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Buying conspicuous organic food when it's crowded: how social crowding and the need for self-expression influence organic food choices

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With an expanding consumer base for organic food globally and a steadily growing interest worldwide, it is important to understand the influencing factors behind organic food preference formation and purchasing decisions. Distinguishing from previous studies, this study focuses on the conspicuousness of organic food consumption and proposes a new concept of conspicuous organic food consumption. This study aims to explore the relationship between social crowding, the need for self-expression, and conspicuous organic food consumption. Through three experimental studies, this study reveals that: (1) social crowding positively influences the consumption of conspicuous organic foods, (2) the need for self-expression plays a mediating role, and (3) self-concept clarity plays a moderating role. Specifically speaking, the conspicuousness leads consumers to increase their choice of organic food under social crowding, with the need for self-expression playing a fully mediating role in this effect. However, this effect only exists among consumers with lower levels of self-concept clarity; when consumers have higher levels of self-concept clarity, the influence of social crowding and non-social crowding on conspicuous organic food consumption does not significantly differ. By highlighting the uniqueness and usefulness of social crowding as an environmental factor, this study can facilitate companies to adjust their organic food marketing strategies to different levels of crowding promptly, thereby expanding organic food consumption.

KEYWORDS

organic food, consumers' preferences, the need for self-expression, sustainable food consumption, self-concept clarity

1 Introduction

Food production and consumption have a significant impact on the environment. Therefore, it is important to realize a shift toward a more sustainable food industry (Hansmann et al., 2020). Organic food is free of chemical pollutants, pesticide residues and other toxic substances (Parizad and Bera, 2023), and has become one of the most popular sustainable consumption options (Chae et al., 2024), with a gradually growing market space. The consumer base of organic food has been expanding globally over the past few decades, and interest in organic food has been growing steadily around the world. Academics have shown strong research interest in how to further expand the consumer market for organic food (Pant et al., 2024). One argument is that expanding organic food consumption can be achieved by lowering

its prices, as the price is a major obstacle limiting consumers' purchase of organic food (Aschemann-Witzel and Zielke, 2017). However, it is currently relatively difficult to promote organic food sales by adjusting the price of organic food (Berger, 2019).

To promote the sustainability of organic food, first and foremost, companies need to be able to make a profit. Understanding the drivers of organic food preference and purchase decisions can help companies better understand the psychology of organic food consumers to make better marketing decisions and ultimately improve economic efficiency (Hansmann et al., 2020). A large body of literature reports various motivations for consumers to buy organic food, such as taste, nutritional value, health, the environment, and even farmer welfare (see Kushwah et al., 2019).

In fact, food consumption is a more social issue, and some social motives, such as conspicuousness, also influence food choices (Barauskaite et al., 2018). Studies on virtue signaling (Konuk and Otterbring, 2024), status signaling (Puska, 2019), and other related studies on organic food are beginning to emerge. Unfortunately, the conspicuousness of organic food has not been sufficiently explored. As an impression management strategy, consumers express virtue and pro-sociality by purchasing organic food, which in turn conveys their ideal image (Folwarczny et al., 2023). This is because consumers who purchase organic food are perceived by others as more ethical, selfless, and sincere while being evaluated as more approachable, committed, and open-minded (Borau et al., 2021). This study proposes the concept of conspicuous organic food consumption to provide evidence. Based on the signaling properties of pro-social behaviors, studies have proposed conspicuous pro-social product consumption (Johnson et al., 2018), conspicuous donation behavior (Grace and Griffin, 2009), conspicuous benevolence (Griskevicius et al., 2007), conspicuous conservation (Sexton and Sexton, 2014), conspicuous pro-social behavior (Yao et al., 2020) and conspicuous green consumption (Li et al., 2022). Based on the above studies, conspicuous organic food consumption can be defined as consumption for the purpose of displaying one's moral identity, pro-social image, and social status due to the presentability and public nature of organic food. This concept integrates the concepts of conspicuous consumption and organic food consumption as an extension of conspicuous pro-social behavior.

A recent study on conspicuous consumption (Ding and Yang, 2021) found that social crowding affects conspicuous consumption. Social crowding refers to a state of constrained individual experience caused by excessive population density per unit area (Maeng et al., 2013). According to the State of World Population Report 2023, the total global population at this stage is up to 8 billion (Fund, 2023). With such a huge population base, the phenomenon of social crowding in cities has become more and more serious, such as shopping malls on weekends, supermarkets around festivals, etc. Social crowding becomes one of the situational factors that cannot be ignored in influencing consumer behavior. Generally speaking, social crowding is often associated with negative experiences and feelings (Blut and Iyer, 2020). However, recent research has begun to explore that social crowding has a positive impact on consumer behavior, e.g., increased preference for green products (Feng et al., 2022), prosocial intentions (Tong and He, 2022), minimalistic consumption (Gong et al., 2023), etc. Therefore, this study supposes that social crowding will also affect organic food consumption. However, social crowding, an important contextual factor, is still

under-researched (Ding and Yang, 2021), and there is a lack of research on social crowding in food marketing. Only a few studies were found on the relationship between social crowding and food consumption (Hock and Bagchi, 2018; Maeng et al., 2013). There are still many issues worthy of exploration regarding the relationship between social crowding and organic food consumption.

Since the essential motivation for the conspicuous tendency is to gain the admiration of others and to convey information about one's wealth or social status by publicly displaying the characteristics of the product purchased (Sharma et al., 2024). This study can infer that conspicuous organic food consumption is more contextually influenced (Balabanis and Stathopoulou, 2021; Griskevicius et al., 2010). That is, conspicuous organic food consumption can be affected by social crowding. However, despite the significance of understanding organic food consumption through the attribute of conspicuousness, current research appears to lack sufficient exploration in this area (Folwarczny et al., 2024). Literature on the role of self-expression benefits in driving the purchase of organic food is still in its nascent stages (Boobalan et al., 2022).

In summary, this study investigates the impact mechanisms between social crowding and conspicuous organic food consumption. The next sections of this study are as follows: first, the research hypothesis and model framework are presented. Then, the hypotheses proposed in this study are tested through three experiments. After that, the results of the study are discussed and the practical implications of this study are presented. Finally, the limitations of this study and the directions for future research are presented.

2 Literature review and hypothesis development

2.1 Organic food consumption

Organic food refers to food that is purely natural, pollution-free and of high quality in accordance with specific production principles, in which organisms and their products obtained by genetic engineering are not used, and chemically synthesized pesticides, fertilizers, growth regulators, additives and other substances are not used, and which follow the laws of nature and the principles of ecology (Parizad and Bera, 2023). According to the United States Department of Agriculture (USDA), organic food enhances the quality of the environment by protecting soil and water conservation and utilizing renewable resources to produce nutritious food, resulting in long-term benefits for the environment and for people (Guilbert and Wood, 2012). Therefore, the demand for organic food is increasing globally, but the market for organic food is still small. Numerous literatures have mentioned that price is the most significant barrier factor for organic food consumption (Pant et al., 2024). Compared to regular food, organic food is more expensive to grow and invest in and has lower yields because it cannot be produced on a large scale, resulting in higher prices for organic food (Wang et al., 2017). Therefore, adjusting the price of organic food is not an easy task.

