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Panic buying during COVID-19: Survival psychology and needs perspectives in deprived environments

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ABSTRACT

Panic buying (PB), a typical consumer behaviour induced by crisis, was observed worldwide in the face of COVID-19 pandemic. Drawing on Survival Psychology and Maslow’s motivation theories, this study introduced a theoretical model to establish the factors affecting consumers’ PB and investigate their interrelationships. An online survey was designed and administered to 508 respondents in Singapore. Then, structural equation modelling was implemented to study the survey data. The results indicated that the effects of several constructs namely, normative social influence, observational learning, perceived severity, and perceived scarcity, with mediation by control, impose significant influence on consumers’ PB. Analysis of total effects showed that normative social influence has the strongest effect on PB. This is followed by perceived scarcity, control, social trust, observational learning, and perceived severity. Two diverse research paradigms centring on Survival Psychology and Maslow’s motivation theories were integrated to offer a logical explanation of the motivation driving PB. By utilising a theory-driven approach, the current study has offered a unique approach to interpreting consumers’ PB. Overall, this study enhances current research on consumers’ PB, offers new insights into understanding the motivating factors behind consumers’ PB, and implicates policies on tackling hoarding situations in the event of crisis such as the COVID-19 pandemic.

1. Introduction

The novel coronavirus (COVID-19) that was first discovered in December 2019, and with many variant forms reported in different parts of the world in early 2020, is posing as a growing health threat globally. Recently (December 2020), a more serious variant, the UK COVID-19 strain, is rapidly spreading around the globe and this has heightened the pandemic. As of January 2021, the virus continues to infect and claim the lives of many worldwide, and also greatly impact upon the infected and non-infected alike. During occurrence of traumatic events such as natural calamities and healthcare crises, it is expected that people experience changes in their behaviour [1]. One significant phenomenon that was detected across numerous countries was that of Panic Buying (PB) by consumers, particularly at the onset of COVID-19.

A change in consumer behaviour is commonly activated by a change in environmental stimuli. Any change that is too extreme or rapid can overwhelm an individual’s cognitive capability in handling the situation, which induces intense emotion-influenced responses. This can lead to PB [2] whereby individuals purchase extraordinarily huge amounts of goods amid or following a perceived calamity, or when expecting a surge in price or scarcity.

PB is a herd behaviour which frequently leads to scarcity and increase in prices of goods [3]. This leads to negative externalities as necessities are inefficiently allocated in the society where vulnerable groups such as the elderly can no longer access them [4]. PB may also create a sense of alarm, panic, and peril amongst those affected. Hereby, such hoarding of goods is deemed socially undesirable and results in adverse economic impact. Additionally, the unpredictable and sharp rise in demand for consumer goods, along with shut-down of transport facilities or traffic restrictions, present numerous obstacles in areas such as procurement, replenishment, and delivery. This worsens stockout situations and frequently causes an increase in the price of consumer goods.

Given the severe negative implications of PB, many studies have been carried out to examine the factors affecting PB. The literature on PB can be classified into two streams. One literature stream has focused on establishing and investigating socio-environmental variables which are factors relating to influences from the society and social groups (e.g., family, friends). These variables include observational learning,
coercive and non-coercive social influence, and trust [5,6]. Using an observational learning perspective, Zheng et al. [6] noted that physical (i.e. verbal cues) and virtual (i.e. social media posts) prompts from peers and loved ones can influence individuals’ PB. Another literature stream has focused on establishing and investigating psychological variables which relate to the emotional and mental state of consumers. The variables include perceived severity, fear of the unknown, anticipated regret, disaster-induced coping behaviour, perceived lack of control and perceived scarcity [7–11]. One of the most common psychological explanations is that hoarding storable goods provides individuals with a sense of control over the high-risk situation created by a disaster [11]. The onset and lingering COVID-19 pandemic has left the public with fear and uncertainty. Hence, many consumers have resorted to PB as a means to manage their feeling of insecurity and regain control over the situation [5,11,12]. Research conducted by Sim et al. [9] established that PB is an act of self-preservation in the face of a traumatic circumstance whereby the survival of an individual and community is at risk especially when under quarantine situation. The perceived scarcity effect is also largely associated with PB, and hoarding escalates if scarcity emerges for primary essential products [13–15]. It also leads to individuals experiencing insecurity which sequentially sets off more endeavours to stockpile products frantically [14].

From reviewing the literature, it was established that existing studies have focused primarily on psychological and social prompts to PB rather than on individuals’ motivational needs in the face of threat. Accordingly, the purpose of the current study is to advance theoretical research on consumers’ PB. The objective is to investigate the prompts of PB in relation to Survival Psychology and Maslow’s motivation theories.

In utilising Maslow’s Hierarchical Theory, this study investigates the satisfaction or utility driving certain wants and needs, and the factors motivating individuals’ consumption behaviour. Maslow [16] postulated a hierarchy that classifies human behaviours into five tiers and further categorised them into two groupings – deficiency needs and growth needs, as presented in Fig. 1. Deficiency needs are the basic needs of humans and arises due to deprivation. It consists of the first four tiers: (1) physiological needs, (2) safety needs, (3) social needs, and (4) esteem needs. Generally, there is a strong tendency for consumers to focus on satisfying the most vital needs of human, before progressively ascending to upper levels and towards the more discretionary growth needs [17]. This instinctual human behaviour becomes more apparent especially during stressful periods such as during an emergency or crises, when the vital needs of human are compromised, and cognitive function becomes impaired.

The precept of satisfaction or utility driving certain wants and needs is also supported by Survival Psychology which recognises that changes in human behaviour is a means of self-protection in the presence of a stressor. In the face of extreme stress, the primitive part of the human brain tends to become more dominant and prompts the individuals to undertake certain behaviours that are essential for survival [18–20]. This changes in behaviour may seem to be “out of norm” and irrational as they tend to have poor humanistic expression. Survival Psychology also recognises that individuals may go through certain behavioural changes such as PB, and negative occurrences of herd mentality. In analysing occurrences of changing individuals’ behaviours in response to health crises, it is crucial to grasp the decision-making processes of consumers. Therefore, supported by Survival Psychology, the current study argues that the bottom four tiers of the Maslow’s Hierarchy of Needs, which represent deficiency needs, can be applied to explain PB of consumers.

The structure of the rest of the paper is as follows. First, the following literature discusses relevant Survival Psychology and Maslow’s motivation theories, upon which a theoretical model is entertained to account for individuals’ PB. The research method used to obtain, organise, illustrate, and interpret the data is then elaborated. The important findings are reviewed, accompanied by theoretical and practical implications to theory and policies, which then concludes with directions for future research.

2. Literature review

2.1. Theoretical model and arguments

This study reviews and introduces Survival Psychology and Maslow’s Hierarchical Theory to explain consumers’ PB. These theories are based on motivation psychology which involves consumers’ thoughts, emotions, and behaviours. Fig. 2 presents the theoretical model. The model is developed by interpreting the theories and consists of a network of constructs and their effects on consumers’ PB.

