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Merging the norm activation model and the theory of planned behavior in the context of drone food delivery services: Does the level of product knowledge really matter?

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ABSTRACT

This study attempted to merge two theories, which included the norm activation model (NAM) and the theory of planned behavior (TPB), in order to explain eco-friendly behavioral intention formation in the context of drone food delivery services. In addition, this study deepened the theoretical framework by considering the moderating role of product knowledge about the pro-environmental role of the drone-based food delivery services. Sixteen hypotheses were tested using a total of 401 samples collected in Korea. The data analysis results indicated that all hypotheses within the model that merged the NAM and the TPB were statistically supported. Furthermore, product knowledge played a moderating role in the relationship between (1) ascribed responsibility and personal norm, (2) attitudes and behavioral intentions, and (3) subjective norm and personal norm.

1. Introduction

A drone, or an unmanned aerial vehicle (UAV), was originally developed for military purposes and was mainly used as reconnaissance and assault weapons (Muchiri & Kimathi, 2016). The utilization of drones has greatly expanded based on the advancements achieved in its capabilities, such as collecting a wider, range of information, accessibility to difficult terrains, and rapid movement (Nex & Remondino, 2014; Shavarani, Nejad, Rismanchian, & Izbirak, 2018). For example, it is used for broadcasts, cartography, agricultural imaging, fire detection, and humanitarian aid, such as transporting vaccines (Haidari et al., 2016; Muchiri & Kimathi, 2016; Song & Ko, 2017). In logistics services, the use of drones as delivery vehicles has been considered as a promising response to increasing road traffic and the incremental demand for transportation particularly growing last-mile delivery (Shavarani et al., 2018). Announcing plans and tests to deliver products by drones has been a popular publicity stunt for many companies over the past few years (Carlsson & Song, 2017).

The importance of drone-based delivery is no exception to the foodservice industry. The food delivery market is growing substantially worldwide. It has shown an annual growth rate (AGR) of 9.6%, which will result in a market volume of US$ 137,596 million by 2023, and the estimated market volume in South Korea will be US$ 2761 million by 2023 with 11.2% AGR (Statista, 2019). The foodservice delivery drones

are not operated by individual controls, but by a computer program that allows the user to enter the air route before delivery (Kesteloo. 2018). Thus, the risk of problems, such as air traffic/accident are not high. Drones used for food delivery have also been tested as a greener delivery mode and the realization is highly feasible. For example, a Domino's (DPZ) franchise in the United Kingdom posted a video of the unmanned DomiCopter delivering two pizzas in the company's signature heat wave bags (CNN Money, 2013).

More importantly, it is commonly anticipated through numerous empirical evidence that drone delivery plays a significant role for environmental improvements compared to the current ground delivery means, such as motorcycles or cars, because the drone delivery has the potential to greatly reduce energy consumption and carbon dioxide (CO_2) emissions (Figliozzi, 2017; Goodchild & Toy, 2018). Similarly, it is envisioned that delivery by drones could potentially help reduce the greenhouse gas (hereafter GHG) emissions (Stolaroff et al., 2018). Thus, the use of drones for food delivery services are foreseen as an alternative means of delivery, which is environmentally friendly (Environmental Technology, 2018).

In green research, it is becoming increasingly common to build the research framework on theories, such as the norm activation model (hereafter NAM) and the theory of planned behavior (hereafter TPB) in order to predict eco-friendly behavioral intentions (Han, 2014; Kim, Njite, & Hancer, 2013; Paul, Modi, & Patel, 2016; Steg & De Groot,

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2010). The NAM focused on a person's behavioral intentions deriving from altruistic and moral beliefs (Schwartz, 1977), and it is regarded as the most influential theory in the context of the environment (Berenguer, 2010; Han, Hwang, Lee, & Kim, 2019). On the other hand, the TPB explained a person's deliberate behavioral intentions stemming from volition and non-volitional processes (Ajzen, 1991; Meng & Han, 2018), and many studies have demonstrated the theory's value as motivation triggers in performing pro-environmental behavior (Groening, Sarkis, & Zhu, 2018). Unlike previous studies, this study attempted to merge two theories, which included the NAM and the TPB, in order to explain eco-friendly behavioral intention formation to use drone food delivery services for the first time. It is expected that a comprehensive approach merging key distinctive determinants into one theoretical framework to explain eco-friendly behavioral intentions within the domain of food delivery has rarely been conducted. Combining the NAM and the TPB with discrete but complementary motivations enables the development of a more comprehensive model predicting eco-friendly behavioral intentions that neither individual theory fully captured (Bamberg, Hunecke, & Blöbaum, 2007; Park & Ha, 2014; Wall, Devine-Wright, & Mill, 2007). Nevertheless, no researcher has considered that eco-friendly behavioral intentions in the food delivery context stems not only from moral or norm-based beliefs but also from a person's self-interest and non-volitional intentions.

This study also investigated the moderating role of product knowledge because a deeper knowledge of problems and how to solve them would increase the likelihood of individuals taking actions to protect the environment (Vicente-Molina, Fernández-Sáinz, & Izagirre-Olaizola, 2013). In other words, the relative importance of attitudes, subjective norm, and perceived behavioral control in the prediction of behavioral intentions varies when consumers possess different levels of product knowledge (Chiou, 1998). For this reason, many prior studies have examined the moderating role of product knowledge in consumer research (Gracia & de-Magistris, 2007; Saqib, Mahmood, Khan, & Hashmi, 2015). However, no empirical study to date has conducted an examination of the moderating role of product knowledge in the association of drone food delivery services to explain eco-friendly behavioral intentions.

Therefore, the purposes of this study were to (1) investigate the intricate associations among variables based on the model through merging the NAM and the TPB in order to predict individuals' eco-friendly behavioral intentions in the context of drone food delivery services (2) examine the relative importance among constructs in the proposed model in building the behavioral intentions, and (3) deepen the theoretical framework by considering the moderating impact of product knowledge about the pro-environmental role of the drone-based food delivery services.

