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Towards a unified model of consumers' intentions to use drone food delivery services

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ABSTRACT

The aim of this study is to examine the factors influencing consumers' intentions to use drone food delivery services drawing on four theories, namely the theory of planned behaviour, norm activation theory, technology acceptance model, and perceived risk theory. 305 survey data are collected in Malaysia and analysed using partial least squares structural equation modelling. The findings show that attitudes, perceived behavioural control, and personal norms are significant predictors of intentions. Furthermore, ascribed responsibility and awareness of consequences significantly predict personal norms. Additionally, perceived ease of use, perceived usefulness, and psychological risk are also predictors of attitudes.

1. Introduction

An unmanned low-altitude aircraft that varies in different sizes, and transfers goods that are purchased online are known as drone delivery (Ganjipour and Edrisi, 2022). Industries are changing their ways of operation with the introduction of drones (Leon et al., 2021). Online shops and companies have started to adopt drone delivery to reduce costs and increase efficiency while ensuring environmental sustainability (Yoo et al., 2018). Further, drone delivery capability is projected to deliver a vast majority of goods that have been ordered by consumers on an on-demand basis (Koetsier, 2022). This could be fulfilled easily via drone delivery. However, the usage of drone delivery remains under-utilised due to public perception, government regulations, and the technology itself (Banker, 2022). Regardless of the challenges, multiple U.S companies decided to start expanding the usage of drones as delivery agents after the attainment of approval from the Federal Aviation Administrative in the US and, additionally, inked deals with major retailers to cover bigger coverage areas in the US while planning to penetrate to six new European markets in 2023 (Keane, 2022). According to Statista (2022), the market size of drone package delivery systems is expected to grow from the year 2018–2030 and is speculated to be worth 3.4 billion USD in 2030. WhatNext (2022) has indicated that drone food delivery services will emerge in UAE, the US, Japan, South Korea, Singapore, and Australia. This is because drone food delivery services may operate more efficiently than traditional methods,

such as delivery by car, particularly in suburban areas (Guszkowski, 2021).

Multiple studies recognised the importance of drone delivery services and investigated the motivating drivers of consumers' intentions to use drone delivery services (e.g., Ganjipour and Edrisi, 2022; Jasim et al., 2021; Leon et al., 2021; Osakwe et al., 2022; Yaprak et al., 2021). Nonetheless, empirical research examining consumers' intentions in the usage of drone food delivery is rather limited. Osakwe et al. (2022) identified that outcome expectancy, lifestyle compatibility, and perceived self-efficiency significantly influence consumers' attitudes towards drone food delivery services and intentions to use drone food delivery services. Additionally, past studies (Hwang et al., 2019a, 2021a; Mathew et al., 2021) discovered that consumer innovativeness significantly influences the intentions to use drone food delivery services. Further, Hwang and Kim (2020) found the vital role of expected benefits in determining consumer usage intentions of drone food delivery. Meanwhile, multiple researchers (Hwang et al., 2019b; Kim et al., 2021a) identified consumers' perceived innovativeness as a significant determinant of attitudes towards drone food delivery services, subsequently affecting the intentions to spread word-of-mouth and increasing usage intentions. Moreover, some studies (Choe et al., 2021b; Hwang and Choe, 2019) demonstrated that the perceived risk associated with drone food delivery services plays a crucial role in determining consumers' willingness to use these services. Additionally, it was found that internal environment locus of control (Hwang et al., 2021b) and

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psychological benefits (Hwang et al., 2021c) are significant predictors of consumers' anticipated emotions and intentions to use drones as their delivery tools.

The theory of planned behaviour (TPB) is another theory that has been used to predict consumers' intentions to use drone food delivery services. In brief, the theory states that an individual's intentions to carry out a behaviour can be predicted by three distinctive drivers, namely attitudes, subjective norms, and perceived control behaviour (Ajzen, 1991). For instance, Hwang et al. (2020) employed the TPB to explain consumer intentions in using drone food delivery services. Meanwhile, Kim and Hwang (2020) modified the TPB by merging the norm activation theory (NAT) to explain the behavioural intentions of adopting drone food delivery services from an eco-friendly perspective. Generally, the NAT posits that intentions can be predicted by personal norms, which are in turn influenced by ascribed responsibility and awareness of consequences.

Additionally, the technology acceptance model (TAM) indicated that the formation of attitudes could be caused by two significant factors namely perceived ease of use and perceived usefulness. Waris et al. (2022) applied the extended TAM to access consumers' attitudes and their willingness to use, give recommendations, and pay more for the adoption of drone food delivery services. The theory is also extendable to capture a bigger picture of the predictive factors. Choe et al. (2021a) merged the TAM and TPB to investigate the behavioural intentions of consumers in the usage of drone food delivery services. Thus, we included the two significant driving factors of perceived usefulness and perceived ease of use to predict the attitudes.

Meanwhile, Choe et al. (2021b) applied perceived risk theory, which incorporates factors such as financial risk, time risk, privacy risk, performance risk, and psychological risk, to predict the influence on the image of drone food delivery services. Public speculation on drone delivery services has always been associated with risks, leading to a significant obstacle for consumers to make use of drone food delivery services. For instance, consumers may perceive a potential threat to their privacy associated with the use of drone food delivery services and thus be reluctant to use the services. Perceived risk plays a determining role in affecting consumers' attitudes and behaviour (Mathew et al., 2021). Hence, it is of critical importance to examine the types of perceived risks that would affect consumers' attitudes towards drone food delivery services.

As mentioned earlier, previous studies have employed the TPB, NAT, TAM, and perceived risk theory to investigate consumers' intentions to use drone food delivery services (e.g., Choe et al., 2021b; Hwang et al., 2020). However, most of these studies have examined these theories independently, with a single theory being tested within the context of drone food delivery services. To fill the gap, this research aims to provide a comprehensive understanding of consumers' intentions to use drone food delivery services by developing and testing an integrated model that combines the TPB, NAT, TAM, and perceived risk theory. It is expected that this research can bring new knowledge to the identification of the different factors that have influenced consumers' attitudes and intentions to use drone food delivery services. The findings are expected to serve as a reference for drone food delivery companies to develop effective marketing strategies to attract more consumers to try and use drone food delivery services.