The proposed model integrates Survival Psychology with Maslow’s Hierarchical theory for the purpose of explaining PB. The focus of this study is on the bottom four tiers of Maslow’s Hierarchy (see Fig. 1) as they are the most vital and basic needs of humans. In the face of pandemic, these needs are threatened and deprived. According to Maslow [16]; a deprived environment causes individuals to move towards lower need levels of the hierarchy, before the upper need levels can be satisfied. This study has further divided the bottom four tiers of Maslow’s Hierarchy into six sub-components: (1) physiological needs that consist of perceived scarcity; (2) safety needs that comprise perceived severity; (3) social needs that comprise social influence, observational learning, and social trust; and (4) esteem needs that consist of control (Table 1).

As defined, physiological needs are the biological requirements for basic essentials of life such as food, water and oxygen [21]. Similarly, perceived scarcity refers to the perceived supply level of physical resources which are crucial for normal functioning of an individual [22]. Hence, perceived scarcity can be classified under physiological needs.

Safety needs refer to stability, health and well-being of an individual [21]. Perceived severity is defined as the seriousness that an individual associates with the consequences in the event of a health crisis [23]. Perceived severity proposes that individuals are motivated to undertake self-protection behaviour when faced with potential dangers from the environment to improve one’s safety and well-being [24]. Thus, this makes it relevant and appropriate to be classified under safety needs.

Social needs involve a sense of belonging, where behaviour is motivated by the need for establishing interpersonal relationship and gaining acceptance in a society [21]. This study has classified social influence, observational learning, and social trust under the social needs category as all three sub-components contain an element of social relations as a motivator of one’s behaviour.

Esteem needs are defined as the needs for both self-esteem and for the esteem an individual derives from others. When these needs are fulfilled, the individual gains self-confidence and feels being valued by the society. However, when deprived, the person feels worthless, feeble, and helpless [25]. This study reiterates that gaining or extending control is a way to satisfy one’s esteem needs. In this context, control is defined

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Fig. 1. Maslow’s hierarchy of needs. Source: Maslow [16].
performance in the service of goal-directed behaviour [26]. A strong psychological response will be triggered. According to Survival Psychology, the immediate result of a catastrophe overwhelms the senses as the brain is flooded with sights, sounds, touches, smells, and tastes. Victims of danger are surrounded by information they can neither control nor comprehend that subsequently causes them to become confused and numb and thus suffer from cognitive dysfunction [19]. According to Leach [19], approximately 75% of the population will realize that their reasoning is largely impaired, and that thinking is strenuous in times of disaster. They will behave in a reflexive, almost automatic or mechanistic manner. The field of attention of these individuals becomes very restricted and visually they may suffer from perceptual narrowing. The behaviour of people involved in these life-threatening situations is consistent during disasters. Drabek [31] stated that such a behaviour ‘obeys a structural pattern and is applicable across different types of disaster.’ Hence, it is highly likely that individuals would experience similar psychological responses in the case of COVID-19 pandemic.

The elements of the model are proposed to influence consumers’ control in the event of COVID-19 because they can affect consumers’ cognitive ability. For instance, the component on observational learning can influence consumers’ cognitive appraisals [32]. When an individual is being overwhelmed with information pertaining to hoarding activities of others’ PB, it can induce great distress which leads to perceptual narrowing as the mind is bombarded with intrusive thoughts of stockpiling essential goods [33]. The component related to perceived severity is related to the seriousness of the consequences an individual associates in the event of a health crisis [23]. During a pandemic where there is an elevated perception of risk, the brain detects an impending danger and is under increased cognitive load, leading to a decrease in cognitive control and performance [34]. Finally, the component on perceived scarcity can affect consumers’ evaluation of risks because scarcity reduces the resources (i.e., immediate necessities) that are crucial for survival [35]. Further, perceived scarcity threatens one’s sense of safety which can heighten the perceived risk during the pandemic. This spurs unwanted negative thoughts and stress, leading to a decrease in cognitive control and performance. Based on the aforementioned assertions, H1 to H5 are proposed.

In effect, this study postulates that control has a direct influence on individuals’ PB (i.e., H6). Generally, the inherent need for control lies in the nature of human, and plays a vital role in the survival of mankind [36]. During a health crisis such as COVID-19, an individual’s perception of control would be reduced [37]. PB can be regarded as a means to compensate individuals for their psychological losses by recovering control over the situation [38]. The hypotheses shown in Fig. 2 are

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Table 1
The conceptualisation of Maslow’s deficiency needs.

| Maslow’s Deficiency Needs | Representative Construct(s) | Description |
|--------------------------|-----------------------------|-------------|
| Physiological needs      | Perceived scarcity          | The basic needs crucial for normal functioning of a human being |
| Safety needs             | Perceived severity          | The safety and well-being of an individual |
| Social needs             | Social influence,            | Social relations as a motivator of one’s behaviour |
|                          | Observational learning,     |                                      |
|                          | Social trust                |                                      |
| Esteem needs             | Control                     | The achievement of control strengthens individuals’ belief on their ability to control events, enhancing their self-confidence and morale, hence fulfilling esteem needs |

As the individuals’ perceived ability to exert control over their cognitive performance in the service of goal-directed behaviour [26]. A strong belief of one’s internal control corresponds to a substantial satisfaction in an individual’s esteem needs [27]. Various studies have also illustrated that the achievement of control strengthens individuals’ belief on their ability to control events, enhancing their self-confidence and morale, hence fulfilling esteem needs [28,29]. Since control has a strong influence on an individual’s esteem level, control can be classified under esteem needs. The model as formulated from integrating the various constructs thus provides a fresh perspective for understanding the decision-making process that drives consumer behaviour in the context of a deprived, stressful period such as the case of COVID-19.

This study argues that the bottom three tiers of the Maslow Hierarchy influence control, and subsequently motivating PB. In this context, control is referred to as the individuals’ perceived ability to exercise control over negative invasive thoughts and emotions, and their ability to handle a traumatic situation [30]. In times when individuals’ control has been greatly reduced such as in catastrophic situations, certain psychological responses will be triggered. According to Survival Psychology, the immediate result of a catastrophe overwhelms the senses as the brain is flooded with sights, sounds, touches, smells and tastes. Victims of danger are surrounded by information they can neither process nor comprehend that subsequently causes them to become confused and numb and thus suffer from cognitive dysfunction [19].

Fig. 2. Determinants of Consumer’s PB combining Maslow’s Hierarchy of Needs model and Survival Psychology.
elaborated in the ensuing subsections.

2.2. The determinants of consumers’ control

The following sections illustrate the impacts of the proposed constructs, namely normative social influence, observational learning, social trust, perceived severity and perceived scarcity on individuals’ control.