2. Literature review

2.1. The pro-environmental role of drone food delivery services

Drones are remotely controlled aircraft that originated from military applications, which fly without a human operator onboard, and are now widely used in diverse fields, such as agriculture sectors, emergency healthcare, traffic monitoring, and transportation (Environmental Technology, 2018). For instance, drones are currently being used to spray insecticides in agriculture, which has resulted in a cost savings of 90% over using helicopters (BBC, 2018). Drones are expected to play an important role in the foodservice industry, because they are not affected by traffic congestion, so food can be delivered quickly (Bamburry, 2015). For this reason, many foodservice companies are also striving to commercialize food delivery services using drones. For example, UberEats, which is one of the largest food delivery companies, will have invested a lot of money to develop application technologies to launch food delivery services using drones by 2021 (Forbes, 2018).

More importantly, drones have a great potential to save the

environment. Currently, many studies are conducting and reporting the important role of drone delivery services to reduce GHG emissions. According to The Guardian (2018), it is expected to reduce GHG emissions if the drones replace the role of trucks in the transport industry, so several companies, such as Amazon and Google, are making a lot of efforts to commercialize drone deliveries. In addition, an experiment led by researchers at Lawrence Livermore National Laboratory and Carnegie Mellon University found that delivering packages with small drones enabled a saving of 54 percent compared to truck delivery of packages results in about 1 kg of GHG emissions on average in the U.S. (Stolaroff et al., 2018). Koiwanit (2018) studied drone delivery in Thailand through the life cycle impact assessment (LCIA) method and asserted that an online shopping system that used drone delivery is one of the most environmentally friendly delivery options throughout a wide range of scenarios. Although the impact analysis results vary by the different assumptions and scenarios, such as distance, package weight, size of drone, and urban versus rural, drone-based delivery services are highly recognized as an environmentally friendly mode according to numerous supporting experiments.

Drone-based delivery services have gained a great amount of attention in the foodservice industry because of the various benefits, such as quick food delivery, the reduced labor costs, and the decrease of traffic accidents during delivery. As previously explained, the pro-environmental role of drones is very large because most foodservice companies currently use motorcycles and cars to deliver food. In fact, media and many studies have shown that food delivery using drones is very important for environmental protection (Gharehgozli, Iakovou, Chang, & Swaney, 2017; Environmental Technology, 2018; Hwang, Cho, & Kim, 2019a; Hwang, Kim, & Kim, 2019b; Shavarani et al., 2018; The Times of Israel, 2018). For instance, Gharehgozli et al. (2017) discussed the upcoming trends of food transport and introduced drones as an example of environmentally sustainable alternative to deliver food in the future. The Times of Israel (2018) reported that Flytrex, the firm using drones to deliver food such as sushi and burgers, expanded its supply routes and stressed that drone-based deliveries are better for the environment in reducing the requirement of traffic and transportation infrastructure. Park, Kim, and Suh (2018) investigated the global warming potential (GWP) per 1 km delivery by a drone was one-sixth that of a motorcycle delivery, and the actual environmental impact reduction in consideration of delivery distance was thirteen times higher in a rural area than in an urban area through the LCIA. They also compared the environmental impacts of pizza delivery by motorcycles, which is commonly used in South Korea presently and by drones as a new means of delivery, and they proved a reduction in pollution. Doole, Ellerbroek, and Hoekstra (2018) presented the cost range of delivery by drones is twice as low as the electric bike delivery cost range from an experiment of involving a fast-food delivery scenario in Paris. More recently, Hwang, Kim, and Kim (2019b) asserted that drones contribute to the foodservice industry by minimizing environmental damage compared to the current methods of food delivery services that are based on gasoline powered vehicles. Hwang and Kim (2019) explained the significant role of drone food delivery in protecting the environment based on its operations compared to the ones of traditional delivery modes. In summary, as various existing studies have proved the positive effect of drone-based delivery services on the environment, its eco-friendly role is expected to become more important in the foodservice industry.

2.2. Norm activation model (NAM)

The NAM, which was introduced by Schwartz (1977) in the context of altruistic behavior, was designed to examine individuals' eco-friendly behavioral intentions (Han, 2014; Onwezen, Antonides, & Bartels, 2013). The NAM is a sequential model where problem awareness affects a personal norm that directly influences pro-social behavior via ascription of responsibility (i.e. problem awareness → ascribed

responsibility → personal norm → behavioral intentions). In this theory, norm activation begins with an individual's awareness of conceivably detrimental consequences and that trigger his/her feelings of responsibility for the negative consequences of not acting pro-socially (Schwartz, 1977). This activates a personal norm, which indicates moral obligation to perform or refrain from specific behaviors (Schwartz & Howard, 1981, pp. 189–211) that determines whether he/she should perform a particular behavior that prevents a harmful outcome (Cordano, Welcomer, Scherer, Pradenas, & Parada, 2011). An alternative interpretation of the NAM was developed by including a direct link from problem awareness to personal norm and excluding the path from problem awareness to ascribed responsibility. However the adequacy and higher predicting power of interpreting the NAM as a sequential model is empirically identified in green research (De Groot & Steg, 2009; Han, Hwang, Kim, & Jung, 2015; Steg & De Groot, 2010).

Many existing studies have supported the NAM to be helpful in understanding the eco-friendly behavioral intentions in the hospitality and tourism industry (Han, 2014; Han et al., 2015, 2019; Qiao & Gao, 2017; Vaske, Jacobs, & Espinosa, 2015). Han (2014) asserted the prominent role on causal relationships among variables established with the NAM incorporation of other key dimensions, such as the emotional process to explain the pro-environmental aspects of convention travelers' behavioral intentions. Han et al. (2015) broaden the norm activation framework in a lodging context in explicating hotel guests' post-purchase decision-making process in an environmentally responsible manner. Qiao and Gao (2017) examined the impact of Chinese tourists' behaviors based on the NAM and found tourists' perceptions of climate change and perceived contribution of tourism to climate change both positively affect energy saving and carbon reduction behaviors in tourism. This study developed the following hypotheses, which are consistent with these arguments.