2. Literature review

2.1. Theory of planned behaviour

The TPB was modified from the theory of reasoned action (TRA) in 1980, which explains a person's intentions to take specific action (Ajzen, 1991; Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975). The intentions are assumed to reflect the driving factors to influence behaviour and indicate the likelihood of a person's willingness and efforts in performing the particular behaviour. Generally, the stronger the intentions

(e.g., to use drone food delivery services), the higher the tendency to perform the behaviour (Ajzen, 1991; Koay et al., 2022). However, the notions of this theory will be fulfilled if the behaviour is within the presupposition requirements namely, the person has the call to make the decision, possesses the clear motivation and ability to perform the behaviour, and makes extensive consideration before the behavioural action. Intentions can be mainly predicted using three factors: attitudes, subjective norms, and perceived behavioural control. These factors can be divided into two types, voluntary and involuntary. Attitudes and subjective norms belong to the voluntary category, while perceived behavioural control is considered part of the involuntary category. Perceived behavioural control was introduced as a predictor of intentions in the TPB framework to improve the accuracy in predicting intentions because the TRA was criticised for its assumption that the behaviour under investigation is under volitional control, which is flawed (Ajzen, 1991).

Apart from the three original TPB predictors, the creator of the TPB is flexible for other researchers to modify and expand the TPB framework by adding new predictors (Ajzen, 1991; Koay and Cheah, 2023; Teoh et al., 2022). For instance, past studies integrated the TPB and NAT to predict behavioural intentions (Manosuthi et al., 2020; Meng et al., 2020). Furthermore, Radic et al. (2022) developed a model using the TPB as the base theory along with other supporting theories including the two-step flow theory, diffusion of innovation theory, and perceived risk theory to predict international tourists' behavioural intentions toward the adoption of central bank digital currencies. As a result, in order to comprehensively predict consumers' intentions to use drone food delivery services, we developed an integrated model combining the TPB, NAT, TAM, and perceived risk theory.

Attitudes refer to an individual's positive or negative evaluation of a particular behaviour (Ajzen, 1991). That being said, attitudes are considered the evaluation element of determining behavioural intentions. When an individual holds favourable attitudes towards a particular behaviour, they are more likely to develop positive intentions to engage in that behaviour. Positive intentions, in turn, increase the likelihood of actual behaviour enactment (Koay et al., 2020). Past studies found that attitudes towards drone food delivery services positively influence usage intentions. Hwang et al. (2019a) discovered that positive attitudes towards drone food delivery services increase the likelihood of using drone food delivery services in ordering food. Other researchers have highlighted that a strong positive attitude towards drone food delivery services is indicative of a greater likelihood of intending to use them (e.g., Hwang et al., 2019a; Mathew et al., 2021; Osakwe et al., 2022). Therefore, the following hypothesis is formulated:

H1. : Attitudes have a significant positive influence on intentions.

An individual who perceives a high level of subjective norms is likely to feel social pressure either to engage or not to engage in a particular behaviour (Ajzen, 1985). This social pressure can be a motivating factor for the individual's decision to act or refrain from acting in a certain way. For example, if an individual's reference group encourages them to use drone food delivery services for ordering food, this may motivate the individual to engage in this behaviour, indicating a high level of subjective norms. Hence, it is reasonable to assume that reference groups will influence subjective norms, which in turn affect the formation of intentions to use drone food delivery services. Choe et al. (2021a) discovered that subjective norms positively affect behavioural intentions in the adoption of drone food delivery services. Furthermore, Hwang and Kim (2021) revealed that the magnitude of behavioural intentions is significantly influenced by social influences. On top of that, several researchers also found that subjective norms positively affect behavioural intentions (e.g., Hwang et al., 2020; Kim et al., 2021a). Therefore, this study proposes the following hypothesis:

H2. : Subjective norms have a significant positive influence on intentions.

Perceived behavioural control refers to an individual's confidence in their capability to perform a specific behaviour (Bandura, 1992). This construct is the additional predictor to the TRA as it is deemed an essential element to forecast consumers' intentions to engage in a specific behaviour. According to the TPB, when an individual thinks that the behaviour can be performed within his/her capability, he or she is prone to increase the intentions to execute the behaviour. In the same vein, consumers show high levels of willingness to use drone food delivery if he or she is able to control the navigation of the drone food delivery services. Several studies (Kim and Hwang, 2020; Kim et al., 2021a) found in order for consumers to choose drones as their preferred food delivery method, having the necessary resources such as time, money, and access to opportunities is crucial. Research conducted by Choe et al. (2021a) revealed that perceive behavioural control positively affects consumers' intentions to use drones to deliver their food. We accordingly formulate the following hypothesis:

H3. : Perceived behavioural control has a significant positive influence on intentions.

2.2. Norm activation theory

The NAT explains an individual's interest would be sacrificed for the sake of another's well-being (Schwartz, 1977). This model focuses on explaining altruistic behaviours such as choosing a green delivery approach, using eco-friendly products, and considering the environmental situation in the context of drone food delivery services. The NAT primarily posits that problem awareness and ascribed responsibility are activators of personal norms. In other words, an individual's personal norms will be activated by the individual's awareness of the arising issues that would probably cause detrimental effects to the environment and instigated by a sense of responsibility to protect the environment, refraining from the negative repercussions (Schwartz, 1977). In the context of drone food delivery, we posit that when consumers become aware of the environmental advantages associated with using drones for food delivery, they are more likely to feel a sense of moral obligation to use these services. This sense of responsibility may arise due to the perception that the use of drones as a delivery mechanism can help reduce carbon emissions and promote sustainability.

Personal norms are originated from norms and values that have been developed in one's self-expectation towards a given behaviour (Schwartz, 1977). Individuals who engage in altruistic behaviours typically do not expect any rewards or reciprocation for their actions, even when it involves investing extra effort or time. The motivation behind these actions often stems from a desire to help others and make a positive impact, rather than seeking personal gain or recognition. Hence, applying the logic in the context of drone food delivery services, when consumers realise that the usage of drone food delivery services could reduce the negative impact towards the environment by lowering the greenhouse gas transmission as compared to the traditional delivery methods, consumers' personal norms will be activated (Kreier, 2022). Another study by Wang et al. (2022) showed that personal norms greatly influence consumers' intentions for reducing food waste. A multitude of studies also found that personal norms influence consumers' intentions for choosing eco-friendly products and services (Han et al., 2020; Prakash and Pathak, 2017; Rezaei and van der Heijden, 2022). Consumers who uphold their norms and values are likely to perform a specific behaviour for the sake of sustainability. As such, a hypothesis is formulated as below:

H4. : Personal norms have a significant positive influence on intentions.

The NAT presumed that awareness of consequences and ascription of responsibility are the main drivers to initiate personal norms. Ascription of responsibility is a personal feeling of responsibility for the consequences of the behaviour (Schwartz, 1977). In the context of drone food

delivery services, a sense of responsibility may arise in individuals who feel that not adopting drones as a delivery mechanism could lead to negative consequences, such as increased greenhouse gas emissions and a higher carbon footprint. This responsibility may stem from a desire to act in an environmentally conscious way and reduce one's impact on the environment. Therefore, the adoption of drone delivery services may be seen as a way to fulfil this responsibility and act in a more sustainable manner. Recent studies on environmental responsibility reported that the ascription of responsibility positively affects personal norms (Wu et al., 2022; Zhang et al., 2022). Meanwhile, Kim and Hwang (2020) Kim and Hwang (2020) found a significant relationship between the ascription of responsibility and personal norms in the context of drone food delivery services, based on their sample population in Seoul, Korea. Thus, the following hypothesis is proposed:

H5. : Ascribed responsibility has a significant positive influence on personal norms.