Promoting organic food consumption can be attempted from the consumer demand side. Most studies emphasize health as the main driver for organic food consumption (Rizzo et al., 2020). In addition, sensory appeal (Lee and Yun, 2015), taste (Daraboina et al., 2024), positive emotions (Zheng et al., 2022), animal welfare (de Boer and

Aiking, 2022), environmental perceptions (Ahmed et al., 2021), and income quality (Zheng et al., 2023) all significantly influence organic food consumption. Organic food consumption is largely associated with a range of positive characteristics (e.g., pro-sociality, pro-environmentalism) (Konuk and Otterbring, 2024), and higher prices signal more expensive. As a result, motivations related to organic food consumption, such as the need to gain face (Li and Cui, 2021), obtain social status (Luomala et al., 2020), and achieve a favorable social image (Folwarczny et al., 2023), have also begun to emerge.

2.2 Conspicuous organic food consumption

A behavior can be referred to as conspicuous behavior when it demonstrates an individual's identity, status, or wealth, and earns the individual praise and helps the individual to satisfy his or her ego (Mason, 1984). Extending to the realm of pro-social behaviors, because altruism helps to increase an individual's pro-social status and reputation, it demonstrates an individual's ability and willingness to contribute to the environment (Policarpo and Aguiar, 2020). Therefore, when individuals purchase products related to environmental protection to show that they are pro-social, this consumption behavior characterized by altruistic signaling is conspicuous pro-social consumption behavior (Choi and Seo, 2017). Based on the high-cost signaling theory and indirect signaling theory, Sexton and Sexton (2014) further proposed a definition of conspicuous conservation, in which they noted that pro-social and pro-environmental behaviors can be viewed as costly signals with potentially multiple communicative functions. For example, purchasing an expensive hybrid car not only signals that the purchaser can afford such a vehicle, but also that he or she cares more about the environment and is altruistic. Thus, conspicuous conservation can communicate not only status but also pro-sociality. Other studies have also proposed the concepts of conspicuous donation (Grace and Griffin, 2009), conspicuous consumption of pro-social goods (Johnson et al., 2018), conspicuous pro-social behavior (Yao et al., 2020), and conspicuous green consumption (Li et al., 2022) based on pro-social signaling characteristics.

Organic food contributes to the consumer conspicuousness tendency by emphasizing the rarity and social value of the product. The conspicuousness signaling of organic foods has been partially validated based on the high cost signaling theory. It has been noted that a significant portion of organic food consumption is driven by the virtue signaling and moral identity conveyed by organic. Puska et al. (2018) found that consumers prefer organic food when their desire for status is aroused. Luomala et al. (2020) similarly suggest that preference for organic food can be used as a signal of pro-social status. Specifically, they proposed that consumers who prefer organic foods are usually perceived as status, selfless, and honest, and receive preferential treatment in socialization. Therefore, they suggest that rational use of organic pro-social status signaling in the marketing strategy of organic food could result in better market response. As an impression management strategy, consumers may express virtue and convey their desirable image to others by purchasing organic food, which is considered socially desirable (Folwarczny et al., 2023).

Based on the above studies, conspicuous organic food consumption can be defined as consumption for the purpose of displaying one's moral identity, pro-social image, and social status due to the presentability and public nature of organic food.

2.3 Social crowding

Social crowding is an experiential state in which individuals are constrained due to excessive population density per unit area (Maeng et al., 2013). Social crowding is a very common phenomenon in life, for example, a lot of crowding can be seen on subways, buses and in public places such as shopping malls. Therefore, referring to Maeng et al. (2013), the social crowding in this study focuses on crowding triggered by crowd density.

Benefiting from the maturity of positioning technology and the shift in consumption patterns, research on the impact of social crowding on consumer behavior has received widespread attention in recent years (Shen et al., 2019). On the one hand, social crowding can have a negative impact on consumer behavior. In most cases, social crowding brings negative emotions to consumers in terms of anxiety, fear, and stress. First, when experiencing social crowding, consumers will have thoughts and behaviors of retreating and fleeing (Shen et al., 2019), which in turn will reduce their consumption of the product. For example, social crowding will make consumers reduce interaction with anthropomorphic products (Puzakova and Kwak, 2017). Secondly, the negative emotions brought by social crowding will affect consumers' judgment and produce the wrong perception that the status of crowded stores is poor and the products of crowded stores are low-end, which will prevent them from rational consumption. For example, O'guinn et al. (2015) also found that products in crowded situations are usually perceived by consumers as being of poor quality and low price, and stores in crowded situations are perceived as low places for social class consumption. On the other hand, scholars have also found that social crowding also has a positive effect on consumer behavior. This part of the research is mainly based on the theory of compensatory consumption. These studies point out that when consumers experience social crowding, in order to compensate for the negative effects of individual spatial violations, they will seek diversified ways to alleviate negative emotions such as internal anxiety (Levav and Zhu, 2009). For example, buying self-improvement products (Ding and Zhong, 2020), preferring green products (Feng et al., 2022), and promoting minimalist consumption (Gong et al., 2023). With the development of mobile Internet, people can consume online in various crowded places, which expands the scope and research value of social crowding (Cai et al., 2021). This study will further explore the effect of social crowding on conspicuousness organic food consumption in conjunction with compensatory consumption theory.

2.4 Social crowding and conspicuous organic food consumption

The purpose of conspicuous consumption is to present oneself to others in the outside world by purchasing expensive goods (Park et al., 2023). Organic food has high pro-social attributes that can reflect an individual's social responsibility (Folwarczny et al., 2023) and

demonstrate the status of the individual (Luomala et al., 2020). According to costly signaling theory, consumers are willing to pay high costs to convey positive messages about themselves to the outside world (Berger, 2019). Further, Yao et al. (2020) state that when a green product has a green logo printed on it, the level of conspicuousness of that green product is the highest. Therefore, when the visibility of the label of organic food is high, such as when the label is larger and more visible (Ding and Yang, 2021) the purchase of this green product can be called typical conspicuous green consumption.

Being in a socially crowded environment can lead to negative emotions of anxiety or hostility in individuals due to the obstruction of personal space and restriction of personal behavior (Shen et al., 2019). In other words, when consumers suffer from social crowding, they will face physical and psychological threats. Whereas the resolution of threats is an important intrinsic human motivation (Sun et al., 2021), this resolution of threats stems from the individual's desire to maintain a positive self-evaluation, maintain a good and consistent self-concept, etc. (Choi et al., 2019). Since specific goods and brands have the symbolic function of helping consumers to convey status information (Balabanis and Stathopoulou, 2021), individuals will gain identity by purchasing products associated with identity when they suffer from identity threat or social belonging threat.