2.2.1. The effect of normative social influence on control

Normative social influence refers to the conformance of a behaviour by an individual due to the influence of others so as to gain social acceptance [39]. Such influence can be exerted by peers and family members over an individual through word-of-mouth [40]. The constant prompt and emphasis from significant referents to stockpile can heighten the danger about the pandemic situation, thereby overwhelming the senses and exerting huge amounts of stress cognitively. This increases cognitive load and decreases individuals’ reasoning ability significantly, causing them to disregard their own beliefs about the action and succumb to the peer pressure to gain others’ approval and fit in. Hence, individuals who receive more prompts have higher tendency to succumb to peer pressure, thereby reducing their cognitive control. Herein, the following hypothesis is developed.

**H1.** Normative social influence has a negative effect on consumers’ control.

2.2.2. The effect of observational learning on control

Observational learning is associated with the notion of information cascade which is based on behavioural economics and network theory [41]. It describes a phenomenon where the same decision is made by individuals in a sequential manner, yielding herd behaviour. As decisions such as PB are made consecutively, an individual has an opportunity to witness and learn from the past actions made by others [6, 42]. As the individual is limited to the outside information that others might be privy to, he can only observe and make deduction about the information that the others are informed of [11]. Being flooded with sensory information of other consumers’ PB can cause great distress and the desire to stockpile essential goods plagued the mind [33]. This lack of information may further induce a sense of helplessness in the individual and hence, reduces individuals’ capability to handle the stressful situation in times of pandemic, thereby decreasing an individual’s cognitive control. Therefore, the following hypothesis is proposed.

**H2.** Observational learning has a negative effect on consumers’ control.

2.2.3. The effect of social trust on control

Social trust, in the face of crisis, can be classified into two aspects: trust in the community and government [11]. Trust in the community can be reflected as the collectivistic traits of an individual. Some collectivistic traits include magnanimity, trustworthiness, and being considerate of others’ needs [43]. In contrast, individualistic people tend to be self-reliant, assertive, and highly competitive. The influx of information on the news and social media pertaining to consumers’ PB has the potential to erode trust among the public. As for trust in the government, the government holds an indisputable position in maintaining order and control, providing aid and recovery, and communicating information to the people in the face of a health crisis [44, 45]. Trust between the citizens and the government is critical for ensuring compliance and a joint, harmonised effort to cope and mitigate the outbreak of a virus [46].

An unhealthy level of social trust could trigger individualism among the consumers, worrying that others would buy excessively and leaving none for others [11]. This can instil a lower general confidence among the public which subsequently leads to worsened well-being [45]. Research has suggested that individuals’ well-being affects the perceived control of individuals [47]. This is because a worsened well-being in individuals can compromise their cognitive ability which in turn lead to perceived loss of freedom [48]. Consequently, this can result in a reduction in individual’s cognitive control. On the basis of the above review, the following hypothesis is proposed.

**H3.** Social trust has a positive effect on consumers’ control.

2.2.4. The effect of perceived severity on control

Perceived severity is defined as the seriousness of the consequences an individual associates in the event of a health crisis [23]. Perceived severity, a sub-dimension of the health belief model, proposes that individuals are propelled to take up self-protection behaviour to reduce risk. When faced with stress from the environment, individuals may be induced to adopt various methods to manage the stress and maintain their well-being and health.

Cognitive appraisal is a key process in stress management [49, 50]. It refers to an individual’s perception of a situation and his assessment of the degree to which the situation is stressful. Cognitive appraisal is the process of appraising (a) whether a situation jeopardises individual’s well-being, and (b) undertaking possible actions to overcome or prevent harm [24]. Research has suggested that when an encounter is perceived by individuals as stressful and threatening, it is revealed that individuals experienced higher levels of psychological symptoms and a significant reduction in their well-being [51]. Oliver and Brough [47] proposed that individuals’ well-being affects their perceived control. A worsened well-being can compromise an individual’s cognitive ability which in turn causes him to be more susceptible to PB.

Hence, it is conceivable that in situations where there is an elevated perception of risk, it is highly likely that individuals will be prone to higher frequency of negative thoughts, leading to a decrease in individual’s cognitive control. Hence, the following hypothesis is proposed.

**H4.** Perceived severity has a negative effect on consumers’ control.

2.2.5. The effect of perceived scarcity on control

Perceived scarcity is closely associated with reactance theory which posits that in the event of a threat to one’s behavioural freedom, individuals experience psychological reactance [11]. Psychological reactance is a motivational state that serves to restore the behavioural freedom of an individual [52, 53]. During the COVID-19 pandemic, resources such as essential goods are scarce and anticipated to become inaccessible within a short time frame. Individuals may view it to be a threat to their behavioural freedom as accessibility to these necessities could be reduced or even prevented [54, 55]. Subsequently, this arouses psychological reactance that would heighten the attractiveness of the resource [11, 35]. The individuals’ field of attention may become very restricted and could result in loss of freedom. Based on the above discussion, perceived scarcity of goods would compromise individuals’ cognitive control due to psychological reactance. Hence, the following hypothesis is developed.

**H5.** Perceived scarcity has a negative effect on consumers’ control.

2.3. The direct effect of control on consumers’ PB

PB can be regarded as a means to compensate individuals for their psychological losses by recovering control over the situation [38]. Control is referred to as individuals’ perceived ability to exercise control over negative invasive thoughts and emotions, and their ability to handle a traumatic situation [39]. The inherent need for control lies in the human nature, and it plays a crucial position in the survival of mankind [36]. There are numerous circumstances such as a pandemic that would undermine one’s perception of control. A reduced perception of control would create discomfort and uneasiness which subsequently motivates the individual to regain control.
The compensatory control theory postulates that individuals will seek control over other areas in the case where the origin of discomfort is not amenable to control [56]. This is especially relevant in the case of COVID-19 where the pandemic has rendered many helpless and powerless in many aspects. One way that individuals can seek control over their situations would be through problem solving. Present research reveals that performing problem solving strengthens people's belief of recouping control over the situation [11]. Often, individuals solve problems to improve their circumstances, from a less ideal situation where they experience a lack of control to a more ideal situation where they regain control. Fundamentally, two conditions must be satisfied to propel to participate in problem solving. First, the action must be able to be performed by the individual. Second, it must be trusted that the action will achieve a more ideal state. In this aspect, purchasing consumer goods, such as everyday essentials, satisfies the first requirement as such activity is carried out by consumers regularly and does not take up much cognitive or financial resources. Furthermore, the second requirement is also satisfied as purchasing consumer products is practical. Even though purchasing huge quantities of consumer products is maladaptive [57] as it does not help and can even aggravate the problem of the scarcity of resources, it enables individuals to regain control over the situation indirectly, with the knowledge that majority of the products are useful during the pandemic and even for the future. Hence, the following hypothesis is proposed.

