Technovation xxx (xxxx) xxx

Contents lists available at ScienceDirect

Technovation

journal homepage: www.elsevier.com/locate/technovation

Balancing food waste and sustainability goals in online food delivery: Towards a comprehensive conceptual framework

Amit Shankar [a], Amandeep Dhir [b,c,d,*], Shalini Talwar [e], Nazrul Islam [f], Piyush Sharma [g]

[a] Indian Institute of Management Visakhapatnam, Andhra Pradesh, 530003, India
[b] Department of Management, School of Business & Law, University of Agder, Kristiansand, Norway
[c] Norwegian School of Hotel Management, Faculty of Social Sciences, Stavanger, Norway
[d] Optentia Research Focus Area, North-West University, Vanderbijlpark, South Africa
[e] S.P. Jain Institute of Management and Research (SPJIMR), Mumbai, India
[f] Department of Science, Innovation, Technology and Entrepreneurship, University of Exeter Business School, England, UK
[g] School of Management and Marketing, Faculty of Business and Law, Curtin University, Australia

ARTICLE INFO

Keywords:
Digitalization
Eco-friendly packaging
Food delivery apps (FDAs)
Hospitality
Leftover reuse
Sustainable development goals

ABSTRACT

Increasing food waste is a major threat to sustainability and food security. Recognizing the issue, the United Nations Sustainable Development Goal (SDG) 12 mandates reducing global food waste by 50 percent by 2030. This situation has also given impetus to academic research on consumer food waste in both household and out-of-home settings. However, food delivery apps (FDAs) remain under-researched from this perspective. This is a serious gap because operating under a business model that inherently facilitates food over-ordering, FDAs can be a major source of food waste. Understanding the demand-side factors that drive consumers to order more food than required to satiate their hunger can be useful in mitigating such wasteful indulgences. Noting this, we extend the seminal theory of planned behavior (TPB) to propose direct and intervening mechanisms that can better explicate why consumers indulge in a '*shopping routine*' of ordering more food than required. We analyzed data from 487 FDA users to test the proposed hypotheses. Our results reveal the positive associations of (a) attitude and subjective norms with usage intentions and (b) trust, intentions, and leftover reuse routine with shopping routine. In addition, both proposed moderators—i.e., willingness to pay for eco-friendly packaging and number of years of FDA usage—do, in fact, moderate the associations of leftover reuse routine with both usage intentions and shopping routine. These findings can help marketers and policymakers devise appropriate strategies to promote pro-environmental green behaviors among FDA users without harming the commercial interests of the sector.

1. Introduction

Food waste poses serious social, economic, and environmental sustainability challenges globally (Stancu et al., 2016; De Visser-Amundson, 2020; Dhir et al., 2020; Carolan, 2021). According to a recent report, 1.3 billion tons of food worth USD 2.6 trillion is wasted around the globe each year; this amount of wasted food would be sufficient to feed up to 815 million people (FAO, 2019). Approximately 61 percent of global food waste comes from households while 26 percent comes from food services and 13 percent comes from retail shops (UNEP, 2021). Because they tend to purchase excessive food, which often remains unconsumed and, ultimately, wasted, consumers are the main contributors to food waste globally (Dhir et al., 2020; Petit et al., 2020; Sharma et al., 2021). The scholarly literature has termed this tendency to purchase food in excess (i.e., over and above the quantity required to satiate hunger) a 'shopping routine' (Stefan et al., 2013; Samsioe and Fuentes, 2022).

Past research on shopping routines identifies cash rewards, promotions, and free delivery (e.g., Talwar et al., 2021a) as well as the desire to save time, effort, and costs of food shopping (Wilson et al., 2017; Petit et al., 2020; Schmitt et al., 2021) as key drivers of this wasteful behavior. These findings, however, derive from prior research, which has focused primarily on shopping behavior in the context of household food items. With this narrow focus, the extant research

* Corresponding author. Department of Management, School of Business & Law, University of Agder, Kristiansand, Norway.
E-mail addresses: ashankar@iimv.ac.in (A. Shankar), amandeep.dhir@uia.no (A. Dhir), shalini.talwar@spjimr.org (S. Talwar), n.islam@exeter.ac.uk (N. Islam), Piyush.Sharma@curtin.edu.au (P. Sharma).

https://doi.org/10.1016/j.technovation.2022.102606
Received 3 March 2022; Received in revised form 9 July 2022; Accepted 15 July 2022

has—despite FDAs' growing popularity—ignored the possibility of food waste being generated when consumers order prepared food through such apps (Lee et al., 2020). FDAs offer many advantages, such as convenience, localization, promotional offers, last-minute discounts, authentic reviews, 24/7 access, an exhaustive list of cuisines, menus, and restaurants, and rapid delivery (Kapoor and Vij, 2018; Cho et al., 2019; Xu and Huang, 2019; Shankar et al., 2022; Talwar et al., 2022a). These advantages have led to an exponential increase in the number of active FDA users around the world. This growth is expected to continue, with the number of FDA users anticipated to surpass 1.2 billion by 2023 (Statista, 2018). Offering testimony to the rapid growth of FDA usage globally, recent estimates suggest that FDAs' market volume is likely to reach USD 217.80 billion by the end of 2022 (Statista, 2022). Although the anticipated growth figures are commercially exciting, this digital success story also has a dark side in the form of the sustainability concerns that arise from the potential for such high FDA usage to increase food waste generation.

The scholarly literature on FDAs has also grown substantially, with past studies exploring consumers' usage intentions (Cai and Leung, 2020; Lee et al., 2020; Raza et al., 2020; Song et al., 2021), FDAs' service quality dimensions (Chen et al., 2020), consumers' perceived risks (Hwang and Choe, 2019; Choe et al., 2021), consumers' perceived values (Kaur et al., 2021b; Tandon et al., 2021), barriers to usage (Talwar et al., 2021), and service failures (Furunes and Mkono, 2019; Kaur et al., 2022). The existing scholarship has, moreover, made some attempts, albeit limited, to examine the sustainability-oriented aspects of FDA usage, such as food waste reduction intentions (Olavarria-Key et al., 2021), strategies to reduce food waste (Vizzoto et al., 2021), the effect of message framing on food waste reduction (Zhang et al., 2020), and food ordering behavior that can lead to food waste (Sharma et al., 2021). However, a comprehensive review of the literature regarding FDAs and food waste reveals three persistent gaps: (a) Shopping routine—a significant contemporary measure due to its association with food waste—remains less examined in the FDA context despite being well investigated in household settings (e.g., Grandhi and Appaiah Singh, 2016; Nabi et al., 2021); (b) Scholars have yet to investigate the role of trust—an important variable in the online context, including mobile app usage (Shankar et al., 2020; Chakraborty et al., 2022) and buying and shopping behavior (Patil et al., 2020; Dhir, Sadiq et at., 2021; Dhir, Sadiq et at., 2021)—in driving FDA usage that can lead to food waste generation; and (c) Despite being acknowledged as an important variable in this context, leftover reuse routine—an important food waste reduction strategy examined in the household context (Hamerman et al., 2018; Talwar et al., 2022b)—remains under-explored in terms of FDA usage and its role in driving over-ordering behavior (Talwar et al., 2022a).

Our study addresses these gaps using the well-established theory of planned behavior (TPB), which has been widely deployed to predict consumer intentions across various contexts (e.g., Wu et al., 2015; Alzubaidi et al., 2021). Scholars have also considered TPB a suitable theoretical lens to study the complexity of factors influencing consumers' behavioral decision-making (Arora and Sahney, 2018). The classic TPB postulation links attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC) with intentions to use, which, in turn, drive behavior (Ajzen, 1991). However, scholars are increasingly acknowledging the need to extend and expand the classic TPB conceptualization to capture contemporary nuances and variances in the associated outcome variables (Yadav et al., 2019; Dhir et al., 2020). Guided by this view, we not only model the three original TPB variables but also include two contemporary variables—trust (TR) and leftover reuse routine (LR), which are relevant to the FDA and food waste context. We also extend the classic TPB framework by including two moderating variables—willingness to pay for eco-friendly packaging and number of years of FDA usage. These choices are consistent with the recent literature on FDAs and sustainability. Past studies on FDAs have, in particular, emphasized the role of the number of years of FDA use on consumers' behavioral intentions and usage decisions (M. K. Kim et al., 2016; Sharma et al., 2021). Similarly, the sustainability-focused literature has discussed the willingness to pay for more environmentally friendly options—representing consumers' readiness to sacrifice for the greater good—as a key construct (e.g., Talwar et al., 2022c).

Summarizing the preceding discussion, we propose to address the following research questions (**RQs**): **RQ1**. How are attitude, subjective norms, and perceived behavioral control associated with consumers' intentions to use FDAs? **RQ2**. How are trust and leftover reuse routines associated with FDA users' intentions to use and shopping routine? **RQ3**. How are intentions to use FDAs associated with users' shopping routine? and **RQ4**. Do willingness to pay for eco-friendly packaging and number of years of FDA usage moderate the associations of trust and leftover reuse routine with intentions to use and shopping routine, and if so, how? We answered these questions by analyzing cross-sectional, single-wave data from 478 FDA users.

Our findings make three noteworthy contributions. First, our study is among the pioneering research attempts to examine demand-side behaviors towards FDAs with food waste as the fulcra. The uniqueness of this contribution is further enhanced by the entire study's focus on and alignment with SDG 12. Specifically, our study extends the food waste literature by focusing on the impact of the increasing usage of FDAs on food waste generation and thereby initiating debate regarding the ways in which multiple stakeholders in the sector can balance commercial interests and sustainability concerns. Second, the study extends the seminal principles of TPB by including variables of contemporary interest and pertinence, such as trust, leftover reuse routine, and shopping routine, to better capture the FDA usage behaviors that promote the possibility of food waste generation. Finally, our study makes a novel contribution by examining the moderating effects of two relevant yet under-explored variables—willingness to pay for eco-friendly packaging and number of years of FDA usage. In doing so, it presents more nuanced insights into consumer behavior toward FDAs and FDAs' impact on food waste generation.