Conspicuous organic food has pro-social properties. A positive pro-social image can be created through the purchase of organic food, as well as building an individual's moral identity and establishing a pro-social reputation (Konuk and Otterbring, 2024). Organic food is characterized by low popularity and high price (Wang et al., 2019), with low popularity representing uniqueness and high price conveying status information and identity signals. When individuals suffer from threats, purchasing organic food with low-popularity and high-price characteristics allows individuals to gain stronger self-affirmation (Kraus et al., 2012). Therefore, this study proposes the following hypothesis:

H1: Social crowding significantly and positively affects conspicuous organic food consumption.

2.5 The mediating effect of the need for self-expression

The need for self-expression (SN) refers to the individual's intention to demonstrate his or her personality and other self-related characteristics to others in some way (Kim and Sherman, 2007). Social crowding means that the physical distance between people is reduced and personal boundaries are violated, leading to a lack of individual self (Blut and Iyer, 2020). To regain a sense of control or to cope with a lack of self, individuals often exhibit strategies to display their selves. Ding and Yang (2021) found that when consumers are in a socially crowded situation, ego boundaries become ambiguous, which induces individuals to develop a strong need for self-expression to highlight their selves and consequently make conspicuous product purchases. That is, when in a socially crowded situation, individuals tend to highlight themselves and emphasize their personality traits (Leary et al., 2011) to demonstrate their abilities and enhance their self-identity (Bergsieker et al., 2010). Thus, social crowding stimulates individuals' need for self-expression.

As mentioned above, conspicuous organic food consumption behavior can be understood as a self-expression of the consumer when purchasing such products. Essentially, conspicuous organic food consumption behaviors are self-pretentious behaviors with altruistic motives (Choi et al., 2018). Therefore, individuals with a higher need for self-expression are more inclined to engage in conspicuous organic food consumption to create an altruistic image and to accomplish self-actualization. Hwang (2016) proposed that self-expression is a psychological benefit factor that promotes consumers' organic food purchasing behavior. Therefore, conspicuous organic food has the property of self-expression, while the activation of the need for self-expression promotes the consumption of conspicuous organic food. Therefore, this study proposes the following hypothesis:

H2: Social crowding significantly and positively affects conspicuous organic food consumption, and the need for self-expression plays a mediating role. Specifically, when consumers experience social crowding, their need for self-expression is activated, leading to increased conspicuousness organic food consumption.

2.6 The moderating effect of self-concept clarity

Self-concept clarity (SCC) refers to the degree to which individuals' perceptions of various dimensions of the self are clear, consistent, and persistent (Campbell et al., 1996). It encompasses consistency in the content of the self-concept and stability in the time of self-perception (Campbell et al., 1996). Thus, self-concept clarity is a reflection of an individual's degree of ego. High SCC represents that individuals are clear and confident in their own perceptions and have a high degree of consistency and stability in their perceptions of themselves. It has been found that self-concept clarity is closely related to external environmental stimuli. Individuals with low self-concept clarity tend to rely on external information, often seek external help when making decisions, and are highly influenced by context. For example, Zheng et al. (2018) found that consumers with low SCC, the influence of social comparison on conspicuous consumption tends to be amplified. It has been suggested that lack of self-concept clarity can stimulate consumers' tendency to consume in an ostentatious manner (Mittal, 2015). Individuals with low SCC are more likely to perceive external situations as stressful, confusing, and unpredictable when responding to them (Jiang et al., 2023), and have more difficulty extracting self-relevant information (Campbell et al., 1996). In contrast, individuals with high SCC believe that their own knowledge guides their behavior and feel confident in making decisions based solely on their own perceptions (Burger and Guadagno, 2003), are less susceptible to the influence of others (Duan et al., 2021), and have a higher level of rejection of external stimuli. Therefore, this study hypothesized that individuals with low SCC will have high perceptual uncertainty about the impression they may make on others after experiencing social crowding because they do not have a clear perception of their self-concept and do not have a stable internal standard by which to evaluate themselves. As a result, they will show strong emotional reactions. To compensate for the threat to the self posed by social crowding, they will develop a higher need for

self-expression and further increase conspicuousness organic food consumption. Therefore, this study proposes the following hypothesis:

H3: Self-concept clarity moderates the effect of social crowding on conspicuous organic food consumption. Specifically, social crowding triggers higher conspicuousness organic food consumption when an individual's self-concept clarity is low, while there is no significant difference between individuals under social crowding and non-social crowding in terms of conspicuousness organic food consumption when an individual's self-concept clarity is high.

H4: Self-concept clarity moderated the mediating relationship between social crowding and conspicuousness organic food consumption through the need for self-expression. Specifically, this mediating relationship became stronger when individuals' self-concept clarity was low.

The research model of this study is shown in [Figure 1](#).

3 Materials and methods

3.1 Study overview

Based on consumers' conspicuous tendency, organic food consumption can be categorized into conspicuous organic food consumption and non-conspicuous organic food consumption. This study aims to investigate the effect of social crowding on conspicuous organic food consumption and to explore the psychological mechanisms involved. By constantly changing the experimental stimuli, Study 1 ($N = 90$) aimed to verify the main effect of social crowding on conspicuous organic food consumption. Study 2 ($N = 130$) verified the mediating effect of the need for self-expression in social crowding on conspicuous organic food consumption by measuring participants' needs for self-expression. Study 3 ($N = 180$) verified the moderating effect of self-concept clarity in social crowding on conspicuous organic food consumption by measuring participants' self-concept clarity. This study recruited participants and collected data through a data mart on Credamo. Credamo is an online professional research data platform with over 3 million members providing research and data services to over 2,000 universities and

scholars worldwide. Research completed using Credamo has been published in top international journals in the fields of psychology, management and public health (e.g., [Yang et al., 2024](#)).