Awareness of consequences refers to an individual's consciousness towards the possible adverse implications of not behaving for others' welfare (Steg and De Groot, 2010). According to Park and Ha (2014), it is difficult to develop a strong obligation to perform a certain behaviour without being aware of its possible adverse effects. That means knowledgeable consumers who are aware of the environmental issues would be motivated to develop personal norms and values towards the specific behaviour. Past studies provided evidence that awareness of consequences affects personal norms. For instance, Ho and Wu (2021) indicated that awareness of consequences is predicting personal norms for exploring the intentions to use electric scooters. Thus, the following hypothesis is put forward:

H6. : Awareness of consequences has a significant positive influence on personal norms.

2.3. Technology acceptance model

The TAM was proposed by Davis (1985) to investigate consumers' perception and acceptance towards the characteristics of emerging technology. This model has been adopted in various fields since it is straightforward, backed with statistical evidence, and modifiable to predict consumers' acceptance of new technology (Rauniar et al., 2014). The focus of this model is perceived usefulness and perceived ease of use, where these variables are closely associated with consumers' attitudes towards the adoption of new technology. Additionally, attitudes have been recognised as the essential driver for behavioural intentions to use new technology (Davis, 1985). Given that drone food delivery services are a disruptive emerging technology, the TAM is therefore suitable and appropriate to be used as a theoretical basis to understand factors influencing consumers' intentions to use drone food delivery services. However, Choe et al. (2021a) asserted that "using TAM to explain behavioural intention to use drone food delivery services is not enough and fails to take into account some salient characteristics of drone food delivery services" (p. 20). This is because the TAM was developed mainly focusing on the aspect of the design of systems and therefore may not fully capture the complex nature of drone food delivery services. Thus, the TAM should be integrated with other theories in order to holistically predict new technologies like drone food delivery services.

Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free from effort" (Van der Heijden, 2003, p. 542). Within the context of drone food delivery services, perceived ease of use could imply that consumers believe in the usage of drone food delivery would be easy without extra effort to learn extra skills or knowledge. Several studies discovered that perceived ease of use significantly influences attitudes (Choe et al., 2021a; Riyath and Rijah, 2022; Yaprak et al., 2021). Also, a study conducted by Waris et al. (2022) drawing samples from 354 consumers in Pakistan discovered that perceived ease of use in drone food delivery services will cause

favourable attitudes among consumers. Hence, this study proposes the following hypothesis:

H7. : Perceived ease of use has a significant positive influence on attitudes.

Meanwhile, perceived usefulness is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Van der Heijden, 2003, p. 542). According to Davis (1989), consumers’ intentions to adopt the new technology decline if they find it does not enhance their performance. Having said that, consumer needs to believe that navigating drone food delivery would work effortlessly such as being more convenient, efficient, and effective. Various research revealed that perceived usefulness significantly impacts attitudes (Nguyen et al., 2019; Qi et al., 2021; Yaprak et al., 2021). For instance, Waris et al. (2022) found that the perceived usefulness of drone-based food delivery services has a significant impact on consumers’ attitudes, ultimately leading to greater acceptance and adoption of drone food delivery. Therefore, the following hypothesis is proposed:

H8. : Perceived usefulness has a significant positive influence on attitudes.

2.4. Perceived risk theory

Perceived risk theory suggests that when people engage in transactions, they must contend with uncertain risks and the likelihood and significance of potential negative consequences (Bauer, 1960). Uncertainty will lead to anxiety or apprehension caused by the absence of knowledge about the outcomes or results of undertaking a particular action. When the person perceives a sense of risk when he or she feels doubtful towards the potentially devastating consequences of consuming a particular product or service (Featherman and Pavlou, 2003). Individuals are more likely to prioritise minimising the possibility of errors or mistakes rather than maximising the benefits while engaging in potentially risky behaviour. Perceived risk theory has been extensively researched in the past in multiple fields of study such as tourism and hospitality (Tian et al., 2022), the retail industry (Yuniarti et al., 2022), and food and beverages (Pillai et al., 2022). It has also been used as the determining predictor of consumers’ intentions and willingness to accept the introduction of new technology (Le et al., 2022). Furthermore, researchers have conceptualised perceived risks differently with various sub-dimensions according to the nature of the research context (Koay, 2018). For instance, Sadiq et al. (2022) conceptualised perceived risk as a unidimensional construct to predict online travel purchase behaviour. Moreover, Zhang et al. (2019) used two types of perceived risks, namely safety risk and privacy risk to predict the public’s acceptance of automated vehicles. Also, Choe et al. (2021b) tested the impact of perceived risks with multiple facets (e.g., financial risk, time risk, privacy risk, performance risk, and psychological risk) on consumers’ image of drone food delivery services. In order to holistically understand how perceived risk affects attitudes towards drone food delivery services, this research conceptualised perceived risk in the forms of financial risk, time risk, privacy risk, performance risk, and psychological risk.

Financial risk is the likelihood of consumers experiencing monetary loss due to the higher price paid to acquire the product (Murphy and Enis, 1986). In the context of emerging technology, financial risk pertains to the potential negative impact on financial resources resulting from the adoption of new technology products (Park and Tussyadiah, 2017). Several past studies found that financial risk influences consumer attitudes towards different products (Almajali, 2020; Gunawan et al., 2022). In conjunction with that, Choe et al. (2021b) reported that financial risk is a significant predictor of consumers’ perceived image of drone food delivery services. Consumers are likely to perceive lower purchase risks for a product that can be evaluated based on its objective attributes, enabling them to make informed purchase decisions

(Chatterjee and Kumar, 2017). Hence, the adoption of a new technology, such as drones for delivery services, may pose a risk to consumers who may be hesitant to pay a higher price for this new technology. For example, consumers may feel hesitant to use drone food delivery services if they are required to pay more than they would for traditional delivery methods, such as delivery by motorcycle or car. Therefore, we formulate the following hypothesis:

H9. : Financial risk has a significant negative influence on attitudes.