2. Theoretical background and hypotheses development

2.1. Food delivery apps (FDAs): the digital face of hospitality

As information technology has advanced, the combination of the Internet and mobile phones has produced a new avenue for the sharing economy—shared platforms, usually called food delivery aggregators, which provide a marketplace for online food ordering and delivery (e.g., Zomato, Uber Eats, foodpanda, and Foodora; e.g., Xu and Huang, 2019). A review of the literature indicates that these aggregators, available via FDAs, have emerged as innovative and popular platforms for delivering foods for three key reasons. First, the number of working parents and single-person households has increased, and this shift toward a working parent lifestyle has reduced the home cooking of daily meals (Roh and Park, 2019). By ordering food on FDAs, working parents can save the time and effort that goes into meal preparation (Cho et al., 2019). Second, the increase in internet access and smartphone use has motivated restaurants, third-party delivery platforms, and other intermediaries (e.g., Uber Eats drivers) to provide delivery services, thereby supporting the FDA ecosystem. Third, the interactivity and efficiency of such apps have improved significantly in the recent past (Correa et al., 2019), making FDAs an integral part of the restaurant industry (Cho et al., 2019). In addition to consumer behavior, many recent studies have explored technological advancements related to FDAs (e.g., AI) and their positive impact on consumer behavior (e.g., He et al., 2018; Correa et al., 2019; Xu and Huang, 2019; Dhir et al., 2020; Hwang et al., 2020; Lee et al., 2020; Kaur et al., 2021b).

Despite the growing research on sustainability, SDGs, and food waste in out-of-home and household settings (e.g., Kaur et al., 2021a), however, the scholarly literature has left the linkage between FDA usage and food waste almost entirely unexplored. While some recent studies have

examined this aspect (e.g., Sharma et al., 2021; Talwar et al., 2021b), variables of interest in the food waste literature, such as leftover reuse routine and shopping routine, require deeper examination in the context of FDAs. Because these factors are related to food over-ordering through FDAs and the possibility of subsequent waste recovery, a lack of insights may hinder the ability of concerned stakeholders to act in alignment with the United Nations Sustainable Development Goal 12.3, which calls for the reduction of retail and consumer food waste by 50 percent by 2030 (UNSDG, 2018).

2.2. Theory of planned behavior (TPB)

According to the TPB (Ajzen, 1991), attitude, subjective norms, and perceived behavior control are the basic predictors of consumers' adoption intentions. The TPB (Ajzen, 1991) is considered the most influential theory for explaining consumer adoption behavior (Ajzen, 2011). Scholars identify TPB as an ideal theory to study consumer behavior because it provides sensible explanations for consumers' deliberate choices (Chen et al., 2020). Recognizing TPB's popularity and efficacy, past studies have used it to examine food choices and consumption behavior in various contexts, including over-ordering behavior at restaurants (Yu et al., 2021), green food consumption (Qi and Ploeger, 2019), fruit consumption (Canova et al., 2020; Carfora et al., 2016), organic food consumption (Yadav and Pathak, 2016), healthy eating behavior (Lim et al., 2020), sugar-sweetened beverage consumption intentions (Gregorio-Pascual and Mahler, 2020), adherence to gluten-free diets (Xhakollari et al., 2021), sugar-free consumption (Phipps et al., 2020), consumption of non-perishable food (Lehberger et al., 2021), and fast food consumption (Sharifirad et al., 2013). Recent studies have also utilized TPB in the specific context of FDAs to confirm attitude (Tandon et al., 2021), subjective norms (Troise et al., 2020), and perceived behavioral control (J. J. Kim et al., 2021) as key variables associated with behavioral intentions. Going beyond the classic TPB constructs, scholars have noted that the extended TPB, which accommodates context-specific variables, has greater predictability, comprehensiveness, and parsimony in explaining consumer behavior (Kumar, 2017). For these reasons, this study extends the TPB theory to explore consumer behavior in the context of FDAs.

The TPB's proven efficacy in explaining food consumption behavior in general as well as consumer behavior in the specific context of FDAs makes it a suitable theoretical framework for our study. In the interest of exploring the typicality of food waste behavior in the FDA context effectively, we go a step further and extend the TPB with relevant constructs. In particular, we extend the TPB framework by including consumers' trust in FDAs to capture their motivation to use FDAs and leftover reuse routine to capture their internal offsetting mechanism/ thought process, which might allow them to justify ordering more food than required to satiate their hunger through their intention to reuse any unconsumed food. Finally, our study models over-ordering behavior itself as a shopping routine.

Overall, as presented in Fig. 1, our conceptual model proposes attitude, subjective norms, and perceived behavioral control as antecedents of intentions to use FDAs and trust and leftover reuse routine as antecedents of both intentions to use FDAs and shopping routine. To better illustrate the complex mechanism through which the identified antecedents affect wasteful behavior on FDAs, we further propose the moderating effect of willingness to pay for eco-friendly packaging and number of years of FDA usage on the hypothesized associations. Table 1 presents the operational descriptions of all variables under study.

Table 1
Description of study constructs.

Study constructs	Brief description	Reference
Attitude	An individual's firm belief regarding the value of performing or not performing a particular behavior	Fishbein and Ajzen (1975)
Subjective norms	The social pressure a person faces while performing a particular behavior	Ajzen and Madden (1986)
Perceived behavioral control	A consumer's perception that he or she has the necessary knowledge and resources to perform a specific task	Ajzen (1991)
Trust	A consumer's positive belief about the reliability and quality of the services offered	Shankar et al. (2020)
Leftover reuse routine	An individual's method of reusing and storing food leftovers	Stancu et al. (2016)
Intentions to use	A consumer's positive intent toward FDAs usage	Ajzen (1991)
Shopping routine	The consumer practice of purchasing more food than required	Evans (2012)
Willingness to pay extra for eco-friendly packaging	A consumer's willingness to pay extra for socially responsible products	Yadav et al. (2019)
Number of years of usage	A consumer's affiliation tenure or duration of usage with FDAs service providers	M. K. Kim et al. (2016)

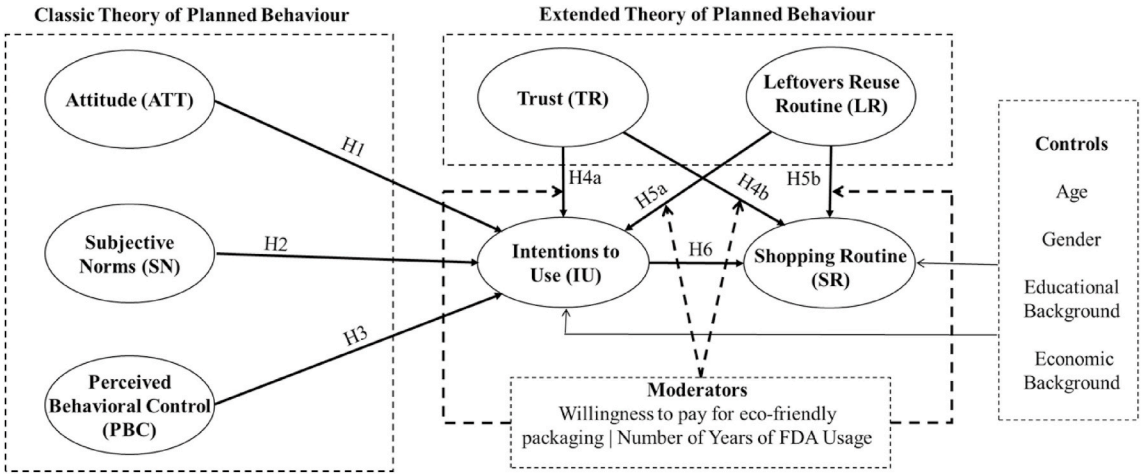

Fig. 1. Conceptual model.

3. Hypotheses development

3.1. Attitude, subjective norms, perceived behavioral control, and intentions to use FDAs

Attitude refers to an individual's positive or negative assessment of performing a behavior (Ajzen, 1991). Previous studies have confirmed that consumers who exhibit a positive attitude will engage in a behavior toward a subject (Ajzen, 2011), such as technology or brand use (Tan et al., 2018). Scholars have also found attitude to be significantly associated with consumers' adoption behavior in several contexts, including green buying behavior (Yadav and Pathak, 2017), web-rooming behavior (Arora and Sahney, 2018), and food waste behavior (Stefan et al., 2013) and food over-ordering behavior (Talwar et al., 2022a). Past findings further suggest that personal characteristics, situational factors, experience, and product performance are crucial elements contributing to consumers' attitudes toward an online service and subsequently to their responses (Shankar and Datta, 2018).

In the context of our study, we propose the effect of attitude on FDA usage. Given past findings regarding the effect of attitude on outcomes, we expect attitude to influence consumers' decisions about using FDAs for food delivery. More specifically, we expect a positive attitude to increase consumers' intentions to use FDAs to order food. In contrast, consumers who exhibit a negative attitude toward FDAs will be less likely to use FDAs to order food. Based on the preceding discussion, we propose the following association:

H1. Attitude is positively associated with intentions to use FDAs.

Subjective norms refer to the impact of family members, friends, peer groups, and society's opinions regarding an individual's choice to exhibit a certain behavior (Ajzen, 1991). Subjective norms have a crucial impact on consumers' adoption behavior in various contexts, including technology adoption (Shankar and Datta, 2018), social media use (Raza et al., 2020), and the choice of green hotels (Yadav et al., 2019). Explaining this impact, scholars note that consumers value the suggestions of the people they follow (Arora and Sahney, 2018) and their behavior is influenced by the people around them (Shankar and Datta, 2018). Explaining further, past studies have reported that consumers feel more confident in making purchase decisions when the people around them support their choice (e.g., Shankar and Jain, 2021).

In the context of the present study, i.e., food-related behavior, the literature has found subjective norms to influence consumers' food choices and food consumption behavior (e.g., Mullan et al., 2013; Stefan et al., 2013; Stancu et al., 2016; Raab et al., 2018). Given the strong theoretical support for the impact of subjective norms on consumers' choices, we suggest that subjective norms are also likely to impact their intentions to use FDAs. More specifically, if individuals believe that their social circle and family approve of their decision to use FDAs to order food, their intentions to use FDAs for that purpose will increase. Hence, we propose the following hypothesis:

H2. Subjective norms are positively associated with intentions to use FDAs.