3.2 Study 1: main effect of social crowding and conspicuous organic food consumption

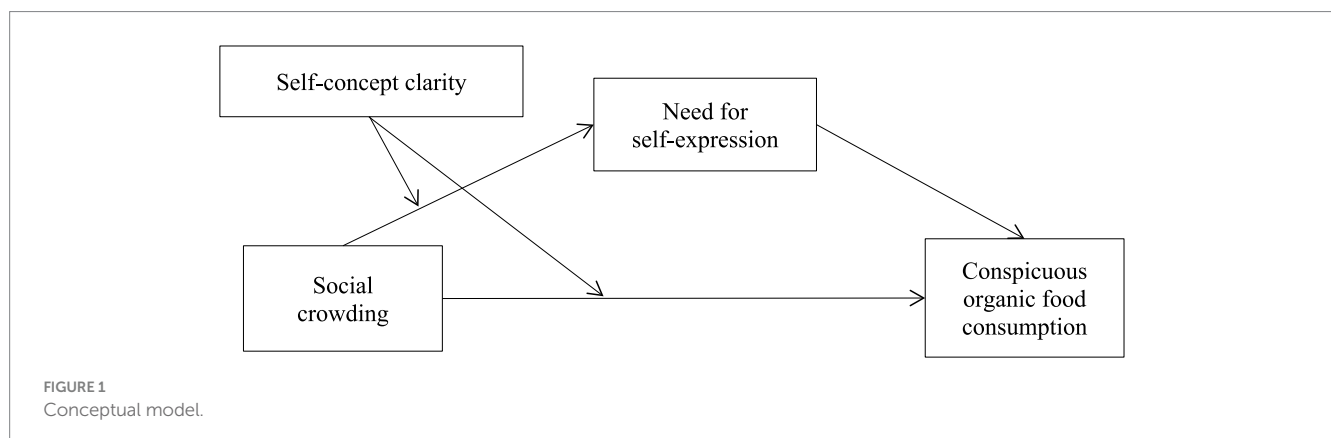
The purpose of Study 1 is to preliminarily test the effect of social crowding on conspicuous organic food consumption, i.e., consumers in social crowding situations tend to purchase conspicuous organic foods compared to consumers in non-social crowding situations. This study adopts a one-way between-groups experiment (social crowding: social crowding group vs. non-social crowding group).

3.2.1 Participants and design

The G*Power 3.1 software ([Cohen, 2013](#)) showed that the minimum planned sample size was 52 with an effect size of 0.4 and power of 0.8. Actually, 90 participants were actually recruited for this study. Only participants who have purchased organic food are allowed to enter the survey. 90 participants (70% female; $M_{age} = 27.7$, $SD_{age} = 7.57$) were randomly assigned to a single factor between-subjects design. Of those, 86% have a bachelor's degree or higher, 34% earn over 6,000 RMB per month, and 27% earn between 4,001 RMB and 6,000 RMB per month. The entire experimental procedure was completed online. Each subject received a cash payment after completing all questions.

3.2.2 Stimulus and procedure

First, participants were randomly assigned to different groups: social crowding group vs. non-social crowding group, and the content of the pictures presented in different groups was not consistent. To avoid participants guessing the purpose of the experiment, the page colophon informed them that this was a picture perception study and asked them to look at the pictures carefully and answer the questions. The manipulated picture of social crowding is consistent with the picture material used in the study by [Maeng et al. \(2013\)](#), as shown in Supplementary Figure S1. We drew on [Guo et al. \(2020\)](#) to reinforce the manipulation effect of social crowding through textual manipulation. Specifically, we required the participants to answer three questions with words:



(1) describe the picture they saw (no less than 20 words); (2) imagine that they were in the situation as much as possible, the more details the better, and then describe their feelings (no less than 20 words); and (3) share a similar experience they had recently encountered in their lives (no less than 20 words). Then, participants were asked to answer the manipulation test question, “Assuming you are in the situation in the picture, what is your perceived level of crowding?” (1 = not crowded at all, 7 = very crowded).

Then, participants were asked to choose between conspicuous organic foods and non-conspicuous organic foods. In this section, participants are presented with two types of organic brown rice (Supplementary Figure S2). According to Ding and Yang (2021), organic labels are large for conspicuous organic foods and organic labels are small for non-conspicuous organic foods. In the present study, a pre-test experiment was done beforehand for this stimulus. 30 participants did not differ significantly in the level of attractiveness and familiarity of the two organic brown rice products (attractiveness: $M_{\text{social crowding}} = 5.36$, $SD_{\text{social crowding}} = 1.40$, $M_{\text{non-social crowding}} = 4.94$, $SD_{\text{non-social crowding}} = 1.53$. $t(28) = -0.78$, $p = 0.44$; familiarity: $M_{\text{social crowding}} = 4.86$, $SD_{\text{social crowding}} = 1.56$, $M_{\text{non-social crowding}} = 4.44$, $SD_{\text{non-social crowding}} = 1.83$. $t(28) = -0.67$, $p = 0.51$). Therefore, the selection of stimulus for this experiment was appropriate. After reading the information, the participants were asked to rate their preference for two specific products, with the following question: “Of the above two organic brown rice products, I prefer product A/B,” using a 7-point scale (1 = product A, 7 = product B). In addition, participants were asked to choose between the two products by asking the question “If you were to buy one of these two products, which one would you be more likely to choose?”

Finally, participants were asked to fill in demographic information.

3.3 Study 2: mediating effect of the need for self-expression

The purpose of Study 2 is twofold: (1) to revalidate the main effects of social crowding and conspicuous organic food consumption; and (2) to verify the mediating effect of the need for self-expression. In this study, the robustness of the main effect will be tested by replacing the stimuli of social crowding and the conspicuous/non-conspicuous organic food. Study 2 used a one-way between-groups experiment (social crowding: social crowding group vs. non-social crowding group).

3.3.1 Participants and design

The G*Power 3.1 software (Cohen, 2013) showed that the minimum planned sample size was 52 with an effect size of 0.4 and power of 0.8. A total of 130 participants were recruited and data were collected through a data mart on the Credamo. Only participants who have purchased organic food are allowed to enter the survey. 128 valid questionnaires (66% female, $M_{\text{age}} = 30.38$, $SD_{\text{age}} = 9.37$) were collected after deleting two questionnaires with obvious logical errors. Among them, 94% have a bachelor's degree or higher, and 49% earn over 6,000 RMB per month. The entire experimental procedure was completed online. Each subject received a cash payment after completing all questions.

3.3.2 Stimulus and procedure

First, participants were randomly assigned to different groups: social crowding group vs. non-social crowding group. To avoid participants guessing the purpose of the experiment, the page header informed them that this was a picture perception study and asked them to look at the pictures carefully and answer the questions. Distinct from Study 1, the picture manipulation of social crowding used was two pictures on the subway Ding and Zhong (2020) (Supplementary Figure S3). Then, consistent with Study 1, participants were asked to complete the picture description task and the manipulation question items.