H1. Problem awareness positively affects ascribed responsibility.

H2. Ascribed responsibility positively affects personal norm.

H3. Personal norm positively affects behavioral intentions.

2.3. Theory of planned behavior (TPB)

The TPB is an extension of the theory of reasoned action (TRA) (Ajzen, 1991). The premise of TRA is that behavioral intentions, which ultimately result in actual behaviors, are completely under volitional control, which is composed of attitudes toward the behavior and social norm (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Attitudes refer to a person's overall evaluation of performing a certain behavior and subjective norm represents one's own perception of how significant social pressure expects them to act regarding the behavior (De Groot & Steg, 2007). However, behavioral intentions are not always under individuals' total volitional control, so Ajzen (1991) developed the TPB, which incorporates perceived behavioral control into TRA. Perceived behavioral control indicates an individual's perception regarding his/her ability and capability to engage in a specific activity (Ajzen & Fishbein, 2000; Wu, Tsai, & Lee, 2017). In order words, it reflects beliefs regarding the access to resources, such as money, time, and other resources, and opportunities needed to perform a behavior which is the focal person's self-confidence in his/her ability to conduct the behavior. De Groot & Steg, 2007 supported the notion of the TPB that personal determinants and social surroundings, which included non-volitional determinants, are significant predictors of eco-friendly behavioral intentions.

Many previous studies have provided the evidence to support the TPB from a view of eco-friendly behavioral intentions in the domain of hospitality and tourism (Han, Meng, & Kim, 2017; Kim et al., 2013; Paul et al., 2016; Verma & Chandra, 2018). For instance, the TPB was successfully employed to investigate the process of travelers' decision making for bicycle touring as a form of sustainable tourism activity

(Han et al., 2017). Kim et al. (2013) explored the emotion-related theoretical framework based on the TPB to examine the relationship between the variables and explain consumers' behavioral intentions to select eco-friendly restaurants. Verma and Chandra (2018) built an extended social-psychological model by incorporating the original variables rooted in the TPB, and they found the attitudes rank high in merit for predicting young Indian consumers' intentions to visit green hotels. Integrating the theoretical and empirical backgrounds, the following hypotheses were therefore proposed.

H4. Attitudes positively affect behavioral intentions.

H5. Subjective norm positively affects behavioral intentions.

H6. Perceived behavioral control positively affects behavioral intentions.

2.4. Merging the NAM and the TPB

The employment of the NAM stemming from pro-social motives and the TPB based on self-interest motives is abundant in the eco-friendly hospitality and tourism context, and the adequacy has been repeatedly asserted by many researchers. Nevertheless, the sufficiency and effectiveness of each individual theory are disputable in explaining eco-friendly behavioral intentions (Bamberg & Möser, 2007; Han & Hyun, 2017). For this reason, many studies have improved the accountability of the norm activation framework by integrating volitional and non-volitional processes (Bamberg et al., 2007; Han, 2014), while numerous researchers broadened the TPB by incorporating vital variables in pro-social behavior (Bamberg & Möser, 2007; Meng & Choi, 2016). Accordingly, more comprehensive research is emerging through combining the NAM and the TPB to illustrate more in-depth insights in eco-friendly behavioral intentions (Han et al., 2019; Han & Hyun, 2017; Onwezen et al., 2013; Park & Ha, 2014). Park and Ha (2014) presented that personal norms from the NAM in conjunction with attitudes and perceived behavioral control from the TPB influence the eco-friendly behavioral intentions of U.S. consumers. In addition, they verified other key variables of the NAM and the TPB that were examined and indirectly associated with eco-friendly behavioral intentions. Han and Hyun (2017) revealed the prediction power of an integrated model, which merged the NAM and the TPB, is superior to that of an individual theory to explicate museum travelers' eco-friendly behavioral intentions.

This present study proposes dynamics among four variables, which are problem awareness and attitudes as well as subjective norm and personal norm through merging the NAM and the TPB. First, the significant and positive association between problem awareness and attitudes has been verified by a lot of existing literature. Meng and Choi (2016) demonstrated the fundamental role of the awareness level of the environmental problems to explicate tourists' environmental behavior. Han and Hyun (2017) asserted that guests who are highly aware of the seriousness of environmental problems are likely to have positive attitudes toward environmentally responsible behavior. In accordance with these findings, in the case of food delivery services, when people get to know the environmental damages of current delivery methods such as motorcycles or cars, they would tend to have favorable attitudes toward pro-environmental delivery mode, such as drone-based services. Based on these discussions, the following hypothesis was therefore proposed.

H7. Problem awareness positively affects attitudes.

Second, the causal link between subjective norm and personal norm has been supported by a lot of research. Subjective norm precedes personal norm because subjective norm, which validates whether or not a specific behavior is socially right, guides a person to determine his/her belief as to whether the behavior is right for him/herself (Bamberg et al., 2007; Byun & Jang, 2019; Onwezen et al., 2013). For example, Park and Ha (2014) asserted that a person's perception about performing recycling is socially desirable, and it will guide his/her

judgment if he/she feels obliged to recycle. Han et al. (2019) identified the salient role of social norm, which is an alternative term of subjective norm, and personal norm to explain passengers' decision making process for environmentally responsible cruise products and verified the positive causal relationship between social norm and personal norm. On the basis of these theoretical and empirical backgrounds, it is reasonable to expect that the social pressure related to environmentally friendly behavior in the food delivery services would influence individuals' moral obligation to perform pro-environmental behavior (i.e. drone food delivery services). Accordingly, this study posited the positive impact of subjective norm on personal norm.

H8. Subjective norm positively affects personal norm.