PBC represents an individual's perception that he or she possesses the necessary knowledge and resources to perform a specific task (Ajzen, 1991). Conceptualized as an individual's ability to control a situation and his or her self-confidence in undertaking a behavior (Shankar and Datta, 2018), PBC enhances the perceived safety and reduces the perceived risks associated with the behavior (Ajzen, 2011). Several studies have identified PBC as an important variable in the classic TPB model, which impacts adoption choice in various contexts of consumer behavior, such as luxury consumption (Shankar and Jain, 2021). Noting the same impact of PBC in the case of technology adoption, scholars have reasoned that consumers tend to adopt new technology when they believe they possess the required resources and capabilities to use such services (Arora and Sahney, 2018). PBC has also been found to have a significant impact on consumers' behavior in the context of food consumption (Mullan et al., 2013). Extending this evidence to the FDA context, we argue that consumers are more likely to use FDAs when they believe in their own ability to do so. Hence, we hypothesize as follows:

H3. Perceived behavioral control is positively associated with intentions to use FDAs.

3.2. Trust, intentions to use FDAs, and shopping routine

Trust refers to an individual's positive belief about the quality and reliability of a product or service based on past experiences (Shankar et al., 2020). Recent scholarly literature has identified trust as a crucial determinant of consumers' adoption of online services and of their perception of online service providers (Shankar and Jebarajakirthy, 2019; Patil et al., 2020; Talwar et al., 2021a). Past studies suggest that due to the absence of face-to-face interactions between online service providers and consumers, trust plays an important role in reducing consumers' perceived risks and forming a positive response toward service providers in mobile commerce (Matute et al., 2016; Shaw, 2014). It is, therefore, hardly surprising that trust is not only positively associated with consumers' intentions to use online services (Liébana-Cabanillas et al., 2014) but also has a significant positive association with positive word-of-mouth in online settings (Talwar et al., 2021a). The above-presented evidence provides sufficient basis for us to contend that in the specific case of FDAs, too, trust is likely to play a positive role in enhancing consumers' intentions to use. In addition, we extrapolate the existing findings regarding the positive role of trust in the online environment to suggest that consumers' trust in FDAs may lead them to order more food than they require. In other words, trust in FDAs, which we expect to increase consumers' intentions to use, is also likely to encourage consumers to indulge in shopping routines that enable them to enjoy the benefits offered of FDAs, such as free delivery loyalty programs, quantity discounts, and so on (Yeo et al., 2017; Xu and Huang, 2019). Hence, we propose the following hypothesis:

H4. Trust in FDAs is positively associated with a) intentions to use FDAs and b) shopping routine.

3.3. Leftover reuse routine, intentions to use FDAs, and shopping routine

Wasting food refers to the disposal of food that is fit for human consumption (Dhir et al., 2020). Food waste is high across the world, making it a major environmental, social, and economic concern. Increasing concerns regarding food waste have stimulated debate about ways to reduce it. One such solution, which many households already likely practice, is the reuse of unconsumed food for future meals. Academic researchers have formalized this approach with the term "leftover reuse routine," and they identify this routine as one of the most effective strategies to reduce food waste (Stancu et al., 2016; Talwar et al., 2022a). Scholars have observed that the increase in awareness about food waste and its negative impact on the environment and society has made consumers more willing to reuse leftovers for future consumption (e.g., Romani et al., 2018).

We interpret past findings to suggest that leftover reuse routine is not only a viable food waste mitigation strategy but also an approach that many consumers have begun adopting to reduce food waste. Extrapolating this thought to the present context, we posit that consumers may—encouraged by their well-established leftover reuse routines—find it even more convenient and cost-effective to have food delivered to their location than to visit a restaurant. Because many consumers do have food delivered to their homes, which increases the probability and ease of reusing unconsumed food, the presence of a well-established leftover reuse routine is also likely to encourage them to order more food than required—whether out of temptation or the desire to take advantage of deals and offers. In addition, past studies have observed that most consumers fail to predict their required food intake accurately when ordering food online to consume at home (Yeo et al.,

2017; Kapoor and Vij, 2018). This could also result in over-ordering. Thus, although a priori evidence is lack, the preceding discussion provides us sufficient rationale to assume a positive correlation between leftover reuse routine and shopping routine. Thereby, we propose the following association:

H5. Leftover reuse routine is positively associated with a) intentions to use FDAs and b) shopping routine.

Consumers' routines play an important role in their food consumption decisions. For instance, planning routines and shopping routines are relevant factors in explaining consumers' food waste behavior. Planning routine refers to checking one's inventory, making a list of required items, and planning a meal in advance (Stefan et al., 2013), whereas shopping routine refers to purchasing more food than one requires (Stefan et al., 2013). Shopping routine is the variable of interest in the current study because it represents a behavior that entails the possibility of food waste generation. Past studies have noted that consumers, including those ordering via FDAs (Sharma et al., 2021), tend to purchase excessive amounts of food so that they can take advantage of bulk order discounts and reduce/save on delivery charges (Stancu et al., 2016). In fact, FDAs use discounts as incentives to attract consumers and encourage them to order large quantities (Sharma et al., 2021). In sum, we speculate that FDAs' pricing schemes and offers are structured so that consumers with positive intentions to use FDAs are likely to order more food than they require to satiate their hunger. Accordingly, we propose the following hypothesis:

H6. Intentions to use FDAs are positively associated with shopping routine.

3.4. Moderation effects

Taking both the sustainability dimension and the consumer perspective into consideration, we include two moderating variables—willingness to pay for eco-friendly packaging and number of years of FDA usage—to capture the effect of individual differences in the hypothesized associations. Our choice of these variables is grounded in the extended literature on consumer behavior.

Prior studies have noted that an increasing awareness of environmental issues (Prakash et al., 2019) and concern for environmental protection has made consumers more willing to pay extra for eco-friendly packaging (e.g., Yadav et al., 2019). This willingness to pay an additional cost for eco-friendly packaging is a crucial indicator of consumers' behavioral intentions toward environment-friendly products (Yadav et al., 2019). We extrapolate from this finding to assume that the same environmental awareness that causes consumers to pay extra for eco-friendly packaging also inclines them to order only as much food as they require. In other words, consumers' willingness to pay extra for eco-friendly packaging symbolizes their environmental concern, which is also likely to make them sensitive to avoiding food waste. We also expect consumers who are willing to pay extra for eco-friendly packaging to have a well-planned routine to reuse any food that remains unconsumed after a meal. In addition, we suggest that environmentally conscious consumers may have stronger intentions to use FDAs because they perceive such apps to be a more environmentally friendly way of procuring food. In sum, we suggest that willingness to pay for eco-friendly packaging may moderate the proposed associations. Hence, we hypothesize as follows:

H7. Willingness to pay for eco-friendly packaging positively moderates the relationships between a) trust in FDAs and intentions to use FDAs, b) trust in FDAs and shopping routine, c) food leftover reuse routine and intentions to use FDAs, and d) food leftover reuse routine and shopping routine.

Because consumers' past experiences and affiliation tenure are likely to affect their usage decisions, FDA usage experience has a crucial impact on consumers' behavioral intentions (M. K. Kim et al., 2016). For instance, consumers who have been ordering food from FDAs for some time may develop a sense of trust toward them, which may also increase their usage intentions (Sharma et al., 2021). Furthermore, due to their long-standing positive experience using FDAs, such consumers might not only have stronger use intentions but also have an established and effective leftover reuse routine if the need arises. At the same time, consumers with a long history of ordering food using FDAs may have developed an ability to better plan their order size, which would help them avoid ordering an excessive amount of food. In other words, experienced FDA users are less likely to impulsively order too much, creating the possibility of food waste. Consumers with a long history of using FDAs are also likely to have more knowledge about the quantity likely to be delivered per food item, which can also help them better manage their order size/quantity. Based on the logic of these arguments and even in the absence of any prior examination of these effects, we propose the following hypothesis:

H8. Number of years of FDA usage positively moderates the relationships between a) trust in FDAs and intentions to use FDAs, b) trust in FDAs and shopping routine, c) leftover reuse routine and intentions to use FDAs, and d) leftover reuse routine and shopping routine.

3.5. Control variables

We include four control variables to capture the socio-demographic profile of the consumer—age, gender, educational background, and economic background. Our choice of these variables as controls is rooted in prior findings that suggest a significant impact of various socio-demographic variables on consumers' behavioral intentions toward food consumption (Stancu et al., 2016; Ray et al., 2019).

4. Methodology

4.1. Sampling and data collection

We collected the data from consumers of leading FDAs providers in India, including Zomato, Swiggy, and Uber Eats. We employed a structured questionnaire comprised of items adapted from the prior literature on FDAs in the context of food waste. To ensure that we collected the data from active FDA consumers, we asked two screening questions: "Do you order food through FDAs?" and "During the last three months, how many times have you ordered food using FDAs?" The study utilized a shopping mall intervention study to collect the data from individuals in two major cities in India. Our research assistants approached 1000 respondents and collected a total of 525 completed surveys (for a response rate of 52.5 percent). During the data screening process, we identified 38 responses as incomplete; hence, we advanced the remaining 487 responses (n = 329, 67.6% males) for further analysis. The collected data were normally distributed and free from outlier issues. The age of the respondents ranged from 24 to 32 years (mean age = 28.65 years, SD = 3.13 years), and 46% of the respondents ($n = 227$) had been using FDAs for more than one year.

4.2. Measures and questionnaire development

The items measuring the study constructs were taken from previously validated scales. However, we modified the wording where appropriate to make the items suitable for the study context. A group of experts, which included three professors and three researchers specializing in the field of marketing, consumer behavior, and hospitality, content-tested the survey instrument. In addition, we conducted a pilot study with 10 participants representing the target population of FDA consumers. We then made the above-mentioned minor modifications of the survey items based on the feedback from the expert group and the pilot study. We used a five-point Likert scale (1 = "Strongly disagree" to 5 = "Strongly agree") to operationalize all constructs. Table 2 presents

Table 2
Study measures, items, and factor loadings.