Then, the participants were asked to choose between conspicuous organic foods and non-conspicuous organic foods. Distinct from Study 1, this experiment was designed with two types of organic vegetables (Supplementary Figure S4). The two organic vegetables had the same brand, variety, price and packaging, differing only in that one had a visible organic label and the other did not display a label to distinguish between conspicuous organic products and non-conspicuous organic products. The same pre-test experiment was done beforehand for this stimulus. 30 participants' results showed no significant differences in the level of attractiveness and familiarity of the two organic vegetable products (attractiveness: $M_{\text{social crowding}} = 5.13$, $SD_{\text{social crowding}} = 2.03$, $M_{\text{non-social crowding}} = 5.07$, $SD_{\text{non-social crowding}} = 1.39$. $t(28) = -0.11$, $p = 0.92$; familiarity: $M_{\text{social crowding}} = 5.87$, $SD_{\text{social crowding}} = 1.13$, $M_{\text{non-social crowding}} = 5.47$, $SD_{\text{non-social crowding}} = 1.73$. $t(28) = -0.75$, $p = 0.46$). Therefore, the selection of stimulus for this experiment is appropriate.

Finally, the participants were asked to fill in the Needs for Self-Expression Scale, the emotion measure, and demographic information. The Needs for Self-Expression Scale (SN; 4-items, e.g., “I have a strong desire to express myself”; 1 = strongly disagree, 7 = strongly agree; Cronbach's $\alpha = 0.96$) was adapted from Ding and Yang (2021). Emotion Scale was measured with reference to Guo et al. (2020), containing three measures of positivity, happiness, and anxiety. A 7-point scale was used.

3.4 Study 3: moderating effect of self-concept clarity

The purpose of Study 3 was to verify the moderating effect of social crowding affecting the conspicuous organic food consumption and to reconfirm the mediating role of the need for self-expression in it. Specifically, according to H3, the effect of social crowding on conspicuous organic food consumption is reinforced when individuals' SCC is low, while the effect of social crowding on conspicuous organic food consumption is diminished when individuals' SCC is high.

3.4.1 Participants and design

Study 3 used a mixed experimental design of 2 (social crowding: social crowding group vs. non-social crowding group) \times 2 (consumption choice: conspicuous organic food vs. non-conspicuous organic food), with social crowding as a between-group experiment and consumption choice as a within-group experiment. The G*Power 3.1 software (Cohen, 2013) showed that

the minimum planned sample size was 128 with an effect size of 0.25 and power of 0.8.

A total of 180 participants were recruited and data were collected through a data mart on the Credamo. Only participants who have purchased organic food are allowed to enter the survey. 180 valid questionnaires (68% female; $M_{age} = 29.96$, $SD_{age} = 7.95$) were collected. Among them, 89% have a bachelor's degree or higher, and 50% earn over 6,000 RMB per month. The entire experimental procedure was completed online. Each subject received a cash payment after completing all questions.

3.4.2 Stimulus and procedure

First, participants were asked to complete the Self-Concept Clarity Scale. As [Supplementary Table S1](#) shown, the scale was adopted from [Campbell et al. \(1996\)](#). After pre-research, two questions, SCC3 and SCC6, were deleted and 10 items were retained. SCC10 was a reverse question. The scale was conducted on a 7-point scale (SCC; 10-item, e.g., "I often have contradictory perceptions of myself"; 1 = strongly disagree, 7 = strongly agree; *Cronbach's* $\alpha = 0.95$).

Then, participants were randomly assigned to different groups: social crowding group vs. non-social crowding group. The manipulated images ([Supplementary Figure S5](#)) used are two images from the park ([Tong and He, 2022](#)). The other processes were the same as in Study 1 and Study 2, and participants were required to complete the picture description task and manipulate the question items.

Next, participants were asked to choose between conspicuous organic foods and non-conspicuous organic foods. The experimental stimuli used were the two organic teas in [Supplementary Figure S6](#). The organic label is large for conspicuous organic food, and the organic label is small for non-conspicuous organic food ([Ding and Yang, 2021](#)). Similarly, a pre-test was conducted on this stimulus beforehand. The same pre-test experiment was done beforehand for this stimulus. 30 participants' results showed no significant differences in the level of attractiveness and familiarity of the two organic tea products (attractiveness: $M_{social\ crowding} = 5.13$, $SD_{social\ crowding} = 1.46$, $M_{non-social\ crowding} = 4.86$, $SD_{non-social\ crowding} = 1.41$. $t(28) = -0.51$, $p = 0.61$; familiarity: $M_{social\ crowding} = 5.00$, $SD_{social\ crowding} = 1.41$, $M_{non-social\ crowding} = 4.64$, $SD_{non-social\ crowding} = 1.78$. $t(28) = -0.61$, $p = 0.55$). Therefore, the selection of stimulus for this experiment is appropriate. After reading the information, the participants were asked to rate their preference for two specific products.

Finally, the participants were asked to fill in the Needs for Self-Expression Scale and demographic information. The Needs for

Self-Expression Scale was the same as which in Study 2 (SN; 4-items, e.g., "I have a strong desire to express myself"; 1 = strongly disagree, 7 = strongly agree; *Cronbach's* $\alpha = 0.93$).

4 Results

4.1 Study 1: main effect of social crowding and conspicuous organic food consumption

4.1.1 Manipulation check

The results showed that $M_{social\ crowding} = 6.71$, $SD_{social\ crowding} = 0.46$, $M_{non-social\ crowding} = 1.64$, $SD_{non-social\ crowding} = 1.25$. $t(88) = -25.60$, $p < 0.001$. Thus, the perceived crowding in the social crowding group was significantly higher than that in the non-social crowding group. The social crowding manipulation used in this study was effective.

4.1.2 Conspicuous organic food preference

The results indicated that the degree of conspicuous organic preference was higher for social crowding ($M_{social\ crowding} = 4.31$, $SD_{social\ crowding} = 2.58$) than for non-social crowding ($M_{non-social\ crowding} = 3.09$, $SD_{non-social\ crowding} = 2.27$), $t(88) = 2.39$, $p < 0.05$. Thus, participants in a social crowding situation were more likely to choose A goods, i.e., social crowding increases individuals' willingness to consume conspicuous organic foods, and H1 was supported.

4.1.3 Conspicuous organic food consumption choices

To further verify the relationship between social crowding and conspicuous organic food consumption choice, social crowding was used as the independent variable (1 = social crowding, 0 = non-social crowding) and consumption choice as the dependent variable (1 = conspicuous organic brown rice, 0 = non-conspicuous organic brown rice). The results of the chi-square analysis showed that consumers in a socially crowded situation were more likely to choose conspicuous organic brown rice ($\chi^2(1) = 7.57$, $p = 0.005 < 0.01$), i.e., social crowding increases individuals' willingness to consume conspicuous organic foods. [Table 1](#) shows that participants in the social crowding group were more likely to choose the conspicuous organic brown rice than those in the non-social crowding group. The frequency of choosing conspicuous organic brown rice was higher for participants in the social crowding group, while there was no significant difference between the frequency of choosing conspicuous organic brown rice and non-conspicuous organic brown rice for participants in the non-social crowding group. Therefore, social

TABLE 1 Frequency of consumer choice in Study 1.