Performance risk refers to the likelihood of the product failing to perform as expected and being incapable to deliver the required benefits (Featherman and Pavlou, 2003). Drone food delivery services are expected to enhance the efficiency of the delivery process and promote effective delivery. For instance, consumers would expect delivery to be fast and accurate when they use drone food delivery services. Nonetheless, there is a possibility that these drones are unable to perform accordingly. For instance, Ravich (2015) speculated that drones may crash into other drones and are likely to fall from the skies, causing pedestrians in jeopardy. Therefore, its usability may raise doubts among prospective users. The effect of performance risk on users’ attitudes towards drone delivery services has not been extensively researched in previous studies. For instance, Choe et al. (2021b) discovered the relationship between performance risk and consumers’ image towards drone food delivery. Although there are limited studies in the context of drone food delivery services, the connection between performance risks and attitudes towards using emerging products has been shown (Gunawan et al., 2022). Hence, this study proposes the following hypothesis:

H10. : Performance risk has a significant negative influence on attitudes.

Privacy risk has been an emerging issue for new technology specifically drones. Park et al. (2021) reported that the general public has raised concerns about the safety and security risks associated with using drones as delivery tools. These risks include the potential for drones to cause damage to buildings, invade the privacy of residents, and engage in illegal trespassing. Xie et al. (2022) also raised concerns about the unauthorised collection and potential leakage of private information of consumers, such as the collection of data and photographs during the delivery service process. Some studies reported that there is a significant relationship between privacy risks and consumer behaviour (Leon et al., 2021; Mathew et al., 2021; Yoo et al., 2018). Further, Al-Rawashdeh et al. (2022) discovered that privacy risk is the main factor for consumers to adopt new, emerging technologies. Additionally, Khan et al. (2019) showed that consumers who are less likely to be concerned about privacy would develop positive attitudes towards drone food delivery services. Therefore, it is believed that consumers who perceive a low risk to their privacy associated with drone food delivery services are more likely to hold positive attitudes towards this new delivery method. Therefore, the following hypothesis is formulated:

H11. : Privacy risk has a significant negative influence on attitudes.

According to Jacoby and Kaplan (1972), psychological risk refers to the psychological discomfort experienced as a result of adopting an inferior product. This risk is particularly heightened when it comes to the selection of high-end technology products and services. (Choe et al., 2021b). This is because high-end technological services are intangible, and consumers may find it difficult to thoroughly evaluate the potential risks associated with these services. A study by Morosan (2012) reported that the introduction of biometric systems to consumers may face obstacles due to consumers’ high perception of psychological risks associated with accepting new technologies. Similarly, consumers are reluctant and hesitant to use drone delivery services due to their futuristic concept. Hwang and Choe (2019) found that psychological risk negatively influences the image of drone food delivery services. In another study of another context, psychological risk has also been shown

as a predictor of consumers' purchase intentions (Sharma et al., 2022). We accordingly formulate the following hypothesis:

H12. : Psychological risk has a significant negative influence on attitudes.

While drone food delivery services have been acknowledged as a time-saving alternative to traditional delivery methods, individuals may need to invest time in searching for adequate information about these services and learning how to navigate them (Hwang and Choe, 2019). This may result in delays and longer waiting periods before consumers can try out this new delivery system, as drone food delivery is still considered a novel mechanism. Therefore, time risk may incur. Time risk refers to the likelihood of consumers wasting time or effort while inconveniently using the new technology (Garner, 1986). Hence, consumers may need to allocate additional time to become comfortable with the use of drones for food delivery services, which poses a time risk. This time risk may cause consumers to hesitate in accepting new products or technologies. Hence, this study proposes the following hypothesis:

H13. : Time risk has a significant negative influence on attitudes.

The full research model is presented in Fig. 1.

3. Methodology

3.1. Sampling procedure

The present research used a quantitative research approach. A self-administered survey questionnaire was used for data collection. The survey was distributed by using an online questionnaire survey in Malaysia to target young consumers because they represent the technology-savvy categories of consumers (Bilgihan, 2016) and are

prone to accept new changes and development for emerging technology at a faster rate such as contactless services (Kim et al., 2021b), intelligent digital voice assistance (Fernandes and Oliveira, 2021), omics traceability technologies (Castellini et al., 2022), facial recognition technology (Boo and Chua, 2022). Since drone food delivery services have yet to be commercialised in Malaysia, an introductory video has been provided to explain how drone food delivery works. This study used a convenience sampling method to collect data by distributing the self-administrative survey questions to students. In order to reduce social desirability bias, all of the collected data will remain anonymous, and their responses will be considered private and confidential. A total of 305 data were collected. The minimum sample size required in this study was 103, according to the G²power calculation. This study has sufficient samples as it has exceeded the minimum requirement by 202 samples.

The data analysis results portrayed that 43.6 % are males and 56.4 % are females. The age range of the respondents is between 18-year-old to 50-year-old. 217 of the respondents are Chinese, 49 of them are of others, followed by 27 respondents are Indian, and 17 of them are Malay. 231 of the respondents (75.7 %) are undergraduate students, 47 respondents (15.4 %) are pre-university students, followed by 16 respondents (5.2 %) are postgraduate students, and 11 respondents (3.6 %) are secondary school students.

3.2. Measures

To ensure the validity of the constructs, we adapted validated and tested scales from previous studies. previously. Some items were modified to match the context of this study. The complete list of the adapted scales can be seen in Appendix A. Participants were asked to provide their agreement towards statements related to their intentions and motivations to use drone food delivery services on a response format