Scale items	λ	M	SD
Attitude (ATT; Stancu et al., 2016)		3.55	0.93
ATT1: Ordering food via FDAs is gratifying.	.80		
ATT2: Ordering food via FDAs is pleasant.	.87		
ATT3: Ordering food via FDAs is satisfying.	.89		
ATT4: Ordering food via FDAs is good.	.82		
Subjective norm (SN; Ajzen, 1991)		3.43	1.07
SN1: Most people who are important to me would approve of my ordering food via FDAs instead of conventional restaurants.	.87		
SN2: Most people who are important to me want me to order food via FDAs instead of conventional restaurants.	.90		
SN3: Most people who are important to me think that I should order food via FDAs instead of conventional markets.	.85		
Perceived behavioral control (PBC; Stefan et al., 2013)		4.00	0.89
PBC1: Ordering food from FDAs is easy for me.	.90		
PBC2: If I wanted to, I could easily order food from FDAs.	.89		
PBC3: Ordering food from FDAs depends entirely on me.	.58		
Shopping routine (SR; Stefan et al., 2013)		3.04	1.21
SR1: I often buy unintended food items when ordering via FDAs.	.76		
SR2: I often buy too much food when ordering via FDAs.	.94		
SR3: I usually buy more food than required if FDAs offer good value for the money.	.80		
Trust (TR; Yadav et al., 2019)		3.47	1.21
TR1: I perceive ordering food via FDAs to be reliable.	.88		
TR2: Ordering food via FDAs appears trustable to me.	.90		
TR3: No risk is involved in ordering food via FDAs.	.84		
Leftovers reuse routine (LR; Stancu et al., 2016)		3.53	1.02
LR1: Leftovers are usually eaten as such or just reheated when used again.	.79		
LR2: Leftovers are usually transformed into a different dish by adding some ingredients before eating them.	.77		
LR3: Leftovers are stored in appropriate conditions so they will last.	.74		
Intentions to use (IU; Ajzen, 1991)		3.49	1.05
IU1: I intend to order food via FDAs in the coming week.	.84		
IU2: I plan to order food via FDAs in the coming week.	.88		
IU3: I am willing to order food via FDAs in the coming week.	.79		

Note. λ = Standardized factor loadings; M = Mean; SD = Standard deviation.

all scale items and sources.

4.3. Data analysis method

We employed a two-step approach to analyze the data (Anderson and Gerbing, 1988). We performed a confirmatory factor analysis (CFA) to examine the reliability and validity of the measurement scales. Recognizing that structural equation modeling (SEM) is the most suitable tool to access complex multiple latent constructs and relationships (Hair et al., 2010), we utilized SEM in AMOS 26 to examine the proposed hypotheses. We also considered SEM the most appropriate tool for data analysis because our study proposes intention to use FDAs as both an antecedent and outcome variable. Finally, we utilized PROCESS macro for SPSS to validate the hypotheses related to moderation.

5. Results

5.1. Multicollinearity and common method bias (CMB)

After ascertaining that the data were normally distributed, we computed the variance inflation factors (VIF) for the independent variables to determine whether the issue of multicollinearity affected the collected data. The test produced VIF values below the recommended threshold of 5.0 (Hair et al., 2010), thus indicating that all five independent variables were free from any issues of multicollinearity. Specifically, the VIF values for the study variables ranged from 1.13 to 2.88.

Because we measured the dependent and independent variables through responses to a single instrument from the same set of respondents, common method bias (CMB) also posed a threat. Therefore, consistent with Podsakoff et al.'s (2003) recommendation, we performed Harman's single-factor test to examine the data for CMB. The analysis revealed that a single factor accounted for only 46.07% of the total variance, which is below the recommended threshold value of 50 percent and thus indicates that the data were free from CMB.

5.2. Measurement model

We examined the validity, reliability, and dimensionality of the constructs via a CFA. The CFA indicated a good model fit ($\chi^2/df = 2.64$, $CFI = 0.96$, $TLI = 0.95$, $RMSEA = 0.06$). The average variance extracted (AVE) values for all study constructs exceeded the threshold of 0.5, while their composite reliability (CR) values exceeded the threshold of 0.7, suggesting convergent validity (Hair et al., 2010). As Table 2 shows, the factor loadings for all constructs were significant ($p < 0.01$) and above 0.7, which is an additional indicator of convergent validity (Hair et al., 2010). Moreover, the square root of the AVE value of each construct exceeded the correlation coefficient of the corresponding construct, indicating the constructs' discriminant validity (Fornell and Larcker, 1981). Furthermore, the correlation among study constructs was significant and below 0.90 (Tabachnick and Fidell, 2012). Finally, the CR values for the study constructs, which exceeded 0.70, established the study's reliability. Table 3 presents these values.

5.3. Control variables

Previous studies have demonstrated that including control variables may improve the robustness of a study's findings (Talwar et al., 2020). Hence, we controlled for the confounding effects of the respondents' age, gender, educational background, and economic background on our structural model. None of the control variables exerted any significant influence on consumers' usage intentions. Similarly, gender and educational background had no significant influence on shopping routine. However, age and economic background did significantly influence shopping routine.

5.4. Structural model

The SEM we used to validate the hypotheses also indicated a good fit ($\chi^2/df = 2.42$, $CFI = 0.96$, $TLI = 0.94$, $RMSEA = 0.05$; Hair et al., 2010). The model explained 71.6% of the variance in consumers' intentions to use FDAs and 34.4% of the variance in their shopping routine. Fig. 2 presents the results of the statistical analysis.

The results for the hypothesis testing indicated the significant positive associations of attitude (H1: $\beta = 0.68$, $p < 0.001$) and subjective norms (H2: $\beta = 0.16$, $p < 0.05$) with intentions to use FDAs. Next, shopping routine exhibited a positive association with trust in FDAs (H4b: $\beta = 0.22$, $p < 0.01$), leftover reuse routine (H5b: $\beta = 0.30$, $p < 0.001$), and intentions to use FDAs (H6: $\beta = 0.18$, $p < 0.05$). Thus, H1, H2, H4b, H5b, and H6 received support. Surprisingly, we observed no significant associations of intentions to use with PBC (H3: $\beta = -0.08$, $p > 0.05$), trust in FDAs (H4a: $\beta = 0.10$, $p > 0.05$), and leftover reuse routine (H5a: $\beta = -0.02$, $p > 0.05$). Hence, we rejected H3, H4a, and H5a.

5.5. Moderation analysis

The moderation analysis conducted using Model 1 in PROCESS macro involved bootstrapping the effects 5000 times, resulting in the production of interaction terms and their 95% confidence intervals. As the results in Table 4 reveal, willingness to pay for eco-friendly packaging positively and significantly moderated the relationship between leftover reuse routine with intentions to use FDAs ($\beta = 0.24$, $p < 0.05$) and shopping routine ($\beta = 0.27$, $p < 0.05$). Thus, H7c and H7d received support, while H7a and H7b were rejected. Next, number of years of

Table 3
Validity and reliability analysis.

	CR	AVE	MSV	ASV	LR	IU	ATT	SN	PBC	SR	TR
LR	.81	.59	.20	.13	**.77**						
IU	.88	.70	.70	.38	.32	**.84**					
ATT	.91	.72	.70	.45	.36	.83	**.85**				
SN	.91	.76	.60	.39	.36	.72	.78	**.87**			
PBC	.84	.65	.39	.23	.24	.50	.62	.57	**.80**		
SR	.87	.70	.23	.16	.44	.43	.42	.39	.15	**.84**	
TR	.91	.76	.69	.43	.44	.74	.83	.78	.57	.48	**.87**

Note. Composite reliability = CR, Average variance extracted = AVE, Maximum shared variance = MSV, Average shared variance = ASV, LR = Leftovers reuse routine, IU = Intentions to use, ATT = Attitude, SN = Subjective norm, PBC= Perceived behavioral control, SR = Shopping routine, TR = Trust; Square root of AVE in bold.

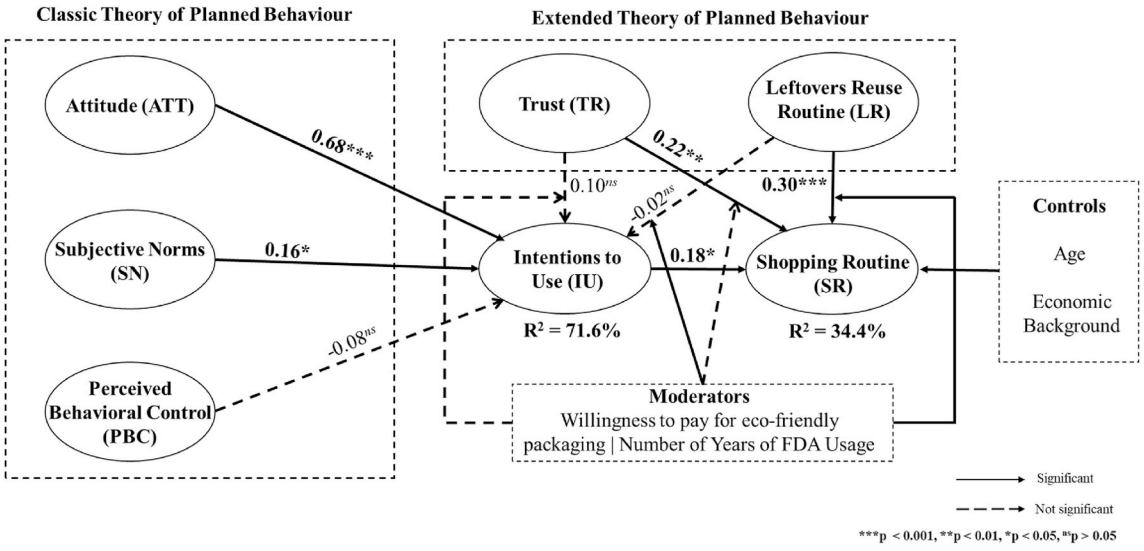

Fig. 2. Results of hypothesis testing.

Table 4
Results of moderation analysis.

Moderator 1: Willingness to pay for eco-friendly packaging						
	β	*t*	*p*	LLCI	ULCI	Moderation?
TR→ ITU	.05	.69	.49	−.0957	.1998	No
TR → SR	.16	1.50	.13	−.0489	.3646	No
LR → ITU	.24	2.44	.02	.0461	.4260	Yes
LR → SR	.27	2.46	.01	.0531	.4773	Yes
Moderator 2: Number of years of FDA usage						
	B	***t***	***p***	**LLCI**	**ULCI**	**Moderation?**
TR→ ITU	.02	1.04	.30	−.0201	.0650	No
TR → SR	.05	1.55	.12	−.0125	.1059	No
LR → ITU	.12	4.25	.00	.0640	.1740	Yes
LR → SR	.08	2.64	.01	.0217	.1469	Yes

FDAs usage positively moderated the relationship of leftover reuse routine with intentions to use ($\beta = 0.12$, $p < 0.01$) and shopping routine ($\beta = 0.08$, $p < 0.05$). Thus, H8c and H8d received support, while H8a and H8b did not.