H6. Control has a negative effect on consumers' PB

3. Methodology

The Checklist for Reporting Results of Internet E-Surveys (CHERIES) framework is adopted in the survey design and implementation. All information and procedures are reported in Appendix A. The subsequent subsections report the measurement items and survey design and administration.

3.1. Measurement items

Measurement items are introduced to operationalise the following constructs in the current literature: normative social influence, observational learning, social trust, perceived severity, perceived scarcity, control, and consumers’ PB (Table 2). For operationalisation normative social influence on consumers’ PB, influences from three critical stakeholders were measured [58]. Correspondingly, they are influences from family members (NSI1), individuals themselves (NSI2), and peers (NSI3).

Five measures were adopted from Wang and Yu [59] to measure observational learning on consumers’ PB. Frequency of the act of stockpiling from four key stakeholders were measured. Accordingly, they consist of friends (OBL1), family members (OBL2), colleagues or classmates (OBL3), and other people who are important to the individual (OBL4).

To measure the effect of social trust on consumers’ PB, three measures were extracted from the research of Lundmark et al. [60] and De Silva et al. [61]. The chosen measures highlight aspects of social trust directed at stakeholders, namely, community (TRU1), media (TRU2), and government (TRU3). The measures have been found to be relevant and sound in the topic of COVID-19 pandemic and are hence selected for this study.

Four measures were adopted from Huang et al. [58] to operationalise perceived severity on consumers’ PB. As depicted in Table 2, the first three measures (SEV1 – 3) show the various aspects of individual’s life that will potentially be affected by the pandemic. The last measure (SEV4) reflects the impact of individual’s well-being as a whole.

To measure perceived scarcity, four measures were adopted from Byun and Sternquist [62]. The scarcity of products was measured in various aspects namely, limited product quantity (SCA1), limited

| Table 2: Construct, measurement items and source. |
|--------------------------------------------------|
| **Construct** | **ID** | **Measurement Items** | **Adapted Source** |
|--------------------------------------------------|
| Normative Social Influence (NSI) | NSI1 | My family prompted me to stockpile products at home | Huang et al. [58] |
| | NSI2 | My previous experience prompted me to stockpile products at home | |
| | NSI3 | My friends prompted me to stockpile products at home | |
| Observational Learning (OBL) | OBL1 | Friends | Wang and Yu [59] |
| | OBL2 | Family members | |
| | OBL3 | Colleagues/Classmates | |
| | OBL4 | Other people who are important to me | |
| Social Trust (TRU) | TRU1 | In your opinion, to what extent it is generally possible to trust the government? | Lundmark et al. [60] |
| | TRU2 | In your opinion, to what extent is it generally possible to trust the media? | De Silva et al. [61] |
| | TRU3 | In your opinion, to what extent is it generally possible to trust the friends? | |
| Perceived Severity (SEV) | SEV1 | If I had COVID-19, my career would be endangered | |
| | SEV2 | If I had COVID-19, my relationships with my family and friends would be affected | |
| | SEV3 | If I had COVID-19, my financial security would be affected | |
| | SEV4 | If I had COVID-19, my entire life would change | |
| Control (CON) | CON1 | The products that I wanted to buy will be very limited during COVID-19 | Byun and Sternquist [62] |
| | CON2 | The brand availability for a product will be very limited during COVID-19 | |
| | CON3 | The sizes of products will be very limited during COVID-19 | |
| | CON4 | The types of products will be very limited during COVID-19 | |
| Panic Buying (PB) | PB1 | I had the urge to grab products immediately | Byun and Sternquist [62] |
| | PB2 | I snapped things up while shopping in this store | |
| | PB3 | Once I picked up a product, I did not want to put it down although (continued on next page) |
3.2. Survey design and administration

The questionnaire contains three segments. The first segment provides an overview of the COVID-19 pandemic and describes the PB phenomenon that is widely observed during this period. Thereafter, objectives were provided, that is, to investigate the level of PB being experienced by consumers during the COVID-19 i.e., experiencing repetitive thought patterns and negative emotions (CON1 – 4). Additionally, it is to be noted that the current study has utilised “control” instead of “lack of control” as the construct to ensure consistency with the existing measurement studies on control. However, as the measurement items above operationalise “lack of control” the study has reverse scaled the measurement items when conducting result analysis to ensure coherence with the “control” construct.

To measure consumers’ PB following the outbreak of COVID-19, five measures were adopted from Kemp et al. [36] who have operationalised “lack of control”. The measures for “lack of control” reflect consumers’ thoughts and actions of in-store stockpiling (PB1 – 5).

### Table 2 (continued)

| Construct | ID | Measurement Items | Adapted Source |
|-----------|----|-------------------|----------------|
|           |    | I was not sure if I would buy it or not |                |
|           | PB4| I hurried to grab the products of interest and kept them to myself |                |
|           | PB5| I found a number of things I wanted to grab immediately even though they were not on my shopping list |                |
| availability of product brand (SCA2), limited product size (SCA3), and limited product type (SCA4). |

Four measures were adopted from Kemp et al. [36] who have operationalised “lack of control”. The measures for “lack of control” reflect the two aspects in which individuals lose control in the wake of COVID-19 i.e., experiencing repetitive thought patterns and negative emotions (CON1 – 4). Additionally, it is to be noted that the current study has utilised “control” instead of “lack of control” as the construct to ensure consistency with the existing measurement studies on control.

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### 3.2. Survey design and administration

The questionnaire contains three segments. The first segment provides an overview of the COVID-19 pandemic and describes the PB phenomenon that is widely observed during this period. Thereafter, objectives were provided, that is, to investigate the level of PB being engaged by consumers as well as to find out the motivations driving consumers’ PB and their consequences. Further, the questionnaire ensures confidentiality of the participants’ identities under any circumstance. By doing so, the respondents are encouraged to provide unbiased answers based on their honest opinions.

The second segment of the questionnaire relates to the measures as shown in Table 3. Respondents were asked to recall an instance whereby they visit the local grocery store following the announcement of the circuit breaker. Thereafter, they were asked to provide rating for each measure according to the respective response anchor or scale.

The third segment gathers participants’ demographic information, namely gender, age, education, housing type, household income, and online shopping frequency.

The survey was administered by engaging a professional survey company, Qualtrics. An online survey was first designed, thereafter panel respondents were invited to take part. To ensure a representative sampling frame, several partnering panels were blended. Next, the questionnaire was soft launched. Responses from a small sample group (n = 50) were gathered and minor changes were made to the survey based on their feedback and the results from exploratory factor analysis. The modified survey was then officially used for data collection with a total of 508 valid completes. A lump-sum survey fee of approximately SGD 7500 was paid to Qualtrics, a portion of which was transferred as monetary rewards to the qualified respondents. Table 3 shows a summary of the sample profile. The statistics show a proportionately balanced sample in terms of age, gender, and income. About 50% of the participants belong to the male group, the older consumer group (i.e., more than 34 years old) or the upper income group (i.e., more than $8000 SGD/month).