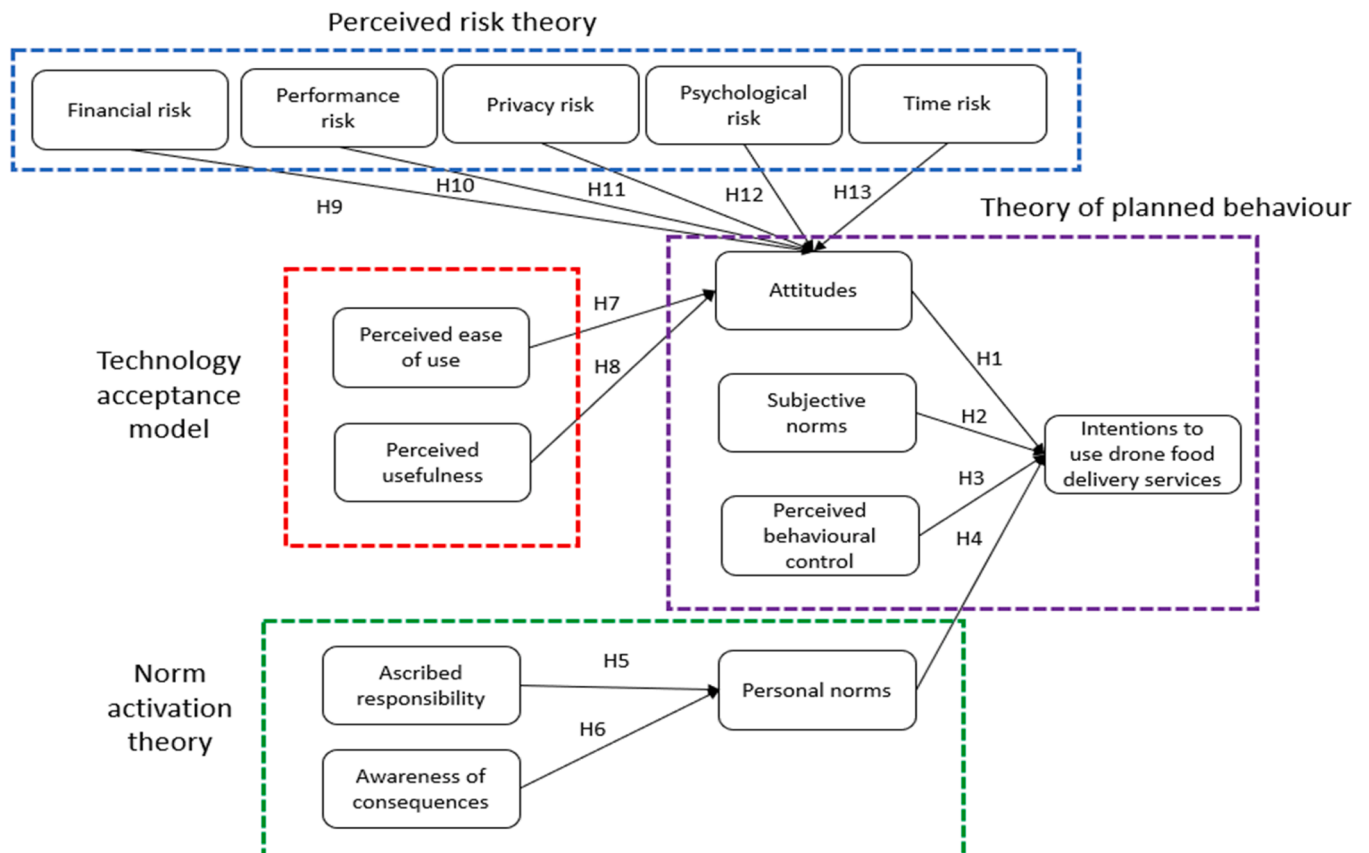


Fig. 1. Research model.

of 5-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree). The constructs involved in this study included intentions, attitudes, subjective norms, perceived behavioural control, personal norms, ascribed responsibility, awareness of consequences, perceived ease of use, perceived usefulness, financial risk, performance risk, privacy risk, psychological risk, and time risk.

4. Data analysis

4.1. Common method bias

Common method bias (CMB) can be an issue of concern when data are collected using the same method at a single time point because it may inflate the estimates of the relationships between two constructs (MacKenzie and Podsakoff, 2012). For this reason, it is essential to examine whether CMB will significantly threaten the validity of the results of this study. We first employed the full-collinearity test which requires a dummy dependent variable generated using random numbers to be regressed on all the constructs of this study including the independent and dependent variables (Kock, 2015). The results showed that all the variance inflated factor (VIF) values were less than the suggested value of 3.3, implying no evidence of CMB. Next, we also employed the measured latent marker variable (MLMV) method using the construct level correction approach to detect CMB (Chin et al., 2013). We used the general community interest scale Amundsen and Martinsen (2014) to represent the MLMV. Subsequently, we compared all the path

coefficients of two PLS-regression models with and without the MLMV and found that there were no substantial changes in the final results (see Appendix B). Hence, we can confidently confirm that our data were safe from CMB.

4.2. Measurement model

The quality of measurement models involves assessing reliability, convergent validity, and discriminant validity, following the recommendations by Hair et al. (2019). As shown in Table 1, all Cronbach's alpha and composite reliability values were greater than 0.7 (Jöreskog, 1971), showing a high degree of internal consistency. Next, convergent validity was also achieved as all average variance extracted (AVE) values and outer loadings were greater than 0.5 and 0.7 respectively (Hair et al., 2019). Two items (PSY1 and PU3) were removed due to their low outer loading (<0.4). In terms of discriminant validity, we used the Heterotrait-Monotrait ratio (HTMT) criterion. As shown in Table 2, all the HTMT ratio values were far below the threshold of 0.9 (Henseler et al., 2015), suggesting that discriminant validity was not a problem.

4.3. Structural model

After examining the reliability and validity of the measurement model, we continued with the assessment of the structural model involving the examination of the hypothesised relationships. We first checked for any multi-collinearity problem by examining VIF values

Table 1
Measurement model.

Construct	Item	Loading	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Ascribed responsibility	AR1	0.927	0.917	0.948	0.858
	AR2	0.924			
	AR3	0.927			
Attitudes	ATT1	0.906	0.859	0.914	0.781
	ATT2	0.840			
	ATT3	0.904			
Awareness of consequences	AC1	0.942	0.937	0.959	0.887
	AC2	0.952			
	AC3	0.932			
Financial risk	FR1	0.908	0.887	0.929	0.814
	FR2	0.919			
	FR3	0.881			
Intentions	INT1	0.912	0.896	0.935	0.827
	INT2	0.890			
	INT3	0.927			
Perceived behavioural control	PB1	0.660	0.765	0.858	0.672
	PB2	0.898			
	PB3	0.880			
Perceived ease of use	PE1	0.898	0.891	0.932	0.821
	PE2	0.925			
	PE3	0.896			
Performance risk	PER1	0.894	0.864	0.908	0.768
	PER2	0.789			
	PER3	0.938			
Personal norms	PN1	0.831	0.837	0.902	0.755
	PN2	0.893			
	PN3	0.880			
Privacy risk	PR1	0.896	0.931	0.956	0.878
	PR2	0.955			
	PR3	0.959			
Psychological risk	PSY1	removed	0.836	0.884	0.795
	PSY2	0.773			
	PSY3	0.997			
Perceived usefulness	PU1	0.938	0.869	0.939	0.885
	PU2	0.942			
	PU3	removed			
Subjective norms	SN1	0.935	0.933	0.957	0.882
	SN2	0.935			
	SN3	0.948			
Time risk	TR1	0.808	0.833	0.888	0.727
	TR2	0.812			
	TR3	0.931			

Table 2
HTMT.