Fig. 3a–d also illustrate the results.

6. Discussion

The results for the main effects indicate that attitude and subjective norms significantly impact intentions to use FDAs. In contrast, PBC, the third classic TPB construct, did not significantly influence intentions to use. Hence, H1 and H2 stand supported, but H3 does not. This outcome implies that consumers who have a positive attitude toward FDAs tend to adopt such apps for online food ordering, a finding that aligns with previous studies (Yadav et al., 2019). To elaborate, support for H1 confirms our expectation that consumers who perceive ordering food via FDAs to be gratifying, pleasant, satisfying, and good will exhibit strong usage intentions in the near future. The results also confirm the crucial influence of subjective norms on consumers' usage intentions toward FDAs. This finding likewise aligns with the results of past studies, albeit in different contexts (Yadav et al., 2019; Shankar and Jain, 2021). This finding implies that if most people who are important to consumers approve of and encourage them to order food via FDAs, those consumers will be more likely to use FDAs for food delivery in the near future.

We offer two explanations for the lack of statistical support for H3, which had proposed a positive association between PBC and intentions to use. First, because people now use technology, including mobile apps (such as FDAs), extensively and instinctively (i.e., they need not engage in any conscious thought regarding their capability or control), PBC may no longer be an essential element for their intentions to use (Zhao et al., 2018). Another possible reason for the lack of support for the association of PBC with intentions to use could be the interactive features of FDAs, which make ordering food easy and ensure that they need not possess any specific technical knowledge or expertise.

Unexpectedly, our results also fail to support H4a and H5a, suggesting that trust in FDAs and leftover reuse routine exert no significant impact on consumers' intentions to use FDAs. Based on the extended literature, one would expect that consumers' perceptions that FDAs are reliable, trustworthy, and relatively safe to use would increase their intentions to use FDAs. Our results, however, contradict this expectation. Because past studies have demonstrated a crucial role for trust in consumers' adoption behavior (e.g., Shankar et al., 2020), we find it difficult to explain the apparent lack of association between trust and intentions. We thus call for further exploration with data collected from

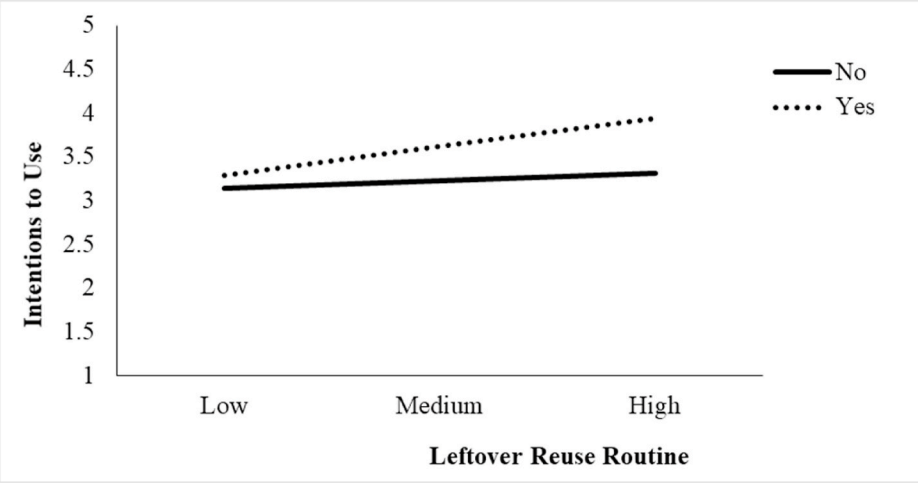

Fig. 3a. Moderating effect of willingness to pay for eco-friendly packaging.

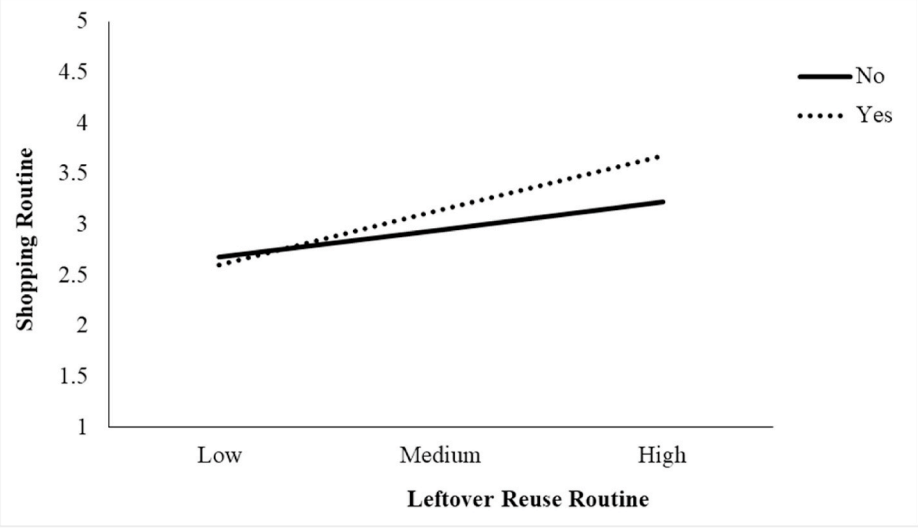

Fig. 3b. Moderating effect of willingness to pay for eco-friendly packaging.

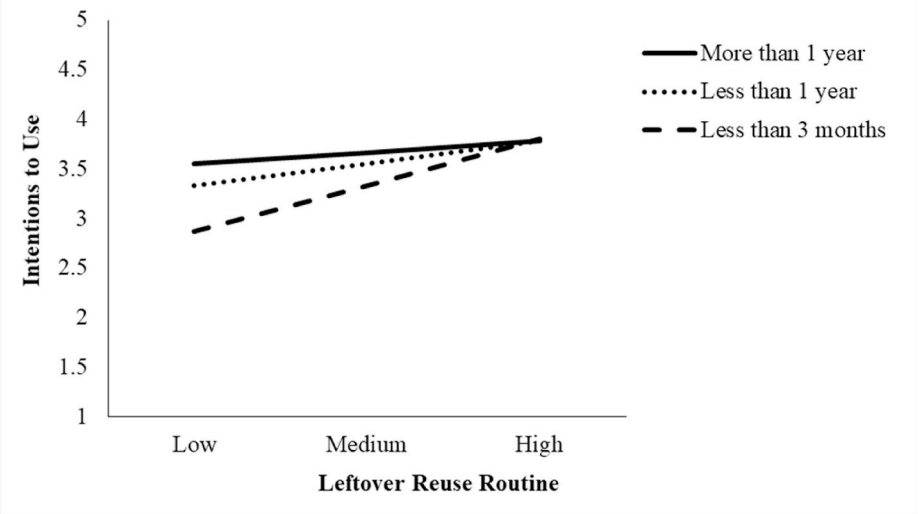

Fig. 3c. Moderating effect of number of years of FDA usage.

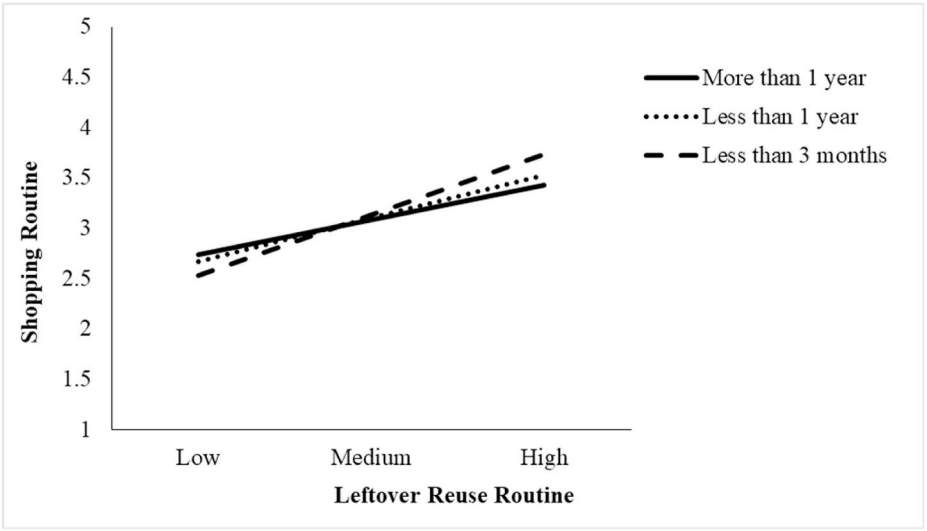

Fig. 3d. Moderating effect of number of years of FDA usage.

a larger, more varied sample to confirm that trust plays no role in driving FDA usage intentions.

The results also do not support the anticipated positive association between leftover reuse routine and intentions to use. Although past studies have acknowledged leftover reuse routine as a significant and valuable consumer food waste reduction strategy (Stefan et al., 2013; Stancu et al., 2016; Talwar et al., 2022a), we offer the fact that consumers do not believe their FDA usage will result in food waste as a possible explanation for the apparent lack of association between leftover reuse routine and intentions to use FDA. In other words, in consumers' minds, FDA usage and food waste are not related; therefore, any thoughts of leftover reuse fail to impact their usage intentions.

In contrast, H4b and H5b stand supported, confirming the significant positive associations of trust in FDAs and leftover reuse routine with shopping routine. These findings are consistent with previous studies (Patil et al., 2020; Sharma et al., 2021). The support we find for the positive association between trust and shopping routine suggests that FDA users who perceive such apps to be a reliable and safe avenue for ordering food will tend to order food items they did not originally intend to order, especially if those items offer good value for the money. Similarly, support for the positive association between leftover reuse routine and shopping routine indicates that consumers' well-established routine of storing and subsequently using leftovers—either by simply reheating them or transforming them into a different dish—increases their tendency to over-order food from FDAs, whether instinctively or in response to the deals these apps offer.