2.5. The moderating role of product knowledge

Knowing a person or an object leads to increased knowledge structure, which affects consumer information processing activities in several ways (Verain, Dagevos, & Antonides, 2015). According to Rao and Sieben (1992, p. 258), product knowledge refers to "the amount of accurate information held in memory as well as self-perceptions of product knowledge" and consumers' product knowledge has been recognized as a characteristic that influences all phases in the decision process (Bettman & Park, 1980). Product knowledge in our study was therefore defined as the degree of individual knowledge about the pro-environmental role of drone food delivery services. Consumers with various levels of product knowledge differ with their perceptions of a product and weigh the criteria differently with product evaluation (Alba & Hutchinson, 1987; Laroche, Vinhal Nepomuceno, & Richard, 2010). That is, consumers with high product knowledge are more likely to process information analytically by applying decision criteria that should be readily available from memory (Bettman & Park, 1980). On the other hand, consumers who possess low product knowledge have less confidence in the ability to carry out the consumption behavior and are likely to rely on heuristic cues (Chiou, 1998). Hence, the difference between high and low level individuals with respect to the amount of product knowledge results in different outcomes, such as product judgments and behavioral intentions (Chiou, 1998; Hwang & Lee, 2018; Lee & Lee, 2011; Moreau, Lehmann, & Markman, 2001).

In this regard, the concept of product knowledge has been broadly studied to explain consumer behavior. In particular, the moderating role of product knowledge has been identified in the relationships between cognitive evaluation and behavioral intentions or attitudinal path toward behavior (Benyamin, Djuwita, & Ariyanto, 2018; Chang, 2004; Chen & Deng, 2016; Chiou, 1998). Furthermore, consumers' product knowledge has been considered as one of the major factors in regard to the evaluation and adoption of a new product (Fu & Elliott, 2013; Moreau et al., 2001). For example, Berger, Ratchford, and Haines (1994) asserted that attitudes on purchase intention for a durable product are strong when consumption is perceived to be based on more product knowledge. Chiou (1998) investigated the relative influence of constructs rooted in the TPB on purchase intention according to the different levels of product knowledge and verified the moderating impact of product knowledge among variables, such as attitudes, subjective norm, and perceived behavioral control, on intention. Barr (2003) examined the association between psychological variables and eco-friendly behavioral intentions in comparison with various waste management behaviors and demonstrated that greater knowledge enhanced individuals' ability to participate pro-environmental behavior. Chang (2004) suggested the contrasting attitudes formation, the degree of likelihood, and consumers' high versus low product knowledge with the expectation and disconfirmation process. Josiassen, Lukas, and Whitwell (2008) found that the importance given to the image of the product's country of origin is moderated by the level of knowledge that consumers have about the products. Huijts, Molin, and Steg (2012) reviewed psychological factors in building a person's sustainable energy technology acceptance based on theories and extant empirical studies.

Their results posited that knowledge can change individuals' opinions and could affect their willingness to use through their belief. Fu and Elliott (2013) asserted that product knowledge directly influences on consumers' intentions to purchase a consumer technology product and also moderates the effects of attitudes and subjective norm on their purchase intention. Nordlund, Jansson, and Westin (2016) collected data from 1192 car owners to study the adoption of new transportation technology through norm activation processes. They explained the importance of personal norms and argued that greater knowledge is required when it comes to an individual's behavioral intention. Zuo et al. (2017) interviewed 24 individuals to identify factors moderating personal norms in the field of dust pollution control and they articulated the role of knowledge in association with environmentally friendly behavior. Benyamin et al. (2018) explained that product knowledge itself doesn't make consumers feel obligated to behave in an eco-friendly way, however the impact of adverse consequence on personal norms is stronger when individuals possess enough environmental knowledge. Hwang and Lee (2018) identified product knowledge as a significant moderator in making positive behavioral intentions in senior tourism. Consistent with these arguments, product knowledge about a drone with a sustainable competitive advantage would be associated with the key dimensions of the NAM and the TPB to explain environmental behavioral intentions.

H9a. Product knowledge moderates the relationship between problem awareness and ascribed responsibility.

H9b. Product knowledge moderates the relationship between ascribed responsibility and personal norm.

H9c. Product knowledge moderates the relationship between personal norm and behavioral intentions.

H9d. Product knowledge moderates the relationship between subjective norm and behavioral intentions.

H9e. Product knowledge moderates the relationship between subjective norm and behavioral intentions.

H9f. Product knowledge moderates the relationship between perceived behavioral control and behavioral intentions.

H9g. Product knowledge moderates the relationship between problem awareness and attitudes.

H9h. Product knowledge moderates the relationship between subjective norm and personal norm.

2.6. Proposed conceptual model

The proposed conceptual model is displayed in Fig. 1. The original NAM is comprised in the box of dotted line, which includes problem awareness, ascribed responsibility, personal norm, and behavioral intentions, and the TPB model is presented in the box of solid line, which includes attitudes, subjective norm, perceived behavioral control, and behavioral intentions. The paths from problem awareness to attitudes and from subjective norm to personal norm are incorporated by merging two theories. In addition to applying the notion of the NAM and the TPB, this study predicted that consumers' product knowledge about the pro-environmental role of drone food delivery services moderates the casual relationships among the key variables and behavioral intentions. Consequently, the proposed conceptual model involves a total eight latent constructs with 16 hypotheses.