	Conspicuous organic brown rice	Non-conspicuous organic brown rice	Total
Social crowding	31	14	45
	63.3%	34.1%	50.0%
Non-social crowding	18	27	45
	36.7%	65.9%	50.0%
Total	49	41	90
	100%	100%	100%

crowding increases individuals' willingness to consume conspicuous organic foods.

4.2 Study 2: mediating effect of the need for self-expression

4.2.1 Manipulation check

The results showed that $M_{social\ crowding} = 6.60$, $SD_{social\ crowding} = 0.53$, $M_{non-social\ crowding} = 1.32$, $SD_{non-social\ crowding} = 0.53$; $t(126) = -56.43$, $p < 0.001$. Thus, the perceived crowding in the social crowding group was significantly higher than the perceived crowding in the non-social crowding group. The social crowding manipulation used in this study was effective.

4.2.2 Conspicuous organic food preference

The results indicated that the degree of conspicuous organic preference was higher for social crowding ($M_{social\ crowding} = 4.60$, $SD_{social\ crowding} = 2.67$) than for non-social crowding ($M_{non-social\ crowding} = 2.87$, $SD_{non-social\ crowding} = 2.37$), $t(126) = 3.87$, $p < 0.001$. Thus, participants in a social crowding situation were more likely to choose A goods, i.e., social crowding increases individuals' willingness to consume conspicuous organic foods, and H1 was supported again.

4.2.3 Conspicuous organic food consumption choices

The results of the chi-square analysis showed that consumers in a socially crowded situation were more likely to choose conspicuous organic vegetables ($\chi^2(1) = 8.07$, $p = 0.004 < 0.01$), i.e., social crowding increases individuals' willingness to consume conspicuous organic foods. Table 2 shows the frequency of consumption in different groups.

TABLE 2 Frequency of consumer choice in Study 2.

	Conspicuous organic vegetables	Non-conspicuous organic vegetables	Total
Social crowding	41	22	63
	61.2%	36.1%	49.2%
Non-social crowding	26	39	65
	38.8%	63.9%	50.8%
Total	67	61	128
	100%	100%	100%

4.2.4 Mediation analysis

First, a one-way ANOVA was conducted to verify the mediating mechanism of the need for self-expression. The results showed that $M_{social\ crowding} = 5.25$, $SD_{social\ crowding} = 1.45$, $M_{non-social\ crowding} = 2.01$, $SD_{non-social\ crowding} = 0.72$; $F(1, 126) = 258.06$, $p < 0.001$, $\eta^2 = 0.67$. Participants in social crowding group had a higher willingness to express themselves compared to participants in non-social crowding group.

Further, a hierarchical linear regression was used to verify this relationship again. The results are shown in Figure 2. The need for self-expression fully mediates the effect of social crowding on conspicuous organic food consumption. To ensure multicollinearity is not an issue, variance inflation factors (VIF) were calculated. The result indicates a VIF score of 3.05, which is less than 5, confirming that there is no multicollinearity present in the research findings. H2 was supported.

Finally, we excluded possible alternative explanations for emotions. The results showed that there was no significant difference between participants in the social crowding and non-social crowding groups in positive ($M_{social\ crowding} = 4.59$, $SD_{social\ crowding} = 1.78$, $M_{non-social\ crowding} = 4.75$, $SD_{non-social\ crowding} = 1.56$; $t(126) = 0.56$, $p = 0.57$), happy ($M_{social\ crowding} = 4.48$, $SD_{social\ crowding} = 1.69$, $M_{non-social\ crowding} = 4.49$, $SD_{non-social\ crowding} = 1.43$; $t(126) = 0.06$, $p = 0.95$) and anxiety ($M_{social\ crowding} = 3.52$, $SD_{social\ crowding} = 1.90$, $M_{non-social\ crowding} = 2.94$, $SD_{non-social\ crowding} = 1.58$; $t(126) = -1.90$, $p = 0.06$). Therefore, emotion is not a potential mediating variable.

4.3 Study 3: moderating effect of self-concept clarity

4.3.1 Manipulation check

The results showed that $M_{social\ crowding} = 5.93$, $SD_{social\ crowding} = 0.99$, $M_{non-social\ crowding} = 1.31$, $SD_{non-social\ crowding} = 0.68$; $t(178) = -36.44$, $p < 0.001$.

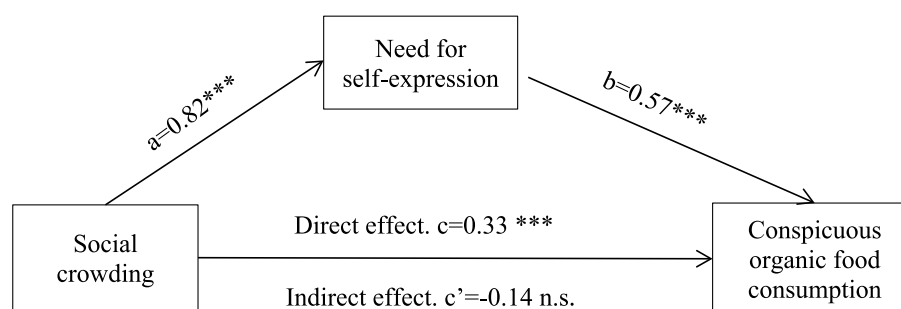


FIGURE 2 Mediating effects of the need for self-expression. *** $p < 0.001$. n.s. means not sufficient.

Thus, the perceived crowding in the social crowding group was significantly higher than the perceived crowding in the non-social crowding group. The social crowding manipulation used in this study was effective.

4.3.2 Conspicuous organic food preference

The results indicated that the degree of conspicuous organic preference was higher for social crowding ($M_{social\ crowding} = 4.69, SD_{social\ crowding} = 1.96$) than for non-social crowding ($M_{non-social\ crowding} = 2.79, SD_{non-social\ crowding} = 2.21$), $t(178) = 6.10, p < 0.001$. Thus, participants in a social crowding situation were more likely to choose A goods, i.e., social crowding increases individuals' willingness to consume conspicuous organic foods, and H1 was supported again.

4.3.3 Conspicuous organic food consumption choices

The results of the chi-square analysis showed that consumers in a socially crowded situation were more likely to choose conspicuous organic tea ($\chi^2(1) = 17.133, p < 0.001$), i.e., social crowding increases individuals' willingness to consume conspicuous organic foods. Table 3 shows the frequency of consumption in different groups.

4.3.4 Mediation analysis

First, a one-way ANOVA was used to analyze the effect of social crowding on the need for self-expression, and the results showed that $M_{social\ crowding} = 4.88, SD_{social\ crowding} = 1.86, M_{non-social\ crowding} = 3.94, SD_{non-social\ crowding} = 1.58; F(1, 178) = 13.22, p < 0.001, \eta^2 = 0.07$. Compared to participants in a non-social crowding group, participants in a social crowded group had a higher willingness to express themselves. Next, bootstrapping [PROCESS model 4 (Hayes, 2017)] supported the proposed causal relationships. The results showed that need for self-expression mediated the preference for social crowding and

conspicuous organic food consumption ($\beta = 0.16, SE = 0.04, 95\%CI: [0.07, 0.24]$, not including 0).