Regarding the last direct effect, our findings support H6, indicating that intentions to use have a significant impact on shopping routine. This result aligns with the findings of previous studies regarding food over-ordering via FDAs (e.g., Sharma et al., 2021). Support for this association confirms that consumers who intend to use FDAs to order food in the near future also tend to purchase more food than they can immediately consume.

In terms of the moderation effects, H7c and H7d are supported, but H7a and H7b are not. Support for H7c indicates that willingness to pay for eco-friendly packaging positively moderates the associations of leftover reuse routine with both intentions to use and shopping routine. To elaborate, consumers who are willing to pay for eco-friendly packaging exhibit stronger intentions to use FDAs than do those who are unwilling to pay extra for eco-friendly packaging at both low and high leftover reuse routine intensities. However, the difference between the intentions of consumers who are willing and unwilling to pay extra for eco-friendly packaging is greater for consumers with a higher rather than lower level of leftover reuse routine. Similarly, support for H7d indicates that at low intensity of leftover reuse routine, consumers who are willing to pay extra for eco-friendly packaging exhibit a lower intensity of shopping routine than do those who are unwilling to pay extra for eco-friendly packaging. In contrast, at high intensity of leftover reuse routine, consumers who are willing to pay more for eco-friendly packaging exhibit higher intensity of shopping routine than do those who are unwilling to pay these extra costs.

Next, while H8c and H8d stand supported, H8a and H8b do not. Support for H8c demonstrates that number of years of FDA usage exerts the same effect on the usage intentions of consumers with a high intensity of leftover reuse routine. However, it has a varied effect on the usage intentions of consumers with a low intensity of leftover reuse routine. To elaborate, the results suggest that consumers who have been using FDAs for more than one year exhibit stronger intentions to use FDAs than do those who have been using FDAs for less than one year. At the same time, support for H8d implies that the number of years of FDA usage has varied effects on the shopping routines of consumers who exhibit different intensities of leftover reuse routine. Explaining further, the results can be interpreted to mean that at a low intensity of leftover reuse routine, consumers who have been using FDAs for more than one year exhibit a higher intensity of shopping routine than do those who have been using FDAs for less than one year. In comparison, at high intensity of leftover reuse routine, consumers who have been using FDAs for more than one year exhibit lower intensity of shopping routine than do those who have been using FDAs for less than one year.

7. Conclusion

This study aimed to investigate the ways in which FDA usage contributes to food waste. The study employed an extended TPB model to understand various factors that drive consumers' intentions to use FDAs. These intentions drive food over-ordering behavior, which, in turn, creates the possibility that such food will remain unconsumed and, ultimately, be wasted. In addition to the direct associations, which we grounded in the TPB framework, we also contemplated and investigated the effects of two relevant moderators—willingness to pay for eco-friendly packaging and number of years of FDA usage. Testing these moderators enabled us to develop a fuller understanding of the dynamics of the proposed associations. Specifically, we sought answers to four research questions by analyzing data from 478 FDA users. In response to **RQ1**, which examined the association of the classic TPB constructs (attitude, subjective norms, and PBC) with FDA usage intentions, we found the positive associations of attitude and subjective norms with FDA usage intentions but no statistically significant

association between PBC and FDA usage intentions. In the case of **RQ2**, which examined the associations of trust and leftover reuse routine with intentions to use and shopping routine, we observed the positive associations of the former two variables only with shopping routine. Regarding **RQ3**, our results confirmed the proposed positive association between intentions and shopping routine. Finally, in response to **RQ4**, which examined the moderation effects of willingness to pay for eco-friendly packaging and number of years of FDA usage on the associations of trust and leftover reuse routine with intentions to use and shopping routine, our results confirmed all moderation effects. Our findings offer noteworthy theoretical and practical implications, which we discuss below.

7.1. Theoretical contributions

Our study offers four academic implications. First, the study contributes to a keener understanding of consumer adoption and usage intentions toward FDAs, a rapidly emerging digital form of hospitality (Rivera, 2019). Thus far, the related literature has remained skewed toward the technology acceptance perspective, i.e., the opportunities and threats associated with FDAs as a technology tool (e.g., Correa et al., 2019). Meanwhile, it offers fewer insights on consumer choice behavior and preferences (e.g., Kaur et al., 2021). The findings of this study illuminate the antecedents of consumers' usage intentions toward FDAs, including socio-psychological factors, such as attitude, subjective norms, and perceived behavioral control. A deeper knowledge of the mechanism through which these drivers impact consumers' positive intentions toward FDAs enriches the existing literature and provides a platform for future research in the area.

Our second contribution involves shifting the focus of all stakeholders to the possibility that FDA usage has a dark side in the form of food waste generation. Given their advantages and inherent features, FDAs may cause consumers to order more food than they require, which has the potential to generate food waste. This is a quite serious aspect because the United Nations has identified food waste as a key threat to sustainable development (UNSDG, 2018). Our study utilizes variables such as trust, leftover reuse routine, and shopping routine to illuminate the complex relationships among FDA usage, the possibility of food waste generation and mitigation, and other factors, including the packaging of food for delivery. Previous research largely focuses on the positive behavioral outcomes of consumers' trust (Patil et al., 2020; Shankar et al., 2020). Scholars have also acknowledged leftover reuse routine as a crucial way of reducing food waste (Talwar et al., 2022a). Presenting a finer-grained and deeper understanding of the associated complexities, our findings challenge conventional thinking by highlighting the hidden negative effects of consumers' trust in FDAs and their leftover reuse routine, which cause them to order more food than they require to satiate their hunger (i.e., to indulge in a shopping routine). Here, we find that trust and leftover reuse routines can increase consumers' tendency to indulge in shopping routines, thereby increasing the possibility of food waste. To elaborate, we reveal that consumers' trust in FDAs, which engenders positive feelings and rationalizes their indulgence in over-ordering through their leftover reuse routine, drives them to exhibit a higher intensity of shopping routine. In sum, our study advances the debate on food waste in the digital context, which has thus far remained confined to food-sharing platforms (e.g., Mazzucchelli et al., 2021; Nica-Avram et al., 2020).

Third, our study deepens the scholarly literature in the area by extending the TPB to examine and explicate consumer behavior and decision-making in hospitality settings while also accounting for the sustainability perspective. Scholars have made scant efforts thus far to examine the consumer response to FDAs by invoking the TPB or extending it to make it more hospitality-specific (J. J. Kim et al., 2021). By using the TPB as our theoretical framework, we thus contribute to the advancement of the TPB in contemporary and diverse consumer behavior domains. Our study not only modeled the classic TPB constructs to investigate variables that could promote behavior that generates food waste but also extended the theory by identifying contextually relevant constructs, such as trust in FDAs, leftover reuse routine, and shopping routine.

Finally, our study examines the moderating effects of relatively less explored yet contextually relevant variables—willingness to pay for eco-friendly packaging and number of years of FDA usage—on the associations of trust and leftover reuse routine with usage intentions and shopping routine. Although the existing literature has found these variables to be crucial (M. K. Kim et al., 2016; Stefan et al., 2013; Yadav et al., 2019), scholars have made only limited efforts to examine their moderating effects. Thus, our study contributes to the existing literature by offering newer and fuller perspectives.

7.2. Practical implications

Our study also offers four implications for the tourism and hospitality sector. Because FDAs are an integral part of the restaurant industry (Cho et al., 2019), our findings are particularly crucial to managers therein. The study likewise offers insights for online food delivery service providers as they craft strategies to improve the consumer experience. The findings of our study can also help restaurants and online food delivery service providers to better understand the key factors affecting consumer responses to FDAs.

First, with regard to the implications for restaurant managers, the findings of our study uncover the drivers of consumers' intentions to use FDAs to order prepared food for delivery to their preferred location. Past scholars have identified app-related factors, such as information quality, design, convenience, and others (Cho et al., 2019; Ray et al., 2019; Sharma et al., 2021), with the potential to increase FDA usage—for example, by improving the ordering interface. Our study builds upon these efforts to reveal the ways in which consumer-related variables, such as attitude and trust, impact usage intentions and over-ordering behavior. Our findings demonstrate that restaurants, which operate in a hyper-competitive segment, can enhance their profit margins by engaging consumers, building their trust, and encouraging them to develop positive attitudes, through collaborations with FDAs. Furthermore, restaurants can—by emphasizing leftover reuse—overcome the ethical dilemma involved in the association of over-ordering and food waste. Two possible strategies for this could be (a) to coordinate with FDAs to create a platform on which FDA users can share leftover reuse recipes and experiences (similar to the currently available option of online reviews) and (b) to place a sticker on food packages to indicate the date through which food is safe to eat/use.

Second, our findings that subjective norms and attitudes are positively associated with usage intentions provide valuable insights for FDA service providers and marketers seeking to promote the use of their apps by improving customer engagement. Because intentions to use increase under the influence of peers and friends' opinions, FDA providers can enlist existing users to influence their social circle. To this end, they can request that users post testimonials for their apps. Ideally, FDA service providers should keep these testimonials distinct from more traditional online reviews and ratings. FDAs can, moreover, encourage users to tag their friends in these testimonials. Overall, our findings regarding the positive drivers of FDA usage can guide service providers to develop effective marketing strategies to increase their market share and profits. At the same time, by highlighting the importance of leftover reuse routine and the ways it can be leveraged not only to persuade users to order more but also to educate them to avoid food waste, we help service providers to advance their commercial interests in ways that align with the UN's Sustainable Development Goals.

Third, our findings can aid the marketers on whom FDAs rely to promote their apps' usage. For instance, our findings regarding the positive moderating effects of willingness to pay for eco-friendly packaging and number of years of FDA usage can help marketers to develop effective strategies to positively impact existing consumers' continued

usage intentions. One means to this end could be to introduce a loyalty program to enhance the user experience, provide promotional offers to increase order frequency, and provide high-quality and hygienic packaging to enhance consumers' willingness to pay for eco-friendly packaging, which will, in turn, increase food ordering through FDAs.

Finally, our study's conceptualization and findings highlight the need for policymakers to contemplate the formulation of some regulations or at least guidelines to sensitize FDAs to the ways in which their promotional approaches contribute to food waste and hinder the achievement of sustainability targets, especially SDG 12.