Construct	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Ascribed responsibility														
2. Attitudes	0.432													
3. Awareness of consequences	0.515	0.459												
4. Financial risk	0.216	0.223	0.248											
5. Intentions	0.376	0.890	0.465	0.144										
6. Perceived behavioural control	0.299	0.568	0.409	0.202	0.555									
7. Perceived ease of use	0.296	0.520	0.319	0.123	0.572	0.543								
8. Perceived usefulness	0.361	0.683	0.441	0.317	0.640	0.552	0.570							
9. Performance risk	0.204	0.089	0.195	0.535	0.061	0.236	0.107	0.174						
10. Personal norms	0.518	0.570	0.437	0.210	0.578	0.379	0.331	0.550	0.152					
11. Privacy risk	0.269	0.165	0.106	0.369	0.097	0.123	0.041	0.143	0.490	0.162				
12. Psychological risk	0.139	0.040	0.022	0.230	0.040	0.105	0.122	0.028	0.505	0.066	0.539			
13. Subjective norms	0.392	0.423	0.291	0.107	0.436	0.313	0.294	0.368	0.062	0.539	0.217	0.270		
14. Time risk	0.322	0.130	0.149	0.411	0.163	0.090	0.093	0.081	0.473	0.197	0.610	0.645	0.347	

(Benitez et al., 2020). The results reported none of the VIF values was greater than the critical value of 5. Next, a bootstrapping procedure with 5000 re-samples was conducted to test the significance of path coefficients (Hair et al., 2019). The full structural model results can be seen in Table x. It was found that attitudes ($\beta = 0.633, p < 0.001$), perceived behavioural control ($\beta = 0.131, p < 0.01$), and personal norms ($\beta = 0.127, p < 0.01$) except subjective norms ($\beta = 0.061, p > 0.05$) have a significant positive influence on intentions. Hence, H1, H3, and H4 were supported but H2 was not. Next, support was found for the H5 and H6 as both ascribed responsibility ($\beta = 0.348, p < 0.001$) and awareness of consequences ($\beta = 0.223, p < 0.01$) have a significant positive influence on intentions. It was also found that the positive influence of perceived ease of use ($\beta = 0.241, p < 0.001$) and perceived usefulness ($\beta = 0.446, p < 0.001$) on attitudes was significant, supporting H7 and H8. Lastly, of the 5 risk dimensions, only psychological risk ($\beta = -0.132, p < 0.05$) was found to have a significant positive influence on intentions, whereas financial risk ($\beta = 0.031, p > 0.05$), performance risk ($\beta = -0.067, p > 0.05$), privacy risk ($\beta = 0.092, p > 0.05$), and time risk ($\beta = 0.133, p > 0.05$) were found to have no significant influence on intentions. Effect sizes (f^2) for all path coefficients were also reported in Table 3.

Additionally, the coefficient of determination (R^2) values of intentions, attitudes, and personal norms were 0.648, 0.410, and 0.246, respectively. R^2 values of 0.75, 0.5, or 0.25 can be considered to have substantial, moderate, or weak in-sample explanatory power (Hair et al., 2011). The out-sample explanatory power of the model was also examined using the PLSpredict algorithm (Shmueli et al., 2019) (see Table 4). The Q^2 value in PLSpredict compares the prediction errors of the PLS-path model against simple mean predictions, and a Q^2 predict value of greater than zero indicates that the PLS-path model has

Table 3
Structural model.

Relationship	Path coefficient	Standard error	t value	95% BCCI	p value	Decision	f^2
Theory of planned behaviour							
H1: Attitudes -> Intentions	0.633	0.042	15.054	[0.564, 0.703]	0.000	Supported	0.713
H2: Subjective norms -> Intentions	0.061	0.045	1.353	[- 0.014, 0.136]	0.088	Not supported	0.008
H3: Perceived behavioural control -> Intentions	0.131	0.047	2.758	[0.053, 0.209]	0.003	Supported	0.036
Norm activation theory							
H4: Personal norms -> Intentions	0.127	0.053	2.395	[0.040, 0.215]	0.008	Supported	0.030
H5: Ascribed responsibility -> Personal norms	0.348	0.069	5.079	[0.224, 0.450]	0.000	Supported	0.124
H6: Awareness of consequences -> Personal norms	0.223	0.072	3.106	[0.107, 0.343]	0.001	Supported	0.051
Technology acceptance model							
H7: Perceived ease of use -> Attitudes	0.241	0.063	3.809	[0.130, 0.337]	0.000	Supported	0.071
H8: Perceived usefulness -> Attitudes	0.446	0.064	6.934	[0.341, 0.551]	0.000	Supported	0.227
Perceived risk theory							
H9: Financial risk -> Attitudes	0.031	0.061	0.506	[- 0.065, 0.137]	0.306	Not supported	0.001
H10: Performance risk -> Attitudes	-0.067	0.075	0.889	[- 0.216, 0.032]	0.187	Not supported	0.005
H11: Privacy risk -> Attitudes	0.092	0.068	1.345	[- 0.022, 0.199]	0.089	Not supported	0.009
H12: Psychological risk -> Attitudes	-0.132	0.074	1.772	[- 0.256, - 0.018]	0.038	Supported	0.019
H13: Time risk -> Attitudes	0.133	0.087	1.537	[- 0.040, 0.245]	0.062	Not supported	0.017

Table 4
PLS-predict.

Item	Q^2 predict	PLS		LM		PLS-LM	
		RMSE	MAE	RMSE	MAE	RMSE	MAE
INT1	0.359	0.680	0.521	0.717	0.528	-0.037	-0.008
INT2	0.340	0.693	0.543	0.741	0.565	-0.048	-0.022
INT3	0.340	0.724	0.549	0.746	0.572	-0.022	-0.022

predictive relevance. The results showed that the Q^2 predict value for intentions was 0.420 which was greater than zero. Next, all RMSE and MAE values of the majority indicators of creation in the PLS-path model were smaller than in the linear regression model, implying strong predictive power.

5. Findings

5.1. Theoretical implications

The significant positive influence of attitudes on intentions indicates that consumers who have positive attitudes towards drone food delivery services are more likely to consider using drones as a delivery option for their food orders. This finding is consistent with previous studies (Hwang et al., 2019; Mathew et al., 2021; Osakwe et al., 2022) that have shown attitudes to be a key factor influencing usage intentions. Specifically, individuals who have developed positive emotions and beliefs towards drones as reliable delivery tools are more likely to have intentions to adopt drones as their primary delivery option.

Despite the positive influence of attitudes on intentions, subjective

norms have been found to have a negligible effect on usage intentions for drone food delivery services. This suggests that consumers' decisions to use drones for food delivery are not heavily influenced by social factors such as the opinions of family members, peers, and friends. This finding contradicts previous studies (Choe et al., 2021a; Hwang and Kim, 2021) which have found social influence to have a significant impact on consumers' intentions to use drone food delivery services. One potential explanation for the contradictory results across previous studies could be attributed to variations in how people from diverse cultures perceive and value social influence (Lee and Wan, 2010). Further, another reason for the insignificant influence of subjective norms might be that drone food delivery services are relatively new. As such, many consumers may be eager to test these services, irrespective of whether their peers or family endorse or object to their usage.

The study also found that perceived behavioural control has a significant influence on usage intentions for drone food delivery services, which is consistent with previous research (Choe et al., 2021a; Kim and Hwang, 2020; Kim et al., 2021a). This suggests that consumers who feel they have greater control over their decision-making are more likely to use drone delivery services for their food orders. A greater control indicates consumers possess sufficient resources such as time, financial capability, and opportunities to adopt drones as their delivery option.