3. Methods

3.1. Measures

Measurement items for the constructs of the NAM, which include problem awareness, ascribed responsibility, personal norm, and
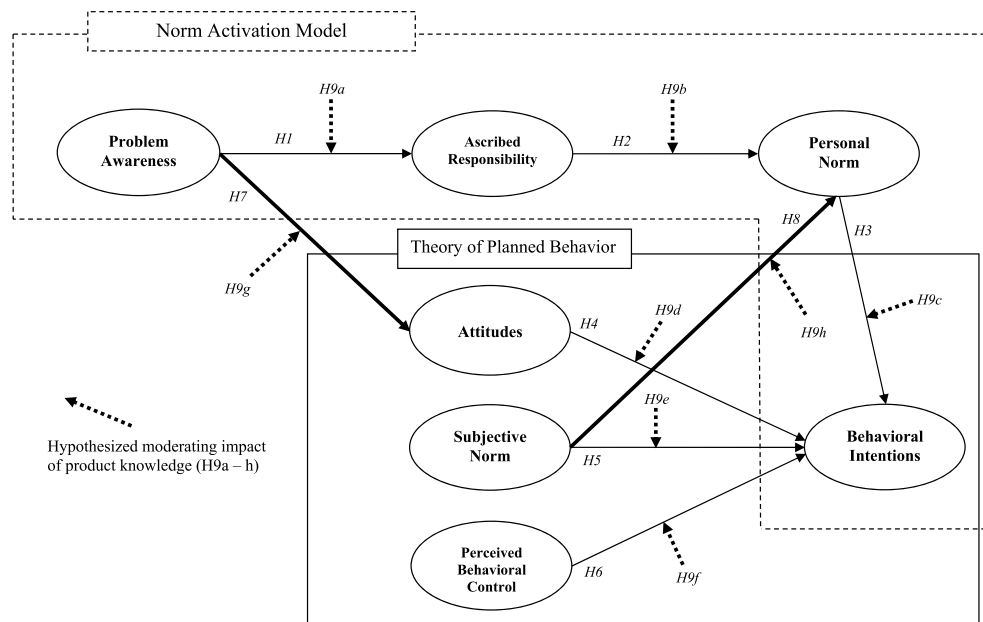
Fig. 1. Proposed conceptual model.

Note: The moderating role of product knowledge as incorporated into norm activation model (NAM) and theory of planned behavior (TPB).

behavioral intentions, were cited from existing studies. More specifically, problem awareness was measured with three items adapted from De Groot and Steg (2009) and Han (2014). In addition, ascribed responsibility was measured with three items used by Han and Hwang (2016) and Schwartz (1977). Personal norm was measured with three items borrowed from De Groot and Steg (2009) and Han and Hyun (2017). The measurement items for the constructs of the TPB, such as attitudes, subjective norm, perceived behavioral control, and behavioral intentions, were borrowed from prior research. Specifically, three items regarding attitude were cited from Ajzen (1991), Han et al., (2015), and Hwang et al. (2019a). Three items about subjective norm were used from Ajzen (1991) and Paul et al. (2016). Three items on perceived behavioral control were adapted from Ajzen (1991) and Han and Hyun (2017). Lastly, three items regarding behavioral intentions use were cited from Ajzen (1991) and Han and Hyun (2017). In addition, product knowledge was measured with three items used by Chang (2004) and Hwang and Lee (2018) (i.e. "I feel quite knowledgeable about the eco-friendly role of drone food delivery services," "When compared to other people, I know a lot about the eco-friendly role of drone food delivery services," and "I know pretty much about the eco-friendly role of drone food delivery services").

All measurement items for the eight constructs were modified to fit the context of drone food delivery services. This study employed a seven-point Likert scale (i.e. 1 = strongly disagree and 7 = strongly agree) in order to measure all constructs except for attitudes. In terms of the attitudes, three bipolar semantic-differential scales were employed (e.g. "Negative" [1]–"Positive" [7]). The questionnaire was developed based on the above measurement items. In addition, the first version of the questionnaire was in English, but the questionnaire was translated from English into Korean using the blind translation-back-translation method for the data collection. In order to verify the reliability of the measurement items, this study conducted a pre-test survey based on 50 actual restaurant patrons using online surveys, one of the convenience sampling techniques, in Seoul, Korea. To clearly explain the eco-friendly role of the drones, a newspaper article based on Stolaroff et al.'s paper (2018) was presented to the respondents before the survey. The result of data analysis showed high levels of reliability, because the values of Cronbach's α for all constructs were higher than 0.70 (Nunnally, 1978).

3.2. Data collection

The main data collection proceeded similar to the pre-test survey. The survey was distributed to foodservice customers who recently used food delivery services within six months using an online company system in Seoul, Korea. Similar to the pretest, the respondents were given a newspaper article before the survey to improve their understanding of the eco-friendly role of the drones. The questionnaire was distributed to 4525 panel members, and 442 answered the questionnaire. Of the 442 respondents, 41 respondents were deleted because of multicollinearity problems and visual inspections. As a result, 401 respondents were used for analyses.

4. Data analysis

4.1. Descriptive statistics

Table 1 provides the demographic characteristics of the samples. Among the samples, a total of 197 samples were males (49.1%), and 204 samples were females (50.9%). In addition, their mean age was 38.05 years old. In terms of monthly household income, 27.9% of the samples showed that their household income ranged from US$2001 to US$3000. About half of the samples were married (50.4%, $n = 202$). Lastly, most of the samples showed that they held a bachelor's degree (63.6%, $n = 255$).

4.2. Confirmatory factor analysis

The confirmatory factor analysis (hereafter CFA) was conducted in order to evaluate the measurement structure of the proposed conceptual model using the AMOS (Analysis of Moment Structures) program. The CFA model showed a satisfactory fit to the data (Goodness-of-fit statistics: $\chi^2 = 383.075$, df = 168, χ^2/df = 2.280, $p < .001$, NFI = 0.963, IFI = 0.979, CFI = 0.979, TLI = 0.973, and RMSEA = 0.057). All factor loadings fell within the range between 0.763 and 0.972, and they were significantly loaded to their related latent construct at $p < .001$. The specific variables employed in this study and their standardized factor loadings are shown in Table 2. In addition, the values of Cronbach's α for all constructs were greater than 0.70 (Nunnally, 1978). Lastly, the composite reliability values ranged from 0.878 to 0.972, which indicated a

Table 1
Profile of survey respondents (n = 401).

Variable	n	Percentage
Gender		
Male	197	49.1
Female	204	50.9
Monthly household income		
US$6001 and over	22	5.5
US$5001-US$6000	14	3.5
US$4001-US$5000	38	9.5
US$3001-US$4000	50	12.5
US$2001-US$3000	112	27.9
US$1001-US$2000	108	26.9
Under US$1000	57	14.2
Marital status		
Single	202	50.4
Married	195	48.6
Widowed/Divorced	4	1.0
Education level		
Less than high school diploma	46	11.5
Associate's degree	64	16.0
Bachelor's degree	255	63.6
Graduate degree	36	9.0
Mean age = 38.05 years old		

high level of internal consistency for each construct, because they were higher than the suggested cutoff of 0.50 (Bagozzi & Yi, 1988).