### Table 3

| Construct | ID | Measurement Items | Adapted Source |
|-----------|----|-------------------|----------------|
| Gender    | Female | 247 | 49 |
| Male      | 261 | 51 |
| Age (years) | 16-34 | 247 | 49 |
| 35-49     | 193 | 38 |
| 50 and above | 68 | 13 |
| Education | Below Secondary | 1 | 0 |
| Secondary  | 35 | 7 |
| Post-Secondary | 40 | 8 |
| Diploma   | 147 | 29 |
| University Graduate | 223 | 44 |
| Postgraduate | 62 | 12 |
| Housing   | Others | 3 | 1 |
| IDB       | 396 | 78 |
| Condominium | 85 | 17 |
| Landed    | 24 | 5 |
| Household income (SGD/month) | 0 | 4 | 1 |
| 1–3999    | 99 | 19 |
| 4000–7999 | 179 | 35 |
| 8000–11,999 | 122 | 24 |
| 12,000–19,999 | 79 | 16 |
| 20,000 and above | 25 | 5 |
| Online Shopping Frequency | Almost Never | 2 | 0 |
| Few times a year | 85 | 17 |
| Few times a month | 258 | 51 |
| Few times a week | 139 | 27 |
| Daily     | 24 | 5 |

Note: IDB denotes public housing by Housing & Development Board. * Variable used as a control factor in the theoretical model.

### 4. Results and discussion

#### 4.1. Demographics of respondents

The demographic profile of the 508 participants is depicted in Table 3. The distribution of male (49%) and female (51%) participants was relatively balanced. The gender proportion of the sample is close to Singapore’s gender distribution of 48.9% male and 51.1% female ([https://www.singstat.gov.sg/find-data/search-by-theme/population/elderly-youth-and-gender-profile/latest-data](https://www.singstat.gov.sg/find-data/search-by-theme/population/elderly-youth-and-gender-profile/latest-data)).

Next, majority of the respondents (85%) hold a diploma and above. The observation that majority of the participants are well-educated is in line with the Singapore’s focus on education. As reported by Singstat ([https://www.singstat.gov.sg/find-data/search-by-theme/population/education-language-spoken-and-literacy/latest-data](https://www.singstat.gov.sg/find-data/search-by-theme/population/education-language-spoken-and-literacy/latest-data)), literacy rate among residents aged 15 years & above was 97.5% in 2019. Thus, it is to no surprise that 85% of the participants hold a diploma’s degree. The above-mentioned comparisons furnish some affirmation pertaining to the sample’s representativeness.

Additionally, majority of the respondents (83%) participated in online shopping activity at a frequency of at least a few times per month. This corresponds with the findings from a study ([https://digitalinfluencecelab.com/singapore-digital-marketing-statistics-2020/](https://digitalinfluencecelab.com/singapore-digital-marketing-statistics-2020/)) that Singapore has a high internet penetration rate (84%), with approximately 70.3% of the population participating in online shopping.

Structural equation modelling involves performing the measurement model analysis and structural model analysis [63]. The measurement model analysis aims to investigate the link between the constructs and their measurement items while the structural model analysis investigates the link between the constructs framed by the hypotheses. Post hoc analysis is also performed to examine omitted, significant relationships found between the constructs. The measurement model
analysis consists of assessment of the model fit, convergence, reliability and discriminant validity as a whole. The structural model analysis consists of simultaneously estimating the hypothesised connections between the constructs. The direct, indirect, and total effect analysis is also performed to obtain greater theoretical and policy implications.

### 4.2. Measurement model analysis

Table 4 presents the findings from the measurement model analysis. The fit indices of the measurement model fulfill the threshold initiated by Hu and Bentler [64]. Accordingly, Comparative-Fit Index (CFI) and Tucker-Lewis index (TLI) are higher than the suggested value of 0.950 while Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR) do not exceed 0.080 and 0.100, respectively. Thus, these ascertain that the measurement model has good fit.

The findings presented in Table 4 also suggest the reliability of measurement items. Correspondingly, the composite reliabilities and factor loadings of the measurement items are above the threshold of 0.700 and 0.800 [63]. The findings in Table 5 also indicate validity. Firstly, as the average variance extracted (AVE) of each construct exceeds 0.500, convergent validity is shown [63]. Next, discriminant validity is established as the squared correlations of a given pair of constructs are smaller than AVE.

As the nature of collecting data through surveys is perceptual, it is foreseen that common method bias may be prevalent. Through performing Harman’s single factor test [65], it is affirmed that common method bias is negligible as the test outcome shows the variance of the one factor model contributes to a mere 39% of all the indicators.

### 4.3. Structural model analysis

The estimated structural model is presented in Fig. 3. To account for the influence of control variables on consumers’ PB, factors such as online shopping frequency, education, and income were also included.

| Construct                          | Item  | A   | AVE | CR   |
|-----------------------------------|-------|-----|-----|------|
| Normative Social Influence (NSI)  | NSI1  | 0.821 | 0.798 | 0.922 |
|                                   | NSI2  | 0.950 |     |      |
|                                   | NSI3  | 0.904 |     |      |
| Observational Learning (OBL)      | OBL1  | 0.856 | 0.792 | 0.938 |
|                                   | OBL2  | 0.882 |     |      |
|                                   | OBL3  | 0.912 |     |      |
|                                   | OBL4  | 0.909 |     |      |
| Social Trust (TRU)                | TRU1  | 0.511 | 0.530 | 0.760 |
|                                   | TRU2  | 0.901 |     |      |
|                                   | TRU3  | 0.720 |     |      |
| Perceived Severity (SEV)          | SEV1  | 0.811 | 0.614 | 0.864 |
|                                   | SEV2  | 0.692 |     |      |
|                                   | SEV3  | 0.806 |     |      |
|                                   | SEV4  | 0.819 |     |      |
| Perceived Scarcity (SCA)          | SCA1  | 0.798 | 0.732 | 0.916 |
|                                   | SCA2  | 0.879 |     |      |
|                                   | SCA3  | 0.881 |     |      |
|                                   | SCA4  | 0.863 |     |      |
| Control (CON)                     | CON1  | 0.882 | 0.756 | 0.925 |
|                                   | CON2  | 0.936 |     |      |
|                                   | CON3  | 0.862 |     |      |
|                                   | CON4  | 0.791 |     |      |
| Panic Buying (PB)                 | PB1   | 0.814 | 0.655 | 0.905 |
|                                   | PB2   | 0.822 |     |      |
|                                   | PB3   | 0.726 |     |      |
|                                   | PB4   | 0.861 |     |      |
|                                   | PB5   | 0.819 |     |      |

Note: Table 5 presents the findings from the measurement model analysis. The fit indices of the measurement model fulfill the threshold initiated by Hu and Bentler [64]. Accordingly, Comparative-Fit Index (CFI) and Tucker-Lewis index (TLI) are higher than the suggested value of 0.950 while Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR) do not exceed 0.080 and 0.100, respectively. Thus, these ascertain that the measurement model has good fit.