Next, this study showed that personal norms are positively associated with intentions to use drone food delivery services. The finding is consistent with previous research (Han et al., 2020; Kreier, 2022; Wang et al., 2022), which has shown that personal norms are a strong predictor of behavioural intentions. Consumers who have a strong moral obligation to protect the environment and place a high value on sustainability are more likely to adopt drone technology as a means of food delivery. This is due to the fact that drones are promoted as being able to operate with high efficiency and minimal environmental impact compared to traditional delivery methods.

In addition, the finding revealed that ascribed responsibility is positively linked with personal norms, which is consistent with past studies (Wu et al., 2022; Zhang et al., 2022). Ascribed responsibility will activate personal norms that uphold consumers' moral values in creating a better future for the future generation. This is because consumers with a strong sense of responsibility would think on behalf of others and make choices that would benefit people as a whole rather than maximising personal benefits. Consumers who have a high level of ascribed responsibility may feel a stronger sense of obligation to take action to protect the environment, such as adopting drone food delivery services, to ensure that future generations can make use of existing resources. Consistent with Ho and Wu (2021), awareness of consequences is also found to have a significant positive influence on personal norms, indicating that consumers who have a strong sense of moral obligation towards conserving natural resources and protecting the global ecosystem are more conscious of the possible negative repercussions of not adopting drone food delivery services.

Next, perceived ease of use was found to have a significant positive influence on attitudes, which is in line with previous studies (Choe et al., 2021a; Riyath, Rijah, 2022; Waris et al., 2022; Yaprak et al., 2021). Consumers who perceive drone food delivery services as easy to use are more likely to develop positive attitudes towards the service. As consumers become increasingly tech-savvy, they can easily access and use such services through mobile apps without the need for additional technical knowledge or skills. Another variable of the TAM, perceived usefulness, was found to have a significant positive association with attitudes towards drone food delivery services, which is congruent with prior studies (Nguyen et al., 2019; Qi et al., 2021). If consumers perceive that using drones for food delivery can bring multiple positive effects, such as timely and convenient delivery of their ordered food, it can lead to positive attitudes towards drone food delivery services.

Furthermore, the present study found that financial risk does not significantly influence attitudes towards drone food delivery services, suggesting that the potential for financial loss does not play an

important role in affecting consumers' decisions to adopt drone food delivery services. We surmise that the financial risk associated with drone food delivery services cannot be determined at the moment because these services are still new and have not yet been fully commercialised. Moving forward, performance risk has been identified to have no significant influence on attitudes, which is consistent with the findings of Mathew et al. (2021) who also found no relationship between performance risk and attitudes. One possible explanation for this result is that consumers may be willing to tolerate the challenges and occasional system failures that are inherent to new technologies such as drone delivery services because they understand that the technology is still in its early stages and expect further improvements in the future.

Our findings indicate that privacy risk does not have a significant impact on attitudes. Some studies found that privacy risk is an important predictor of attitudes (Al-Rawashdeh et al., 2022; Khan et al., 2019; Leon et al., 2021). One possible explanation for this could be that consumers trust that local authorities will take the necessary steps to ensure that drone food delivery companies comply with government regulations. Furthermore, these companies would have already obtained the necessary approvals from local authorities before beginning operations, which may increase consumers' confidence in their privacy practices. As a result, consumers may assume that their data will be kept private and confidential. Another possible explanation is that younger consumers may place less importance on privacy and security (Yuan et al., 2022), which could contribute to the lack of significant impact of privacy risk on attitudes towards drone food delivery services.

Moreover, psychological risk was found to have a negative impact on attitudes. This means that if consumers believe that adopting drone food delivery services would have a negative impact on their self-esteem or self-image, they are less likely to have favourable attitudes towards these services. The findings are in line with Hwang and Choe (2019) and Sharma et al. (2022) that reported psychological risk negatively influences consumer behaviour. Next, this study found that time risk does not influence attitudes, indicating that the potential time lost in learning how to use this new service does not significantly affect consumers' attitudes. We believe that consumers today are generally tech-savvy and may require minimal effort to learn how to access drone food delivery services through mobile apps. Additionally, since our sample primarily consists of younger consumers who are typically more open to new ideas and technologies, they may be more willing to exert the additional effort required to learn new technologies (Bang and Su, 2022; Brito, 2012).

5.2. Managerial implications

As drone food delivery technology continues to develop, it is crucial for marketers to utilise informative advertising strategies to educate consumers about this emerging delivery method so that consumers could develop positive attitudes towards drone food delivery services and subsequently try using the services. Based on the findings, we suggest several important recommendations to drone food delivery companies to encourage consumers to use their services. Given that attitudes are a significant predictor of intentions, companies must slowly develop consumers' attitudes towards drone food delivery services. As perceived ease of use has been found to have a significant influence on attitudes, companies should emphasise the ease of navigation for drone delivery services, which does not require any additional knowledge and is suitable for consumers of all educational levels. For instance, to promote the ease of navigation and increase consumer confidence in drone food delivery services, companies can offer introductory events that allow consumers to get more information regarding the services and try using the service themselves. Additionally, perceived usefulness has been reported to significantly influence consumers' attitudes. Companies can promote the efficiency and effectiveness of drone food delivery services by utilising a comparative advertising strategy that highlights the advantages of drone delivery over traditional methods. Information advertising methods can also be employed to inform consumers about

the delivery time and accuracy of the drone delivery process. This method could make consumers appreciate the usefulness of drone food delivery services.

Next, consumers who have high levels of personal norms are inclined to use drone food delivery services and personal norms can be influenced by ascribed responsibility and awareness of consequences. To encourage the adoption of drone food delivery services, it is recommended that companies emphasise the positive environmental impact of this delivery method compared to traditional services. For example, companies can highlight how drone delivery is a more eco-friendly option with a lower carbon footprint and less impact on the environment. Lastly, psychological risk is the only risk factor that has a significant negative influence on attitude. Hence, companies should find ways to reduce consumers' psychological risk associated with drone food delivery services. Consumers experience psychological risk when using drone food delivery services does not fit in well with their self-image and makes them feel anxious. Therefore, we suggest companies first explore how consumers perceive drone food delivery services and which aspects of the services make them feel anxious. Given that drone food delivery services are not widely available at this moment, it is not surprising for consumers to feel anxious due to uncertainties.