As presented in Table 3, all values of average variance-extracted (hereafter AVE) were greater than the suggested cutoff of 0.500 (Hair, Black, Babin, Anderson, & Tatham, 2006), which suggested that the convergent validity of all constructs was statistically supported. Lastly, the values of AVE for each variable exceeded all of the squared correlations (R^2) between all the possible pairs of constructs, which indicated a high level of discriminant validity (Fornell & Larcker, 1981).

4.3. Structural equation modeling

A structural equation modeling (SEM) was performed to test hypotheses 1 through 8 in the proposed model. The overall evaluation of the model fit showed a suitable fit of the model to the data (Goodness-of-fit statistics: $\chi^2 = 812.158$, df = 181, χ^2/df = 4.487, $p < .001$, NFI = 0.916, CFI = 0.932, TLI = 0.922, and RMSEA = 0.094). All eight proposed hypotheses were statistically supported at $p < .05$.

More specifically, Hypothesis 1, which proposed the effect of problem awareness on ascribed responsibility, was statistically supported ($\beta = 0.560, p < .05$). In addition, ascribed responsibility had a positive influence on personal norm ($\beta = 0.248, p < .05$), so Hypothesis 2 was supported. The data analysis results showed that personal norm aided to enhance behavioral intentions ($\beta = 0.619, p < .05$), which supported Hypothesis 3. With regard to the TPB model, attitudes ($\beta = 0.368, p < .05$), subjective norm ($\beta = 0.119, p < .05$), and perceived behavioral control ($\beta = 0.242, p < .05$) were found to be significantly associated with behavioral intentions. Thus, Hypotheses 4, 5, and 6 were supported. As hypothesized, problem awareness had a positive effect on attitudes ($\beta = 0.419, p < .05$). Hence, Hypothesis 7 was supported. Lastly, the result revealed that personal norm was affected by subjective norm ($\beta = 0.657, p < .05$), which supported Hypothesis 8. The results of the SEM are shown in Table 4.

4.4. Moderating role of product knowledge

A multiple analysis with the AMOS program was employed to test the moderating role of product knowledge through the comparison of the chi-square difference between the unconstrained and constrained models according to the difference in the degrees of freedom (Byrne, 2001).

First, the results of the multiple-group analysis revealed that

Table 2
Confirmatory factor analysis: Items and loadings.

Construct and scale item	Standardized loading[a]
Problem awareness (Cronbach's alpha = .960, Composite reliability = .962)	
Current delivery methods (e.g. motorcycle or car) can cause air pollution.	.932
Current delivery methods (e.g. motorcycle or car) can potentially have a negative impact on global warming.	.964
Current delivery methods (e.g. motorcycle or car) can lead environmental pollution.	.941
Ascribed responsibility (Cronbach's alpha = .949, Composite reliability = .948)	
I believe that consumers are partly responsible for environmental problems potentially caused by current delivery methods (e.g. motorcycle or car).	.924
I feel that consumers are jointly responsible for the environmental deterioration potentially caused by current delivery methods (e.g. motorcycle or car).	.947
I believe that every consumer is partly responsible for the environmental problems caused by current delivery methods (e.g. motorcycle or car).	.909
Personal norm (Cronbach's alpha = .944, Composite reliability = .946)	
I feel an obligation to choose an environmentally friendly way, such as drone food delivery services when ordering food.	.913
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.	.925
I feel it is important that consumers behave in a sustainable way when ordering food.	.934
Attitudes (Cronbach's alpha = .922, Composite reliability = .926)	
Using an environmentally friendly way, such as drone food delivery services when ordering food is more likely to be …	
Unfavorable – Favorable	.863
Bad – Good	.894
Negative – Positive	.935
Subjective norm (Cronbach's alpha = .970, Composite reliability = .972)	
Most people who are important to me think I should use an environmentally friendly way, such as drone food delivery services when ordering food.	.951
Most people who are important to me would want me to use an environmentally friendly way, such as drone food delivery services when ordering food.	.972
People whose opinions I value would prefer that I use an environmentally friendly way, such as drone food delivery services when ordering food.	.957
Perceived behavioral control (Cronbach's alpha = .871, Composite reliability = .878)	
Whether or not I use an environmentally friendly way, such as drone food delivery services when ordering food is completely up to me.	.836
I am confident that if I want, I can use an environmentally friendly way, such as drone food delivery services when ordering food.	.915
I have resources, time, and opportunities to use an environmentally friendly way, such as drone food delivery services when ordering food.	.763
Behavioral intentions (Cronbach's alpha = .962, Composite reliability = .960)	
I will use drone food delivery services when ordering food.	.943
I am willing to use drone food delivery services when ordering food.	.941
I am likely to use drone food delivery services when ordering food.	.946
Goodness-of-fit statistics: $\chi^2 = 383.075$, df = 168, χ^2/df = 2.280, $p < .001$, NFI = .963, IFI = .979, CFI = .979, TLI = .973, RMSEA = .057	

Notes 1.
Notes 2: NFI = Normed Fit Index, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation.
[a] All factors loadings are significant at $p < .001$.

Table 3
Descriptive statistics and associated measures.