The findings presented in Table 5 also suggest the reliability of measurement items. Correspondingly, the composite reliabilities and factor loadings of the measurement items are above the threshold of 0.700 and 0.800 [63]. The findings in Table 5 also indicate validity. Firstly, as the average variance extracted (AVE) of each construct exceeds 0.500, convergent validity is shown [63]. Next, discriminant validity is established as the squared correlations of a given pair of constructs are smaller than AVE.

As the nature of collecting data through surveys is perceptual, it is foreseen that common method bias may be prevalent. Through performing Harman’s single factor test [65], it is affirmed that common method bias is negligible as the test outcome shows the variance of the one factor model contributes to a mere 39% of all the indicators.

| Table 5 Convergent and discriminant validity test. |
|-----------------------------------------------|
| NSI                                           |
| 0.798<sup>a</sup> 0.423<sup>b</sup> 0.080 0.234 0.221 0.438 0.482 |
| OBL                                           |
| 0.650<sup>a</sup> 0.792 0.086 0.108 0.118 0.325 0.271 |
| TRU                                           |
| 0.283 0.293 0.530 0.030 0.037 0.031 0.088 |
| SEV                                           |
| 0.484 0.329 0.173 0.614 0.108 0.163 0.127 |
| SCA                                           |
| 0.470 0.344 0.193 0.329 0.732 0.170 0.205 |
| CON                                           |
| 0.662 0.570 0.177 0.494 0.412 0.756 0.303 |
| PB                                            |
| 0.694 0.521 0.297 0.357 0.453 0.550 0.655 |

Note: AVE denotes Average Variance Extracted.

<sup>a</sup> Values along main diagonal are AVE.
<sup>b</sup> Values below main diagonal are correlations between constructs (r).
<sup>c</sup> Values above main diagonal are squared correlations between constructs ($r^2$).

As presented in Table 5, the regression of consumers’ PB is based on the control variables i.e., education, income, and online shopping frequency. Correspondingly, their standardised regression estimates are 0.020, 0.006 and 0.260, respectively. However, only the effect of shopping frequency on consumers’ PB is significant ($p < 0.050$). The effect of income on consumers’ PB is insignificant. This result is unanticipated as individuals with higher household income would have greater purchasing power and hence, higher tendency to engage in PB as compared to individuals with lower income. Similarly, for education, it is expected that consumers who have received higher level of education should have greater awareness and knowledge of the repercussions of PB and therefore lower tendency to engage in PB. The result for online shopping frequency is foreseen as consumers who engage in online shopping more frequently during the lockdown period have a higher tendency to PB. Individuals may be inclined to purchase more than what they actually need for fear of daily necessities being out of stock. Hence, consumers’ PB is more aligned with their shopping preferences.

The constructs, namely, normative social influence, observational learning, perceived severity, and perceived scarcity, have significant, negative effect on an individual’s control. Their respective standardised effects are $-0.240$, $-0.420$, $-0.100$ and $-0.145$. Thus $H_1$, $H_2$, $H_3$ and $H_5$ are accepted. The influence of social trust on control ($\beta = 0.50$), is not significant. Thus, $H_4$ is not accepted. The four variables explain for 49% of the variance in individual’s control ($R^2 = 0.492$). Generally, the results align with this study’s rationale that the four constructs influence the control of an individual, which can be categorised into social, safety and physiological needs.

For instance, one factor that influences control is normative social influence. The constant prompt and emphasis from significant referents refer to stockpile can heighten the danger about the pandemic situation [40], thereby overwhelming the senses and exerting huge amounts of stress cognitively. This increases cognitive load and decreases individuals’ reasoning ability substantially, causing them to disregard their own beliefs about the action and succumb to the peer pressure to gain others’ approval and fit in. Hence, individuals who receive more prompts have higher tendency to succumb to peer pressure, thereby reducing their tendency to PB.
cognitive control.

Next, control is also influenced by observational learning. The individual may be overwhelmed by negative thoughts of goods hoarding when bombarded with information about the PB activities of other consumers [33,42]. This lack of information may further induce a sense of helplessness in the individual and hence, reduces one’s capability to handle the stressful situation in times of pandemic, thereby decreasing an individual’s cognitive control.

Perceived severity posits that in situations where there is an elevated perception of risk, it is highly likely that individuals will be prone to higher frequency of such intrusive thoughts [50,51], leading to a decrease in individual’s cognitive control [47].

Lastly, perceived scarcity explains its effect on control through reactance theory. During the COVID-19 pandemic, resources such as essential goods are scarce and anticipated to become inaccessible within a short time frame. Individuals may view it to be a threat to their behavioural freedom as accessibility to these necessities could be reduced or even prevented [54,55]. Subsequently, this arouses psychological reactance that would heighten the attractiveness of the resource. Based on the above discussion, perceived scarcity of goods would compromise individuals’ cognitive control due to psychological reactance.

Additionally, Fig. 3 suggests that control has a notable and negative effect on consumers’ PB ($\beta = -0.138, p < 0.050$). Thus, $H_6$ is accepted. This can be attributed to the compensatory control theory which posits that consumers engage in PB as a means to regain control over their situation during the COVID-19 pandemic. One way that individuals can seek control over their situations would be through problem solving. Research has shown that performing problem solving strengthens one’s belief of recouping control over the circumstance [11]. PB can be considered as problem solving as it can be performed by individuals and is practical. As a whole, the theoretical model explains about 53% of the variance in consumers’ PB ($R^2 = 0.527$).

Besides the hypotheses presented, the application of the post hoc analysis has revealed new observations. Three new paths were introduced, i.e., normative social influence on PB, social trust on PB and, perceived scarcity on PB. These results can be justified due to the following arguments. For example, one factor that influences PB is normative social influence. Normative influence is referred to as the conformance of one’s behaviour due to others’ influence to gain social acceptance. One way that normative influence can be exercised would be through word-of-mouth [40]. The incessant prompt from significant referents to hoard can lead to conformance, motivated by the desire to attain social acceptance.

Next for social trust, there are two crucial aspects of social trust in the face of disaster: trust in the community and government. First, trust in the community, it exhibits the collectivism of the people, that is commonly linked to characteristics namely magnanimity, trustworthiness and showing considerateness to others [43]. The influx of information on media pertaining to many engaging in PB has a risk of eroding trust. This could trigger individualism among the consumers, worrying that others would buy excessively and leaving none for others and spurring consumers to panic buy [68]. Pertaining to trust in the government, the government holds a critical position in maintaining order and control, communicating information to the public and providing aid and recovery in the face of catastrophe [44,45]. Trust between the citizens and the government is critical for ensuring compliance and a joint and harmonised effort to cope and mitigate the outbreak of a virus. A lack of trust in government may lead to PB as individuals refuse to cooperate with government efforts and choose to hoard, leading to disruption in supply chain [11].