7.3. Limitations and future research directions

The present study makes important empirical contributions to the literature on hospitality, online food delivery services, and food waste. However, its findings must be interpreted in light of certain limitations. First, this study's sample included only FDAs users in India. Hence, the findings are not generalizable to other countries and cultures. However, the robustness of our findings supports our conceptualization, suggesting that future researchers can replicate our model in different contexts. Second, our study used cross-sectional data and thus can only detect associations among variables. Future researchers should conduct longitudinal survey-based studies or experimental studies to overcome this limitation and explore causality among the variables. This recommendation aligns with those of recent scholars who have underscored the need to inject methodological variety into investigations of such behaviors (De Visser-Amundson, 2020). Future research can also expand our model by examining various mediation and moderation effects that could impact the associations between the explanatory and outcome variables. Future studies can identify these factors, incorporate them into the model, and thus expand the study. Some variables that may capture the specificity of the FDA setting include service recovery strategies, restaurant listings, the perceived value of FDA usage, barriers to FDA use, etc. Finally, future scholars can expand our model by including other consumer responses, such as brand love, commitment, satisfaction, word-of-mouth intentions, etc. In sum, our study provides a sound foundation for future research to develop a more comprehensive understanding of various behavioral responses that may emerge from consumers' FDA usage intentions.

References

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50 (2), 179–211.
Ajzen, I., 2011. The theory of planned behavior: reactions and reflections. Psychol. Health 26 (9), 1113–1127.
Ajzen, I., Madden, T.J., 1986. Prediction of goal-directed behavior: attitudes, intentions, and perceived behavioral control. J. Exp. Soc. Psychol. 22, 259–276.
Alzubaidi, H., Slade, E.L., Dwivedi, Y.K., 2021. Examining antecedents of consumers' pro-environmental behaviors: TPB extended with materialism and innovativeness. J. Bus. Res. 122, 685–699.
Anderson, J.C., Gerbing, D.W., 1988. Structural equation modeling in practice: a review and recommended two-step approach. Psychol. Bull. 103 (3), 411–423.
Arora, S., Sahney, S., 2018. Consumer's webrooming conduct: an explanation using the theory of planned behavior. Asia Pac. J. Market. Logist. 30 (4), 1040–1063.
Cai, R., Leung, X.Y., 2020. Mindset matters in purchasing online food deliveries during the pandemic: the application of construal level and regulatory focus theories. Int. J. Hospit. Manag. 91, 102677.
Canova, L., Bobbio, A., Manganelli, A.M., 2020. Predicting fruit consumption: a multigroup application of the theory of planned behavior. Appetite 145, 104490.
Carfora, V., Caso, D., Conner, M., 2016. The role of self-identity in predicting fruit and vegetable intake. Appetite 106, 23–29.
Carolan, M.S., 2021. What is driving consumer food waste: socio-material assemblages of household consumption practices. Appetite 166, 105478.
Chakraborty, D., Siddiqui, A., Siddiqui, M., Rana, N.P., Dash, G., 2022. Mobile payment apps filling value gaps: integrating consumption values with initial trust and customer involvement. J. Retailing Consum. Serv. 66, 102946.
Chen, H.S., Liang, C.H., Liao, S.Y., Kuo, H.Y., 2020. Consumer attitudes and purchase intentions toward food delivery platform services. Sustainability 12 (23), 10177.
Cho, M., Bonn, M.A., Li, J.J., 2019. Differences in perceptions about food delivery apps between single-person and multi-person households. Int. J. Hospit. Manag. 77, 108–116.
Choe, J.Y., Kim, J.J., Hwang, J., 2021. Innovative marketing strategies for the successful construction of drone food delivery services: merging TAM with TPB. J. Trav. Tourism Market. 38 (1), 16–30.
Correa, J.C., Garzón, W., Brooker, P., Sakarkar, G., Carranza, S.A., Yunado, L., Rincón, A., 2019. Evaluation of collaborative consumption of food delivery services through web mining techniques. J. Retailing Consum. Serv. 46, 45–50.
De Visser-Amundson, A., 2020. A multi-stakeholder partnership to fight food waste in the hospitality industry: a contribution to the United Nations Sustainable Development Goals 12 and 17. J. Sustain. Tourism 1–28.
Dhir, A., Sadiq, M., Talwar, S., Sakashita, M., Kaur, P., 2021. Why do retail consumers buy green apparel? A knowledge-attitude-behaviour-context perspective. J. Retailing Consum. Serv. 59, 102398.
Dhir, A., Talwar, S., Kaur, P., Malibari, A., 2020. Food waste in hospitality and food services: a systematic literature review and framework development approach. J. Clean. Prod. 270, 122861.
Evans, D., 2012. Beyond the throwaway society: Ordinary domestic practice and a sociological approach to household food waste. Sociology 46 (1), 41–56.
FAO, 2019. The State of Food and Agriculture 2019. Moving Forward on Food Loss and Waste Reduction. Food and Agriculture Organization—United Nations, Rome.
Fishbein, M., Ajzen, I., 1975. Belief, Attitude, Intention, and Behavior: an Introduction to Theory and Research. Addison-Wesley, Reading, MA.
Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. J. Market. Res. 18 (1), 39–50.
Furunes, T., Mkono, M., 2019. Service-delivery success and failure under the sharing economy. Int. J. Contemp. Hospit. Manag. 31 (8), 3352–3370.
Grandhi, B., Appaiah Singh, J., 2016. What a waste! A study of food wastage behavior in Singapore. J. Food Prod. Market. 22 (4), 471–485.
Gregorio-Pascual, P., Mahler, H.I., 2020. Effects of interventions based on the theory of planned behavior on sugar-sweetened beverage consumption intentions and behavior. Appetite 145, 104491.
Hair, J.F., Anderson, R.E., Babin, B.J., Black, W.C., 2010. Multivariate Data Analysis: A Global Perspective, vol. 7. Pearson Education, Upper Saddle River, NJ.
Hamerman, E.J., Rudell, F., Martins, C.M., 2018. Factors that predict taking restaurant leftovers: strategies for reducing food waste. J. Consumer Behav. 17 (1), 94–104.
He, Y., Zhang, J., Gou, Q., Bi, G., 2018. Supply chain decisions with reference quality effect under the O2O environment. Ann. Oper. Res. 268 (1–2), 273–292.
Hwang, J., Choe, J.Y.J., 2019. Exploring perceived risk in building successful drone food delivery services. Int. J. Contemp. Hospit. Manag. 32 (5), 1775–1794.
Hwang, J., Lee, J.S., Kim, J.J., Sial, M.S., 2020. Application of internal environmental locus of control to the context of eco-friendly drone food delivery services. J. Sustain. Tourism 1–19.
Kapoor, A.P., Vij, M., 2018. Technology at the dinner table: ordering food online through mobile apps. J. Retailing Consum. Serv. 43, 342–351.
Kaur, P., Dhir, A., Talwar, S., Alrasheedy, M., 2021a. Systematic literature review of food waste in educational institutions: setting the research agenda. Int. J. Contemp. Hospit. Manag. 33 (4), 1160–1193.
Kaur, P., Dhir, A., Talwar, S., Ghuman, K., 2021b. The value proposition of food delivery apps from the perspective of theory of consumption value. Int. J. Contemp. Hospit. Manag. 33 (4), 1129–1159.
Kaur, P., Talwar, S., Islam, N., Salo, J., Dhir, A., 2022. The effect of the valence of forgiveness to service recovery strategies and service outcomes in food delivery apps. J. Bus. Res. 147, 142–157.
Kim, J.J., Kim, I., Hwang, J., 2021. A change of perceived innovativeness for contactless food delivery services using drones after the outbreak of COVID-19. Int. J. Hospit. Manag. 93, 102758.
Kim, M.K., Wong, S.F., Chang, Y., Park, J.H., 2016. Determinants of customer loyalty in the Korean smartphone market: moderating effects of usage characteristics. Telematics Inf. 33 (4), 936–949.
Kumar, A., 2017. Extended TPB model to understand consumer "selling" behavior. Asia Pac. J. Market. Logist. 29 (4), 721–742.
Lee, E.J., Lee, K.R., Kim, J.Y., 2020. Analysis of differences in eating alone attitude of Koreans by dietary habits and age. Appetite 152, 104695.
Lehberger, M., Kleih, A.K., Sparke, K., 2021. Panic buying in times of coronavirus (COVID-19): extending the theory of planned behavior to understand the stockpiling of non-perishable food in Germany. Appetite 161, 105118.
Liébana-Cabanillas, F., Sánchez-Fernández, J., Muñoz-Leiva, F., 2014. Antecedents of the adoption of the new mobile payment systems: the moderating effect of age. Comput. Hum. Behav. 35, 464–478.
Lim, S.L., Teoh, C., Zhao, X., Umareddy, I., Grillo, V., Singh, S.S., Khouw, I., 2020. Attitudes & beliefs that influence healthy eating behaviours among mothers of young children in Singapore: a cross-sectional study. Appetite 148, 104555.
Matute, J., Polo-Redondo, Y., Utrillas, A., 2016. The influence of EWOM characteristics on online repurchase intention. Online Inf. Rev. 40 (7), 1090–1110.
Mazzucchelli, A., Gurioli, M., Graziano, D., Quacquarelli, B., Aouina-Mejri, C., 2021. How to fight against food waste in the digital era: key factors for a successful food sharing platform. J. Bus. Res. 124, 47–58.
Mullan, B., Wong, C., Kothe, E., 2013. Predicting adolescent breakfast consumption in the UK and Australia using an extended theory of planned behavior. Appetite 62, 127–132.
Nabi, N., Karunasena, G.G., Pearson, D., 2021. Food waste in Australian households: role of shopping habits and personal motivations. J. Consum. Behav. 20 (6), 1523–1533.
Nica-Avram, G., Harvey, J., Smith, G., Smith, A., Goulding, J., 2020. Identifying food insecurity in food sharing networks via machine learning. J. Bus. Res. 131, 469–484.
Olavarria-Key, N., Ding, A., Legendre, T.S., Min, J., 2021. Communication of food waste messages: the effects of communication modality, presentation order, and mindfulness on food waste reduction intention. Int. J. Hospit. Manag. 96, 102962.