6. Conclusion

6.1. Limitations and future recommendations

The present research has several limitations. First of all, the study employed a convenience sampling method, and the collected data were from young consumers represented by students in Malaysia. Further, although young consumers are technology-savvy and receptive to new technologies, they have unique considerations that must be taken into account. Therefore, the results are unable to be generalised. Future researchers are welcome to conduct research drawing samples from multiple segments of consumers and from different countries to ensure the generalisability of the results. Secondly, this study did not screen the participants for their previous exposure to drone food delivery services. The factors that influence the intentions to use drone food delivery

services may vary between individuals who have previously used the services and those who have not. Hence, we recommend future studies consider this issue in their research design. Thirdly, this study adopted quantitative research that tested antecedents based on concepts and theories. It is recommended to conduct qualitative research specifically in-depth interviews and focus group discussions to uncover new perspectives of consumers towards drone food delivery services. Subsequently, this research focuses mainly on consumers' perspectives on the adoption of drones as the food delivery mechanism, yet the industry perspectives (e.g. investors, marketers, and businesspersons) towards drone potential have yet to be revealed. Therefore, future research could explore the adoption of drones among marketers, investors, and businesspersons. Next, this research has consolidated multiple theories to investigate consumers' adoption towards drone food delivery services, it is suggested that future researchers could adopt this comprehensive framework to be tested in other emerging technologies such as robotics, digital assistance, and automation vehicles. Finally, drone food delivery services are still in the conceptualisation stage where it has yet to be commercialised in Malaysia. Therefore, it is recommended for future researchers uncover the actual usage of consumers on drone food delivery services as well as consumers' perception towards drone food delivery services.

Declaration of Competing Interest

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

Data availability

Data will be made available on request.

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Appendix A. Scales

Intentions (Ajzen, 1991; Han and Hyun, 2017).

- I will use drone food delivery services when ordering food.
- I am willing to use drone food delivery services when ordering food.
- I am likely to use drone food delivery services when ordering food.

Attitudes (Lee, 2009).

- I think that using drone food delivery services is a good idea.
- I think that using drone food delivery services to receive a package would be a wise idea.
- In my opinion, it is desirable to use drone food delivery services.

Subjective norms (Ajzen, 1991; Paul et al., 2016).

- Most people who are important to me think I should use drone food delivery services when ordering food.
- Most people who are important to me would want me to use drone food delivery services when ordering food.
- People whose opinions I value would prefer that I use drone food delivery services when ordering food.

Perceived behavioural control (Ajzen, 1991; Han and Hyun, 2017).

- Whether or not I use drone food delivery services when ordering food is completely up to me.
- I am confident that if I want, I can use drone food delivery services when ordering food.
- I have resources, time, and opportunities to use drone food delivery services when ordering food.

Personal norms (De Groot and Steg, 2009; Han and Hyun, 2017).

- I feel an obligation to choose an environmentally friendly way, such as drone food delivery services when ordering food.
- Regardless of what other people do, because of my own values/principles, I feel that I should behave in an environmentally friendly way when ordering food.
- I feel it is important that consumers behave in a sustainable way when ordering food.

Ascribed responsibility (Han and Hwang, 2016; Schwartz, 1977).

- I believe that consumers are partly responsible for environmental problems potentially caused by current food delivery methods (e.g., motorcycle or car).
- I feel that consumers are jointly responsible for the environmental deterioration potentially caused by current food delivery methods (e.g., motorcycle or car).
- I believe that every consumer is partly responsible for the environmental problems caused by current food delivery methods (e.g., motorcycle or car).

Awareness of consequences (De Groot and Steg, 2009; Han, 2014).

- Current food delivery methods (e.g., motorcycle or car) can cause air pollution.
- Current food delivery methods (e.g., motorcycle or car) can potentially have a negative impact on global warming.
- Current food delivery methods (e.g., motorcycle or car) can lead to environmental pollution.

Perceived ease of use (Davis, 1985; Davis et al., 1989).

- Learning to use drone food delivery services seems to be easy to understand.
- It seems to be easy to use drone food delivery services when ordering food.
- It does not seem to be difficult to use drone food delivery services.

Perceived usefulness (Davis, 1985; Davis et al., 1989).

- Drone food delivery services would enable me to receive food more quickly.
- Using drone food delivery services could make it easier for me to receive food.
- Using drone food delivery services seems to be convenient when receiving food.

Financial risk (Chen, 2013; Hwang and Choe, 2019; Martins et al., 2014).

- The cost of using drone food delivery services is likely to be burdensome.
- Drone food delivery services are likely to cost more than I thought.
- I might get overcharged if I use drone food delivery services.

Time risk (Chen, 2013; Hwang and Choe, 2019; Martins et al., 2014).

- The possible time loss from learning about using drone food delivery services is high.
- If I use drone food delivery services, I am more likely to lose time by switching to a different food delivery service.
- It will take time to learn how to use drone food delivery services.

Privacy risk (Chen, 2013; Hwang and Choe, 2019; Martins et al., 2014).

- Using drone food delivery services may not protect my personal information (e.g., credit card number, phone number, address, etc.).
- Personal information (e.g., credit card number, phone number, address, etc.) when using drone food delivery services may be stolen.
- Personal information (e.g., credit card number, phone number, address, etc.) could be exposed when using drone food delivery services.

Performance risk (Chen, 2013; Hwang and Choe, 2019; Martins et al., 2014).

- The probability that something's wrong with the performance of drone food delivery services is high.
- Drone food delivery services do not seem to perform well.
- Considering the expected level of the performance of drone food delivery services, it would be risky to use them.

Psychological risk (Chen, 2013; Hwang and Choe, 2019; Martins et al., 2014).

- The usage of drone food delivery services would lead me to a psychological loss.
- Using drone food delivery services would not fit in well with my self-image.
- Using drone food delivery services makes me feel anxious.

Appendix B. Common method bias

Relationship	Path coefficient	p value	Path coefficient	p value	Difference?
	Without marker		With marker		
Theory of planned behaviour					
Attitudes -> Intentions	0.633	0.000	0.627	0.000	No
Subjective norms -> Intentions	0.061	0.088	0.054	0.127	No
Perceived behavioural control -> Intentions	0.131	0.003	0.128	0.004	No
Norm activation theory					
Personal norms -> Intentions	0.127	0.008	0.123	0.010	No
Ascribed responsibility -> Personal norms	0.348	0.000	0.310	0.000	No
Environmental concerns -> Personal norms	0.223	0.001	0.214	0.002	No
Technology acceptance model					
Perceived ease of use -> Attitudes	0.241	0.000	0.239	0.000	No
Perceived usefulness -> Attitudes	0.446	0.000	0.415	0.000	No
Perceived risk theory					
Financial risk -> Attitudes	0.031	0.306	0.027	0.336	No
Performance risk -> Attitudes	-0.067	0.187	-0.068	0.148	No
Privacy risk -> Attitudes	0.092	0.089	0.100	0.073	No
Psychological risk -> Attitudes	-0.132	0.038	-0.134	0.017	No
Time risk -> Attitudes	0.133	0.062	0.095	0.120	No

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