, G. Rembielak, Social cues-customer behavior relationship: the mediating role of emotions and cognition, *Int. J. Market. Stud.* 9 (1) (2017) 1–17.
- [64] W.Y. Chan, C.K.M. To, W.C. Chu, Materialistic consumers who seek unique products: how does their need for status and their affective response facilitate the repurchase intention of luxury goods? *J. Retailing Consum. Serv.* 27 (2015) 1–10.
- [65] H. Rachlin, *The Science of Self-Control*, Harvard University Press, 2000.
- [66] A.J.Y.C.Y. Chen, *The Psychology behind Coronavirus Panic Buying*, INSEAD, 2020.
- [67] J.W. Martin, S.A. Sloman, Refining the dual-system theory of choice, *J. Consum. Psychol.* 23 (4) (2013) 552–555.
- [68] F. Strack, R. Deutsch, Reflective and impulsive determinants of social behavior, *Pers. Soc. Psychol. Rev.* 8 (3) (2004) 220–247.
- [69] J.-B. Li, A. Yang, K. Dou, R.Y. Cheung, Self-control moderates the association between perceived severity of coronavirus disease 2019 (COVID-19) and mental health problems among the Chinese public, *Int. J. Environ. Res. Publ. Health* 17 (13) (2020) 4820.
- [70] T.A. Wills, F.X. Gibbons, J.D. Sargent, M. Gerrard, H.-R. Lee, S. Dal Cin, Good self-control moderates the effect of mass media on adolescent tobacco and alcohol use: tests with studies of children and adolescents, *Health Psychol.* 29 (5) (2010) 539.
- [71] H. Xu, K.Z. Zhang, S.J. Zhao, A dual systems model of online impulse buying, *Ind. Manag. Data Syst.* 120 (5) (2020) 845–861.
- [72] M.H. Becker, L.A. Maiman, Sociobehavioral determinants of compliance with health and medical care recommendations, *Med. Care* 13 (1) (1975) 10–24.
- [73] H.-T. Huang, Y.-M. Kuo, S.-R. Wang, C.-F. Wang, C.-H. Tsai, Structural factors affecting health examination behavioral intention, *Int. J. Environ. Res. Publ. Health* 13 (4) (2016) 395.
- [74] J.-B. Sheu, H.-T. Kuo, Dual speculative hoarding: a wholesaler-retailer channel behavioral phenomenon behind potential natural hazard threats, *Int. J. Disaster Risk Reduc.* 44 (2020) 101430.
- [75] X. Gong, Z.K. Zhang Kem, C. Chen, M.K. Cheung Christy, K.O. Lee Matthew, Antecedents and consequences of excessive online social gaming: a social learning perspective, *Inf. Technol. People* 33 (2) (2019) 657–688.
- [76] S.-E. Byun, B. Sternquist, The antecedents of in-store hoarding: measurement and application in the fast fashion retail environment, *Int. Rev. Retail Distrib. Consum. Res.* 18 (2) (2008) 133–147.
- [77] E. Kemp, P.A. Kennett-Hensel, K.H. Williams, The calm before the storm: examining emotion regulation consumption in the face of an impending disaster, *Psychol. Market.* 31 (11) (2014) 933–945.
- [78] J.S. Armstrong, T.S. Overton, Estimating nonresponse bias in mail surveys, *J. Market. Res.* 14 (3) (1977) 396–402.
- [79] P. Podsakoff, S. MacKenzie, J.Y. Lee, N. Podsakoff, Common method biases in behavioral research: a critical review of the literature and recommended remedies, *J. Appl. Psychol.* 88 (2003) 879–903.
- [80] L.t. Hu, P.M. Bentler, Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives, *Struct. Equ. Model.: A Multidisciplinary Journal* 6 (1) (1999) 1–55.
- [81] J. Hair, R. Anderson, B. Babin, W. Black, *Multivariate Data Analysis: A Global Perspective*, vol. 7, Pearson, Upper Saddle River, NJ, 2010.
- [82] J. Cohen, P. Cohen, S.G. West, L.S. Aiken, *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, Routledge, 2013.
- [83] U. Ghani, F.A. Jan, An exploratory study of the impulse buying behaviour of urban consumers in Peshawar, *Int. Conf. Bus. Eco.* (2011) 157–159.
- [84] H.S. Yoon, L.G. Occena, Influencing factors of trust in consumer-to-consumer electronic commerce with gender and age, *Int. J. Inf. Manag.* 35 (3) (2015) 352–363.
- [85] S. Bakshi, Impact of gender on consumer purchase behaviour, *J. Res. Comm. Manage.* 1 (9) (2012) 1–8.
- [86] R.A. Ping Jr., A parsimonious estimating technique for interaction and quadratic latent variables, *J. Market. Res.* 32 (3) (1995) 336–347.
- [87] S.M.Y. Arafat, S.K. Kar, V. Menon, C. Kaliamoorthy, S. Mukherjee, A. Alradie-Mohamed, P. Sharma, M. Marthoenis, R. Kabir, Panic buying: an insight from the content analysis of media reports during COVID-19 pandemic, *Neurol. Psychiatr. Brain Res.* 37 (2020) 100–103.
- [88] S.M.Y. Arafat, S.K. Kar, R. Kabir, Possible controlling measures of panic buying during COVID-19, *Int. J. Ment. Health Addiction* (2020).
- [89] S.M.Y. Arafat, S.K. Kar, V. Menon, P. Sharma, M. Marthoenis, R. Kabir, Panic buying during COVID-19 pandemic: a letter to the editor, *Annals of Indian Psychiatry* 4 (2) (2020) 242.
- [90] Dmitry Ivanov, Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case, *Transportation Research Part E: Logistics and Transportation Review* 136 (2020).