Perceived scarcity is closely associated with reactance theory which posits that in the event of a threat to one’s behavioural freedom, individuals experience psychological reactance [11]. Psychological reactance is a motivational state that serves to restore the behavioural freedom of an individual [52,53]. During the COVID-19 pandemic, resources such as essential goods are scarce and anticipated to become inaccessible within a short time frame. Individuals may view it to be a threat to their behavioural freedom as accessibility to these necessities could be reduced or even prevented [54,55]. Subsequently, this arouses psychological reactance that would heighten the attractiveness of the resource [11,35]. Psychological reactance can stimulate a sense of

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**Fig. 3.** Parameter estimation of the theoretical model after post hoc analysis.

Note: *indicates that the path estimate is significant ($p < 0.050$); Model fit indices: $\chi^2/df = 2.155$, $p < 0.050$, $df = 383$; $CFI = 0.958$; $TLI = 0.953$; $RMSEA = 0.048$; $SRMR = 0.047$
4.4. Direct, indirect, and total effect analysis

The influences of the exogenous variables on endogenous variables are presented in Table 6. Accordingly, the direct, indirect and total effects are represented by $a$, $b$ and $c$. The subscripts $i$ and $j$ represent the exogenous and endogenous variables, respectively. In effect, $i = (1, \ldots, 6)$ where each number represents an exogenous variable and $j = (1, 2)$ where each number represents an endogenous variable.

For the direct effects, the main predictors of control are observational learning ($a_{21} = 0.420$), normative social influence ($a_{12} = 0.240$), perceived scarcity ($a_{51} = 0.145$), and perceived severity ($a_{41} = 0.100$). For PB, its direct predictors are normative social influence ($a_{12} = 0.506$), control ($a_{92} = 0.138$), perceived scarcity ($a_{32} = 0.135$), and social trust ($a_{32} = 0.092$).

As for the indirect effects, observational learning has the strongest effect on panic buy ($b_{22} = 0.058$), followed by normative social influence ($b_{22} = 0.033$), perceived scarcity ($b_{22} = 0.020$), and perceived severity ($b_{22} = 0.0138$). As shown in Fig. 3, the effects of the five constructs on PB are primarily channelled through control.

For the total effects, normative social influence has the strongest effect on panic buy ($c_{12} = 0.539$). This is followed by perceived scarcity ($c_{32} = 0.155$), control ($c_{12} = 0.138$), social trust ($c_{32} = 0.092$), observational learning ($c_{22} = 0.058$), and perceived severity ($c_{42} = 0.014$).

5. Theoretical contributions

This research has contributed significantly to academic research. First, it bridges a critical gap in the literature on consumers’ PB by introducing and synthesising Survival Psychology and Maslow’s motivation theories, to understand the factors influencing consumers’ PB. Currently, there are few studies on consumers’ PB. From the limited number of theoretical work, majority of the studies have focused primarily on psychological and social causes of PB rather than on individuals’ motivational needs in the face of threat [5,7,9,11]. The current study provides an alternative perspective by integrating Survival Psychology and Maslow’s motivation theories to consumers’ PB. Thereafter, the theories provide an in-depth evaluation of the components affecting consumers’ PB.

This research has also contributed by distinguishing, presenting, and operationalising various components impacting consumers’ PB, namely, normative social influence, observational learning, social trust, perceived severity, perceived scarcity and control. These components contribute to a substantial percentage of the variance in consumers’ PB ($R^2 = 0.527$). The result implies that the employment of a combination of theories in the current study to explain consumers’ PB is more fruitful than that of employing a single theory, which is often the case in existing literature. Most notably, the outcomes present complementary relationship between Survival Psychology and Maslow’s motivation theories and thereafter, successfully yielding a unique angle in interpreting consumers’ PB. However, it is to be noted that there are differences in the explanatory power of the respective constructs. According to the total effect analysis, normative social influence has the strongest explanatory power, followed by perceived scarcity and control.

Moreover, the current study achieves a greater nomological apprehension of the relationships between the components affecting consumers’ PB. The outcomes are in line with the study’s primary arguments that normative social influence, observational learning, perceived severity, and perceived scarcity influence control. In addition, control directly affects consumers’ PB. This aligns with the key fundamentals of compensatory control theory whereby the decision to panic buy is to compensate for the individual’s loss of control in other aspects during the pandemic. Consequently, control leads to consumers’ PB directly.

Additionally, this literature has provided measurement and operationalisation of the constructs. The measurement items for the constructs was developed through a synthesis of literature on PB of relevance and thereby adapting them to the context of COVID-19 pandemic.

6. Conclusion

6.1. Summary

The aim of the current literature is to establish the factors affecting consumers’ PB and investigate their interrelationships.

Through the application of Survival Psychology and Maslow’s motivation theories, the current study proposes a model which elucidates consumers’ PB. The primary argument is that PB is directly affected by control. Control can also be explained with four of the proposed constructs i.e., normative social influence, observational learning, perceived severity, and perceived scarcity.

An online survey was carried out in Singapore. The administration of survey resulted in 508 valid completes. The results indicate a relationship whereby normative social influence, observational learning, perceived severity, and perceived scarcity on consumers’ PB are partially mediated by control. The total effects analysis showed that normative social influence has the strongest effect on PB. This is followed by perceived scarcity, control, social trust, observational learning, and perceived severity.

6.2. Policy implications

From the policy viewpoint, this research can bring forth several suggestions for policy makers and the retail industry in the efficient allocation of sparse resources to manage disruptions of strategic and essential goods, while ensuring safe distancing of consumers. Relevant stakeholders should recognise how normative social influence plays such a significant role in influencing consumers’ PB.