Patil, P., Tamilmani, K., Rana, N.P., Raghavan, V., 2020. Understanding consumer adoption of mobile payment in India: extending meta-UTAUT model with personal innovativeness, anxiety, trust, and grievance redressal. Int. J. Inf. Manag. 54, 102144.
Petit, O., Lunardo, R., Rickard, B., 2020. Small is beautiful: the role of anticipated food waste in consumers' avoidance of large packages. J. Bus. Res. 113, 326–336.
Phipps, D.J., Hagger, M.S., Hamilton, K., 2020. Predicting limiting 'free sugar' consumption using an integrated model of health behavior. Appetite 150, 104668.
Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., Podsakoff, N.P., 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. J. Appl. Psychol. 88 (5), 879–903.
Prakash, G., Choudhary, S., Kumar, A., Garza-Reyes, J.A., Khan, S.A.R., Panda, T.K., 2019. Do altruistic and egoistic values influence consumers' attitudes and purchase intentions towards eco-friendly packaged products? An empirical investigation. J. Retailing Consum. Serv. 50, 163–169.
Qi, X., Ploeger, A., 2019. Explaining consumers' intentions towards purchasing green food in Qingdao, China: the amendment and extension of the theory of planned behavior. Appetite 133, 414–422.
Raab, C., Baloglu, S., Chen, Y.S., 2018. Restaurant managers' adoption of sustainable practices: An application of institutional theory and theory of planned behavior. J. Foodserv. Business Res. 21 (2), 154–171.
Ray, A., Dhir, A., Bala, P.K., Kaur, P., 2019. Why do people use food delivery apps (FDA)? A uses and gratification theory perspective. J. Retailing Consum. Serv. 51, 221–230.
Raza, S.A., Qazi, W., Shah, N., Qureshi, M.A., Qaiser, S., Ali, R., 2020. Drivers of intensive Facebook usage among university students: an implication of U&G and TPB theories. Technol. Soc. 62, 101331.
Rivera, M., 2019. Online delivery provider (ODP) services: who is getting what from food deliveries? J. Hospit. Manag. 80, A1–A2.
Roh, M., Park, K., 2019. Adoption of O2O food delivery services in South Korea: the moderating role of moral obligation in meal preparation. Int. J. Inf. Manag. 47, 262–273.
Romani, S., Grappi, S., Bagozzi, R.P., Barone, A.M., 2018. Domestic food practices: a study of food management behaviors and the role of food preparation planning in reducing waste. Appetite 121, 215–227.
Samsioe, E., Fuentes, C., 2022. Digitalizing shopping routines: Re-organizing household practices to enable sustainable food provisioning. Sustain. Prod. Consum. 29, 807–819.
Schmitt, V.G.H., Cequea, M.M., Neyra, J.M.V., Ferasso, M., 2021. Consumption behavior and residential food waste during the COVID-19 pandemic outbreak in Brazil. Sustainability 13 (7), 3702.
Shankar, A., Datta, B., 2018. Factors affecting mobile payment adoption intention: an Indian perspective. Global Bus. Rev. 19 (3_Suppl. l), S72–S89.
Shankar, A., Jain, S., 2021. Factors affecting luxury consumers' webrooming intention: a moderated-mediation approach. J. Retailing Consum. Serv. 58, 102306.
Shankar, A., Jebarajakirthy, C., 2019. The influence of e-banking service quality on customer loyalty: a moderated mediation approach. Int. J. Bank Market. 37 (5), 1119–1142.
Shankar, A., Jebarajakirthy, C., Ashaduzzaman, M., 2020. How do electronic word of mouth practices contribute to mobile banking adoption? J. Retailing Consum. Serv. 52, 101920.
Shankar, A., Jebarajakirthy, C., Nayal, P., Maseeh, H.I., Kumar, A., Sivapalan, A., 2022. Online food delivery: a systematic synthesis of literature and a framework development. Int. J. Hospit. Manag. 104, 103240.
Sharifirad, G., Yarmohammadi, P., Azadbakht, L., Morowatisharifabad, M.A., Hassanzadeh, A., 2013. Determinants of fast food consumption among Iranian high school students based on planned behavior theory. J. Obes. 2013, 1–7.
Sharma, R., Dhir, A., Talwar, S., Kaur, P., 2021. Over-ordering and food waste: the use of food delivery apps during a pandemic. Int. J. Hospit. Manag. 96, 102977.
Shaw, N., 2014. The mediating influence of trust in the adoption of the mobile wallet. J. Retailing Consum. Serv. 21 (4), 449–459.
Song, H., Ruan, W.J., Jeon, Y.J.J., 2021. An integrated approach to the purchase decision making process of food-delivery apps: focusing on the TAM and AIDA models. Int. J. Hospit. Manag. 95, 102943.
Stancu, V., Haugaard, P., Lähteenmäki, L., 2016. Determinants of consumer food waste behavior: two routes to food waste. Appetite 96, 7–17.
Statista, 2018. EServices Report 2018—Online Food Delivery. Retrieved 30 March 2021 from. https://www.statista.com/outlook/374/100/online-food-delivery/worldwide.
Statista, 2022. Online Food Delivery. Retrieved 30 March 2021 from. https://www.statista.com/outlook/dmo/eservices/online-food-delivery/worldwide.
Stefan, V., van Herpen, E., Tudoran, A.A., Lähteenmäki, L., 2013. Avoiding food waste by Romanian consumers: the importance of planning and shopping routines. Food Qual. Prefer. 28 (1), 375–381.
Tabachnick, B.G., Fidell, L.S., 2012. Using Multivariate Statistics, sixth ed. Pearson Education, New York.
Talwar, S., Dhir, A., Scuotto, V., Kaur, P., 2021a. Barriers and paradoxical recommendation behaviour in online to offline (O2O) services. A convergent mixed-method study. J. Bus. Res. 131, 25–39.
Talwar, S., Dhir, A., Singh, D., Virk, G.S., Salo, J., 2020. Sharing of fake news on social media: application of the honeycomb framework and the third-person effect hypothesis. J. Retailing Consum. Serv. 57, 102197.
Talwar, S., Kaur, P., Ahmed, U., Bilgihan, A., Dhir, A., 2022a. The dark side of convenience: how to reduce food waste induced by food delivery apps. Br. Food J. ahead-of-print (ahead-of-print).
Talwar, S., Kaur, P., Kumar, S., Salo, J., Dhir, A., 2022b. The balancing act: how do moral norms and anticipated pride drive food waste/reduction behaviour? J. Retailing Consum. Serv. 66, 102901.
Talwar, S., Kaur, P., Nunkoo, R., Dhir, A., 2022c. Digitalization and sustainability: virtual reality tourism in a post pandemic world. J. Sustain. Tourism 1–28.
Talwar, S., Kaur, P., Okumus, B., Ahmed, U., Dhir, A., 2021b. Food waste reduction and taking away leftovers: interplay of food-ordering routine, planning routine, and motives. Int. J. Hospit. Manag. 98, 103033.
Tan, T.M., Salo, J., Juntunen, J., Kumar, A., 2018. A comparative study of creation of self-brand connection amongst well-liked, new, and unfavorable brands. J. Bus. Res. 92, 71–80.
Tandon, A., Kaur, P., Bhatt, Y., Mäntymäki, M., Dhir, A., 2021. Why do people purchase from food delivery apps? A consumer value perspective. J. Retailing Consum. Serv. 63, 102667.
Troise, C., O'Driscoll, A., Tani, M., Prisco, A., 2020. Online food delivery services and behavioural intention—a test of an integrated TAM and TPB framework. Br. Food J. 123 (2), 664–683.
UNEP, 2021. Food Waste Index Report 2021. *United Nations Environment Programme* Nairobi. Retrieved from: https://www.unep.org/resources/report/unep-food-waste-index-report-2021.
UNSDG, 2018. United Nations sustainable development goals. Retrieved from: https://www.un.org/sustainabledevelopment/sustainabledevelopment-goals-retired-link/.
Vizzoto, F., Testa, F., Iraldo, F., 2021. Strategies to reduce food waste in the foodservices sector: a systematic review. Int. J. Hospit. Manag. 95, 102933.
Wilson, N.L., Rickard, B.J., Saputo, R., Ho, S.T., 2017. Food waste: The role of date labels, package size, and product category. Food Qual. Prefer. 55, 35–44.
Wu, J.-H., Cheng, C.-M., Cheng, P.-J., 2015. Behavioral intention toward urban eco-land performance assessment models using TPB tests. J. Bus. Res. 68 (4), 771–776.
Xhakollari, V., Canavari, M., Osman, M., 2021. Why people follow a gluten-free diet? An application of health behaviour models. Appetite 161, 105136.
Xu, X., Huang, Y., 2019. Restaurant information cues, Diners' expectations, and need for cognition: experimental studies of online-to-offline mobile food ordering. J. Retailing Consum. Serv. 51, 231–241.
Yadav, R., Pathak, G.S., 2016. Intention to purchase organic food among young consumers: evidences from a developing nation. Appetite 96, 122–128.
Yadav, R., Pathak, G.S., 2017. Determinants of consumers' green purchase behavior in a developing nation: applying and extending the theory of planned behavior. Ecol. Econ. 134, 114–122.
Yadav, R., Balaji, M.S., Jebarajakirthy, C., 2019. How psychological and contextual factors contribute to travelers' propensity to choose green hotels? Int. J. Hospit. Manag. 77, 385–395.
Yeo, V.C.S., Goh, S.K., Rezaei, S., 2017. Consumer experiences, attitude and behavioral intention toward online food delivery (OFD) services. J. Retailing Consum. Serv. 35, 150–162.
Yu, Z., Ju, X., Bai, L., Gong, S., 2021. Consumer's over-ordering behavior at restaurant: understanding the important roles of interventions from waiter and ordering habits. Appetite 160, 105092.
Zhang, X., Jeong, E., Olson, E.D., Evans, G., 2020. Investigating the effect of message framing on event attendees' engagement with advertisement promoting food waste reduction practices. Int. J. Hospit. Manag. 89, 102589.
Zhao, Y., Ni, Q., Zhou, R., 2018. What factors influence the mobile health service adoption? A meta-analysis and the moderating role of age. Int. J. Inf. Manag. 43, 342–350.