	No. of Items	Mean (SD)	AVE	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Problem awareness	3	5.35 (1.09)	.894		.552[a]	.422	.413	.264	.432	.504
(2) Ascribed responsibility	3	4.77 (1.11)	.859	.305[b]		.447	.427	.358	.421	.455
(3) Personal norm	3	4.21 (1.22)	.854	.178	.200		.775	.705	.486	.765
(4) Attitudes	3	4.82 (1.31)	.806	.171	.182	.601		.626	.482	.781
(5) Subjective norm	3	4.01 (1.23)	.922	.070	.128	.497	.392		.421	.690
(6) Perceived behavioral control	3	4.65 (1.06)	.706	.187	.177	.236	.232	.177		.599
(7) Behavioral intentions	3	4.49 (1.24)	.890	.254	.207	.585	.610	.476	.359	

Notes 1: SD = Standard Deviation, AVE = Average Variance Extracted.
Notes 2: a. Correlations are above the diagonal and b. Squared correlations are below the diagonal.

product knowledge plays an important moderating role in the relationship between ascribed responsibility and personal norm ($\Delta\chi^2 = 4.390 > \chi^2 = 0.5(1) = 3.84$, df = 1), which supported Hypothesis 9b. More specifically, the path coefficient for the high product knowledge group ($\beta = 0.347$) was higher than for the low product knowledge group ($\beta = 0.152$). Second, the moderating role of product knowledge in the relationship between attitudes and behavioral intentions was confirmed ($\Delta\chi^2 = 3.945 > \chi^2 = 0.5(1) = 3.84$, df = 1). This result indicated that the effect of attitudes on behavioral intentions is significantly different across product knowledge levels, which supported Hypothesis 9d. In regard to the high product knowledge group, the path coefficient between attitudes and behavioral intentions was .460 ($p < .05$). On the other hand, for the low product knowledge group, the path coefficient was 0.224 ($p < .05$). Third, the results showed that the moderating role of product knowledge in the relationship between subjective norm and personal norm was supported (H9h) ($\chi^2 = 6.975 > \chi^2 = 0.5(1) = 3.84$, df = 1). The path coefficients for the high product knowledge group ($\beta = 0.717$) was found to be higher than for the low product knowledge group ($\beta = 0.557$).

However, contrary to expectations, Hypotheses 9a ($\Delta\chi^2 = 0.221 < \chi^2 = 0.5(1) = 3.84$, df = 1), 9c ($\Delta\chi^2 = 1.188 < \chi^2 = 0.5(1) = 3.84$, df = 1), 9e ($\Delta\chi^2 = 0.367 < \chi^2 = 0.5(1) = 3.84$, df = 1), 9f ($\Delta\chi^2 = 1.709 < \chi^2 = 0.5(1) = 3.84$, df = 1), and 9g ($\Delta\chi^2 = 1.231 < \chi^2 = 0.5(1) = 3.84$, df = 1) were not statistically supported. Table 5 represents the results of the multiple-group analyses. In addition, Fig. 2 shows the results of all the hypotheses.

5. Discussions and implications

The present study adopted the research model, which merged the NAM and the TPB into one comprehensive theoretical framework, in order to investigate eco-friendly behavioral intentions to use the drone food delivery services. In addition, this study examined the moderating role of product knowledge, because consumer behaviors are significantly affected by the level of product knowledge. The data analyses were conducted based on the 401 samples in Korea. All hypotheses from 1 to 8 within the model that merged the NAM and the TPB were

statistically supported. Moreover, product knowledge played a moderating role in the relationship between (1) ascribed responsibility and personal norm (Hypothesis 9b), (2) attitudes and behavioral intentions (Hypothesis 9d), and (3) subjective norm and personal norm (Hypothesis 9h). That is, the intensity of the casual relationships depends on the level of individuals' knowledge of the pro-environmental role of drone food delivery services. These statistical results have the following important theoretical and practical implications.

5.1. Theoretical implications

First, the pro-environmental role of drone food delivery services has recently been proven through many successful tests, so it is expected that the drone food delivery services help protect the environment (e.g. Park et al., 2018; Stolaroff et al., 2018). However, there has been very little research that specifically examines its pro-environmental role. The results of this study are theoretically valuable due to the fact that the process of forming individuals' eco-friendly behavioral intentions to use drone food deliver services was first described.

Second, this study tried to incorporate two theories, which included the NAM and the TPB, in order to explain the formation of eco-friendly behavioral intentions in the context of drone food delivery services. The enhanced framework integrating pro-social and self-interest factors was applied in identifying the critical determinants of various environmentally related behaviors, such as museum visitors' pro-environmental behavioral intentions, consumption behaviors related to the environment, and consumers' recycling behavior (e.g. Han & Hyun, 2017; Onwezen et al., 2013; Park & Ha, 2014). Hence, incorporating the NAM and the TPB emerged as a holistic approach and has been proven to be more powerful in predicting consumers' behavioral intentions. However, this present research, to the best of our knowledge, is the first study merging the NAM and the TPB in order to explain eco-friendly behavioral intentions in the domain of drone food delivery services with an additional contribution in the light of product knowledge about the pro-environmental role of the drone-based services. Furthermore, the data analysis results indicated the each construct of these two theories are significantly and positively associated

Table 4
Standardized parameter estimates for structural model.

			Standardized Estimate	t-value	Hypothesis
H1 Problem awareness	→	Ascribed responsibility	.560	12.358*	Supported
H2 Ascribed responsibility	→	Personal norm	.248	6.273*	Supported
H3 Personal norm	→	Behavioral intentions	.619	13.035*	Supported
H4 Attitudes	→	Behavioral intentions	.368	10.802*	Supported
H5 Subjective norm	→	Behavioral intentions	.119	2.740*	Supported
H6 Perceived behavioral control	→	Behavioral intentions	.242	7.166*	Supported
H7 Problem awareness	→	Attitude	.419	8.486*	Supported
H8 Subjective norm	→	Personal norm	.657	15.996*	Supported

Goodness-of-fit statistics: $\chi^2 = 812.158$, df = 181, χ^2/df = 4.487, $p < .001$, NFI = .916, CFI = .932, TLI = .922, RMSEA = .094

Notes 1: *$p < .05$.
Notes 2: NFI = Normed Fit Index, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation.

Table 5
Results for the moderating role of product knowledge.