First, based on the analysis of the total effects on consumers’ PB, addressing the issue of normative social influence resources should be of utmost priority. Therefore, policymakers can educate the public of the

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Table 6 Direct, indirect, and total effects.

| Exogenous (i) | Endogenous (j) |
|--------------|---------------|
|              | Control (1)   | Panic Buy (2) |
| Direct effects ($a_{ij}$) of ... |              |               |
| Normative social influence (1) | 0.240         | 0.506         |
| Observational learning (2)     | 0.420         |               |
| Social trust (3)               |               | 0.092         |
| Perceived severity (4)         | 0.100         |               |
| Perceived scarcity (5)         | 0.145         | 0.135         |
| Control (6)                    |               | 0.138         |
| Indirect effects ($b_{ij}$) of ... |              |               |
| Normative social influence (1) |               | 0.033         |
| Observational learning (2)     |               | 0.058         |
| Social trust (3)               |               | 0.014         |
| Perceived severity (4)         |               | 0.020         |
| Perceived scarcity (5)         |               |               |
| Control (6)                    |               |               |
| Total effects ($c_{ij}$) of ... |              |               |
| Normative social influence (1) | 0.240         | 0.539         |
| Observational learning (2)     | 0.420         | 0.058         |
| Social trust (3)               |               | 0.092         |
| Perceived severity (4)         | 0.100         | 0.014         |
| Perceived scarcity (5)         | 0.145         | 0.155         |
| Control (6)                    |               | 0.138         |

Note: All values are reported as absolute positive and standardised. The larger the effect, the more important is an exogenous variable in influencing the endogenous variable.
negative repercussions of PB and encourage individuals to do their part by not engaging in PB, as well as to encourage others to doing the same. With this initiative, individuals will have greater understanding of the consequences of PB and share consensus of “anti-PB”. Such societal pressure could further deter others from panic buy as they succumb to their desire to fit in.

Thereafter, policymakers can focus on improving perceived scarcity and reducing consumers’ perceived lack of control during the pandemic. First, policymakers should ensure that shelves are replenished so as to assure consumers of availability of essential goods. Next from the media perspective, policymakers should deter media from portraying visual images of stockout situation as well as spreading false news that can cause panic among consumers [71]. Thus, this strategy helps limit consumers’ perception of scarcity, thereby reducing PB. In addition to the above measures, the government can also partner with agencies to initiate activities that can help its people to maintain positive mental health. For instance, the Singapore government has worked with NParks in the distribution of complimentary seed packets to households who are keen to start home gardening. Such activities will be able to support positive mental health of individuals during the lockdown while simultaneously divert the public’s attention from recouping control through PB.

Lastly, resources should be devoted to nurturing the public’s trust within the community and with the government. Mutual trust can be developed by constant assessment of the people’s needs through continuous dialogue. Moreover, it is imperative for governmental agencies to prepare the citizens with evidence-based preparedness and response approaches so that they can protect themselves. For instance, communicating transparent and compassionate messages containing vital information from government to the public is one way to building trust. Apart from addressing the pandemic at hand, the government should nurture trust by devoting resources to mitigate indirect repercussions such as the effects of pandemic on crucial health services, job security and ensuring social cohesion.

6.3. Limitations and recommendations

This study has several limitations. First, this research was carried out in Singapore. It is a developed country with a large proportion of working professionals. Most of the inhabitants have medium to high purchasing power which gives them the ability to hoard large quantities of essential goods. Thus, the analysis of the outcomes must be exercised with care for other contexts, for example, in rural areas or less developed countries. The occurrence of PB could be less intense in a less developed country with a lower average household income. This translates to a lower purchasing power and thus, fewer people are able to afford bulk purchase of goods. Hence, future research can focus on conducting cross-validation to other contexts so as to determine the generalisability of the research model.

Another limitation is that the current study has only proposed Survival Psychology and Maslow’s motivation theories in the interpretation of the components affecting consumers’ PB. Future research can consider initiating other theories or examine the nuances (i.e., moderating effects) in consumers’ PB.

Moreover, this research recognises that the data collected are perceptual as the study utilises stated preference survey. Additionally, the data are cross-sectional. As the survey was administered during the peak of the COVID-19 pandemic where there was a high frequency of PB activity, future research can carry out the surveys over a longer timespan to examine the sustenance of the crisis’ effect so as to deepen the understanding of the motivation behind consumers’ PB.

Finally, this research acknowledges that there are many factors influencing panic buying. It has adopted a theory-driven approach to study PB and have limited the investigation to the perspectives of survival and needs psychology. Therefore, the factors that have been examined are perceived scarcity, severity, social trust, normative social influence, observational learning and control. Future research can consider investigating the contributory factors towards PB based on individuals’ experiences and characteristics. Some of these factors can include (1) responsibilities for vulnerable, dependent people in the care of respondents, (2) history of stress disorder, anxiety, mental illness, (3) personal past on stockpiling, (4) communities & societies in which stockpiling is a cultural norm, (5) learning experience gained from planning professionals and (6) prudent forecasts. On the experience level, in certain communities that have been confronted with the occurrence of unpredictable events such as wars, calamities, and starvation, the culture of hoarding is cultivated as a desirable trait as it reflects the willingness to save and be prepared in times of scarcity. At an individual level, medical history of stress disorder and mental illness plays a part in one’s PB behaviour. Individuals who suffer or have suffered from a mental disorder, especially stress disorder, anxiety and post-traumatic stress, as well as those exposed to traumatic events may be more cautious and prudent in the provision of reserves of essential goods.”

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.

Appendix A

Table A1

| Item Category | Checklist Item | Explanation |
|---------------|----------------|-------------|
| Design        | Survey design  | In the design of the survey, questions were developed with reference to the existing literature. A representative sample was collected from the population of Singapore. IRB has waived the ethical review because non-identifiable data were collected from the respondents. A written consent was given to principal investigator before the start of survey. Data were stored in a physical storage device and password protected. Only the investigators have access to the data. Responses from a small sample group (n = 50) were gathered and minor changes were made to the survey based on their feedback and upon conducting exploratory factor analysis. Open A survey company was engaged and responsible for sending emails to the respondents for completion. Nil |
| IRB (Institutional Review Board) approval and informed consent process | IRB approval | |
|               | Informed consent | |
|               | Data protection  | |
| Development and pre-testing | Development and testing | |
| Recruitment process and description of the sample having access to the questionnaire | Open survey versus closed survey | |
|               | Contact mode | |
|               | Advertising the survey | |

(continued on next page)
### Table A1 (continued)

| Item Category | Checklist Item | Explanation |
|---------------|----------------|-------------|
| **Survey administration** | Web/E-mail | E-mail |
|                | Context | A webpage containing the survey questions was developed. The survey was conducted in English. |
|                | Mandatory/voluntary | Voluntary |
|                | Incentives | Cash or vouchers of about 5 USD were given. |
|                | Time/Date | Data collected between June 2020 to July 2020. |
|                | Randomisation of items or questionnaires | Nil |
|                | Adaptive questioning | Nil |
|                | Number of items | 32 |
|                | Completeness check | Yes |
|                | Review step | Respondents were given opportunity to review answers before submitting. |
| **Response rates** | Unique site visitor | Nil |
|                | View rate (ratio of unique survey visitors to unique visitors) | Nil |
|                | Participation rate (ratio of unique visitors who agreed to participate to unique first survey page visitors) | Nil |
|                | Completion rate (ratio of users who finished survey to users who agreed to participate) | 508/1700 = 29.88% |
| **Preventing multiple entries from the individual** | IP check | IP was recorded. Only single attempt was allowed. |
| **Analysis** | Handling of incomplete Questionnaires | Nil |
|                | Questionnaires submitted with an atypical timestamp | Time of completion was tagged. |

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