4.3.5 Moderating effect

Bootstrapping [PROCESS model 1 (Hayes, 2017)] supported the proposed causal relationships (Table 4). Conspicuous organic food preference was used as the dependent variable (1 = non-conspicuousness, 7 = conspicuousness), perceived crowding as the independent variable, and self-concept clarity as the moderator variable. The results showed that the main effect of social crowding was significant ($\beta = 1.17, SE = 0.12, t = 10.00, p < 0.001, 95\%CI: [0.94, 1.40]$), the main effect of self-concept clarity was significant ($\beta = 0.30, SE = 0.14, t = 2.18, p < 0.05, 95\%CI: [0.03, 0.58]$), and the interaction term of social crowding and self-concept clarity was significant ($\beta = -0.24, SE = 0.03, t = -7.98, p < 0.001, 95\%CI: [-0.30, -0.18]$, not including 0). The inclusion of the interaction term increased R^2 to the same significant level ($p < 0.001$), indicating the significant moderating effect of self-concept clarity. When individuals have a low level of self-concept clarity, experiencing social crowding has a higher preference for conspicuousness consumption than non-social crowding, while when the level of self-concept clarity is high, there is no significant difference between social crowding and non-social crowding in terms of their effects on the degree of preference for conspicuousness organic food consumption. H3 was supported.

4.3.6 Moderated mediating effect

Bootstrapping [PROCESS model 8 (Hayes, 2017)] supported the proposed causal relationships (Table 5). Conspicuous organic food preference was used as the dependent variable (1 = non-conspicuousness, 7 = conspicuousness), perceived crowding as the independent variable, need for self-expression as the mediator, and self-concept clarity as the moderator. The results showed that the effect of social crowding on conspicuous organic food consumption preference through the need for self-expression was significantly

TABLE 3 Frequency of consumer choice in Study 3.

	Conspicuous organic tea	Non-conspicuous organic tea	Total
Social crowding	69	21	90
	62.2%	30.4%	50.0%
Non-social crowding	42	48	90
	37.8%	69.6%	50.0%
Total	111	69	180
	100%	100%	100%

TABLE 4 Results of moderating effect.

Model	Effect	SE	t	p	LLCL	ULCL
Constant	1.93	0.54	3.56	0.0005	0.86	3.00
SC	1.17	0.12	10.00	0.0000	0.94	1.40
SCC	0.30	0.14	2.18	0.0303	0.03	0.58
SC*SCC	-0.24	0.03	-7.97	0.0000	-0.30	-0.18
	R²-chg		F		p	
R ² increase	0.18		63.55		0.000	

Social Crowding (SC), Self-concept Clarity (SCC).

TABLE 5 Results of moderated mediating effect.

Moderator	Effect	SE	LLCL	ULCL	
					SC → SN → CO
Low SCC	1.87	0.30	0.06	0.19	0.42
Middle SCC	3.44	0.10	0.03	0.06	0.16
High SCC	5.01	-0.09	0.04	-0.17	-0.03
			Index of moderated mediation		
SCC	-0.13	0.03	-0.18		-0.07

positive when individuals had low and middle levels of SCC (Low SCC: $\beta = 0.30$, 95%CI: [0.19, 0.42]; Middle SCC: $\beta = 0.10$, 95%CI: [0.06, 0.16]). In contrast, the effect of social crowding on ostentatious organic food consumption through the need for self-expression was significantly negative when the individual's SCC was at a high level (High SCC: $\beta = -0.09$, 95%CI: [-0.17, -0.03]). Thus, social crowding increases an individual's need for self-expression, and hence conspicuousness organic food consumption, when the individual's self-concept clarity is medium and low, while the effect is moderated when the individual's self-concept clarity is high. H4 was supported.

5 Discussion

As an integral part of sustainable development, research related to organic food consumption has flourished. However, organic food is still in the early stages of development, and the current organic food market is still small. It is relatively difficult to expand the market share of organic food directly by lowering the price of organic food, but it is feasible for companies to facilitate the consumer shift to organic food consumption through contextual factors. This study explores the impact of social crowding on organic food, focusing on the conspicuous characteristics of organic food. This study draws the following conclusions.

First, in Study 1, this study predicted that social crowding would increase conspicuous organic food consumption, and the results supported this prediction. Relevant studies on social crowding have been found to increase consumer consumption of safer products (Maeng et al., 2013), increased consumption of high-calorie foods (Hock and Bagchi, 2018), etc. The findings of this study expand on this by showing that social crowding increases the preference for conspicuous organic foods. This conclusion differs from the findings of Wang et al. (2024), who believes that conspicuous motives are more prevalent in consumers' pursuit of clothing and home products, whereas food products are less associated with them. As it described above, organic food consumption is still a niche consumption (Wang et al., 2019), and the symbolic value of buying organic food is greater than the functional value. The purchase of organic food implies that consumers have high disposable income, a green and healthy lifestyle, and pro-social attributes. Thus, buying organic food has conspicuousness attributes. The conclusion of this study aligns with theirs, serving as an expansion and extension of their research. For individuals with a high tendency to conspicuousness, the purchase of organic food can satisfy their need for self-impression management, therefore, when individuals are in a social crowding situation, the attribute of conspicuousness will drive them to prefer organic food.

Previous studies have shown associations between anticipated pride, status, prestige, and the consumption of organic food (Chae et al., 2024; Konuk and Otterbring, 2024; Luomala et al., 2020; Puska et al., 2018).

Second, this study constructs a model of social crowding influencing conspicuous organic food, and explores the psychological mechanisms and boundary conditions. Study 2 and 3 validated the research model. Specifically, the need for self-expression plays a mediating role and self-concept clarity plays a moderating role. Social crowding encroaches on personal space, and excessive interpersonal proximity can blur the boundaries between self and others. The individual perceives that the self is threatened, and therefore the individual has an urgent need to express the self. Driven by this need, individuals increase their tendency to consume conspicuously because conspicuous consumption represents an individual choice that helps them gain the attention of others and communicate their views. This finding is consistent with previous research on compensatory consumption (Ding and Yang, 2021; Zheng et al., 2018). It is important to note that organic food consumption in general can also demonstrate the individual's concern for the environment and convey the individual's pro-sociality and altruism, but conspicuous organic food consumption has an additional purpose of showing status and wealth to others (Yao et al., 2020; Choi et al., 2018). However, this positive effect was only present in participants with low self-concept clarity, and there was no significant difference between the effect of social crowding and non-social crowding on conspicuous organic food consumption when participants had high levels of self-concept clarity.

6 Theoretical contributions

This study makes three significant contributions to the literature: First, this study confirms the role of conspicuous tendency in organic food consumption and enhances the understanding of the characteristics of individual organic food consumption behavior. Most previous studies on organic food purchase motivations have focused on consumers' environmental and personal health motivations, and few studies have focused on whether organic food can be used to denote social status or social standing, i.e., the status motivation of organic food has been downplayed (Folwarczny et al., 2024; Konuk and Otterbring, 2024). Conspicuous consumption does not only occur in the context of purchasing luxury goods; consumers may also be inclined to emphasize and express themselves more when consuming organic food in crowded social environments, thereby increasing their willingness to consume organic food.

Second, this study extends the marketing application of social crowding, broadening the scope and research value of social crowding studies. Existing research indicates that consumers can unconsciously be influenced by cues in their environment, leading to unconscious goals that significantly impact their behavior (Chartrand et al., 2008). With the continuous growth of the population, social crowding becomes an inevitable situation for consumers. However, research on the impact of social crowding and food marketing remains relatively scarce. This study extends the concept of social crowding to the domain of organic food marketing, emphasizing the influence of situational factors on food consumption, thus providing a valuable supplement to existing research.

Third, this study reveals new factors that influence conspicuous consumption and contributes to conspicuous consumption-related research. It has been shown that psychological threats arising from specific social activities can stimulate individuals to develop control and status cravings, which in turn influence consumer tendency to conspicuous consumption. For example, Koo and Im (2019) found that individuals in the low power prefer conspicuous consumption. Park et al. (2023) proved consumers with high PDB are more inclined toward conspicuous consumption. There is also research providing evidence of a connection between mindfulness and conspicuous consumption (Bharti et al., 2022). However, these studies are all based on the micro-level of individual characteristics. Fewer studies have examined conspicuous consumption at the meso-level (Ding and Yang, 2021). This study investigates the mechanism of social crowding as an environmental factor on conspicuous organic food consumption, which is a complement to the literature on conspicuous consumption.

7 Practical implications

This study is poised to assist businesses in better understanding the preferences of organic food consumers and the psychological drivers behind their decisions. Furthermore, it may facilitate the promotion of consumer transition toward organic food consumption, for example, through adjustments in organic food packaging, thereby expanding the organic food consumption market. The managerial and practical implications of this study also include the following.

First, utilizing the conspicuous pro-social signal of organic food in product promotion and stimulating consumers' need for self-expression by emphasizing the added value of organic food may generate good market response. For example, by highlighting the significance of organic food for environmental protection and the high moral quality of consumers who buy organic food in advertisements.

Second, it is not the case that advertising in places with high traffic flow will have better results, but rather the combination of advertising with the characteristics of the product and targeted advertising can achieve good results. The development of AI technology can significantly help solve multifactorial techno-economic problems (Kliestik et al., 2023). With the support of AI technology and big data algorithms, organic food companies can implement precise positioning of the environment where consumers are located, and then further identify potential purchase signals and develop and generate personalized advertising content by judging the foot traffic environment. For example, fresh food merchants can deliver organic

food advertisements to consumers' cell phones during the morning or evening peak hours with bragging rights. Algorithmic big data-based tools can also analyze user data to identify the user groups most likely to convert, make personalized recommendations, and achieve a closed loop of customized marketing (Kliestik et al., 2024).

Third, research confirms that social crowding increases consumers' preference for organic food by stimulating their need for self-expression. Therefore, companies can take the initiative to create some traffic inside organic food stores to promote consumption, such as placing signage outside the store, holding appropriate promotions, and taking measures to increase the level of crowding inside the store to stimulate consumers' need for self-expression. And put organic food products with obvious organic labels in a visible place, which will eventually trigger conspicuous organic food consumption.

8 Limitations and future research

This study also has the following limitations: First, this study only explores social crowding in a general context, and has not yet done more subdivision on the types of social crowding. There are studies that subdivide social crowding into spatial crowding and interpersonal crowding (Liu et al., 2020), and different types of crowding have different effects on consumer behavior. In terms of organic food consumption, does interpersonal crowding lead to the belief that "popular is good" and thus promote organic food consumption? Does spatial crowding trigger negative consumer sentiment, which in turn discourages organic food consumption? In addition, different individuals perceive environmental crowding differently. Some scholars have divided the environment into orderly and disorderly (Blut and Iyer, 2020), and they argue that only disorderly environments reduce individuals' sense of control, while orderly environments do not. So, can social crowding also be divided into orderly and disorderly crowding to explore its different effects on consumer behavior? These are worth further exploration.

Second, due to the limitation of research funding, this study is based on an online platform to complete the experiment, which has certain limitations. By controlling the relevant variables, this study can ensure that the experiment has high internal validity, but the external validity of the experiment has yet to be further verified because the virtual scenario may lead to insufficient subject engagement. In addition, while the sample size used in this study met the minimum sample requirements, increasing the sample size could be considered in the future to improve the statistical validity of the findings. The hypothesis of this study can be tested again in the future through field experiments or secondary data. In addition, the rise of neuromarketing provides a new tool for future research, especially for further validating the effect of offline crowding on online consumption behavior, which can further expand the external validity of this study.

Finally, the definition of organic food varies greatly across the globe, with different countries having different perceptions of organic food consumption. This study serves as an introduction to propose the concept of conspicuousness organic food consumption for research. In the future, samples from more cultural backgrounds should be considered and cross-cultural factors should be fully taken into account to better understand the interpretation and application of conspicuousness organic food consumption in different cultural contexts.

9 Conclusion

This study categorized organic food into two types: conspicuous organic food and non-conspicuous organic food. It verified that social crowding increases conspicuous organic food consumption. The need for self-expression fully mediates the effect of social crowding on conspicuous organic food consumption. Individuals in crowded social environments exhibit higher self-expression needs, leading to a greater preference for conspicuous organic food consumption. When individuals have low clarity of self-concept, the effect of social crowding on conspicuous organic food consumption is strengthened, whereas when individuals have high clarity of self-concept, the effect of social crowding on conspicuous organic food consumption is mitigated. Additionally, self-concept clarity moderates the influence of social crowding on self-expression needs.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Ethics statement

The study did not require further ethics committee approval as it did not involve animal or human clinical trials and was not unethical. In accordance with the ethical principles outlined in the Declaration of Helsinki, all participants provided informed consent before participating in the study. The anonymity and confidentiality of the participants were guaranteed, and participation was completely voluntary. They were financially compensated for their participation in the amount of 2 RMB.

Author contributions

QZ: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Validation, Writing – original draft. XC:

Funding acquisition, Investigation, Validation, Writing – review & editing. HZ: Investigation, Validation, Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2025.1486469/full#supplementary-material>

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