		The low group		The high group		Unconstrained model	Constrained model	$\Delta\chi^2 (1) = 3.84$	Hypothesis
		β	*t*-value	β	*t*-value				
H9a	PA – AR	.456	7.027*	.582	8.436*	$\chi^2 (362) = 1127.277$	$\chi^2 (363) = 1127.498$	$\Delta\chi^2 (1) > .221$	Not supported
H9b	AR – PN	.152	2.979*	.347	5.420*		$\chi^2 (363) = 1131.667$	$\Delta\chi^2 (1) < 4.390$	Supported
H9c	PN–BI	.592	8.410*	.654	9.355*		$\chi^2 (363) = 1128.465$	$\Delta\chi^2 (1) > 1.188$	Not supported
H9d	A – BI	.224	5.162*	.460	9.981*		$\chi^2 (363) = 1131.222$	$\Delta\chi^2 (1) < 3.945$	Supported
H9e	SN–BI	.110	2.012*	.152	2.364*		$\chi^2 (363) = 1127.644$	$\Delta\chi^2 (1) > .367$	Not supported
H9f	PBC–BI	.220	3.965*	.263	5.402*		$\chi^2 (363) = 1128.946$	$\Delta\chi^2 (1) > 1.709$	Not supported
H9g	PA – A	.312	4.133*	.516	7.131*		$\chi^2 (363) = 1128.508$	$\Delta\chi^2 (1) > 1.231$	Not supported
H9h	SN–PN	.557	8.616*	.717	13.405*		$\chi^2 (363) = 1134.252$	$\Delta\chi^2 (1) < 6.975$	Supported

Notes 1: PA = Problem Awareness, AR = Ascribed Responsibility, PN = Personal Norm, A = Attitudes, SN = Subjective Norm, PBC = Perceived Behavioral Control, and BI = Behavioral Intentions.
Notes 2: *$p < .05$.

with individuals' eco-friendly behavioral intentions. In other words, consumers' behavioral intentions are better predicted by moral obligation in conjunction with personal determinants and social surroundings. Thus, the present study provides empirical evidence that considering such views simultaneously, and it better explains the individuals' eco-friendly behavioral intentions in the context of drone food delivery services. Moreover, the salient role of personal norm was verified ($\beta = 0.619$, $p < .05$) in consideration of the relative impact of employed variables on behavioral intentions. This result indicated altruism as a critical concept in the context of sustainability, and it is consistent with recent research findings in diverse pro-environmental sectors that emphasized the vital role of moral obligation (e.g. De Groot & Steg, 2009; Han et al., 2015; Qiao & Gao, 2017).

Third, the results of data analysis revealed that the additional paths built by merging the NAM and the TPB were significantly supported. More specifically, problem awareness had a positive effect on attitudes (Hypothesis 7). That is, when people perceive that current delivery methods, such as motorcycles or cars are the main causes of environmental pollution, they are more likely to have a favorable attitude toward using drone food delivery services. In addition, subjective norm played an important role in the formation of personal norm (Hypothesis 8), which suggested that people are more likely to choose an

environmentally friendly method, such as drone food delivery services when others say that it is important to use the services. These results are consistent with previous studies (e.g. Bamberg & Möser, 2007; Meng & Choi, 2016; Onwezen et al., 2013; Park & Ha, 2014). Hence, this study enriched the sustainability of the literature by delivering evidence of these key constructs' relationships in the context of drone food delivery services.

Fourth, this study deepened the theoretical framework by identifying the moderating role of product knowledge about the pro-environmental role of the drone-based food delivery services in the comprehensive model that combined the NAM and the TPB. As previously explained, the results of the multiple-group analysis showed that product knowledge played an important moderating role in the relationship between (1) ascribed responsibility and personal norm (Hypothesis 9b), (2) attitudes and behavioral intentions (Hypothesis 9d), and (3) subjective norm and personal norm (Hypothesis 9h). In particular, the high product knowledge group showed greater beta values than the low product knowledge group in all the relationships. It can be interpreted that when customers know a lot about the eco-friendly role of drone food delivery services, they are more likely to have moral obligations and show eco-friendly behavioral intentions. The results of this study are similar to previous studies (Chiou, 1998;
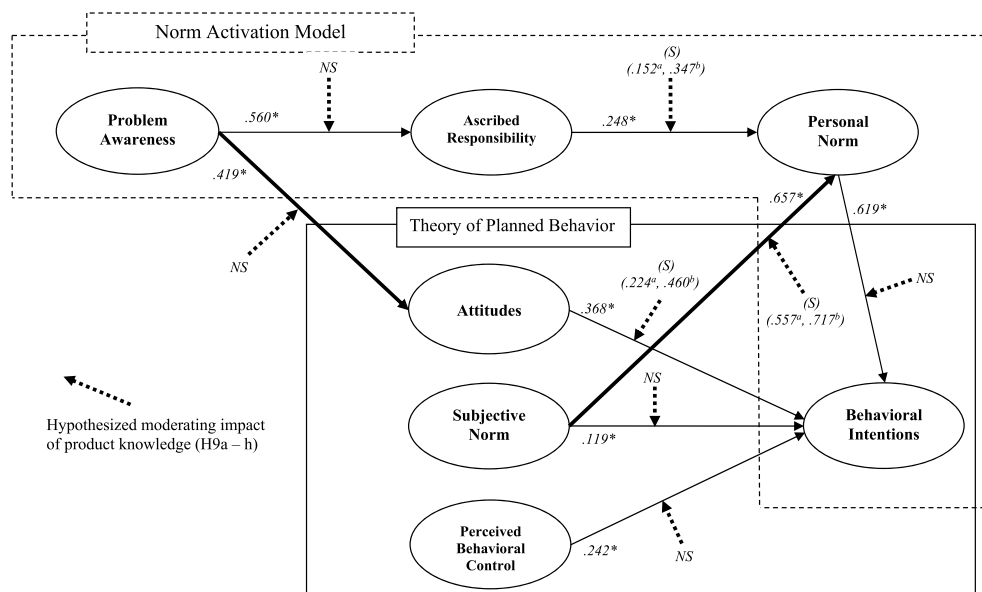

Fig. 2. Standardized theoretical path coefficients.
Notes 1: *$p < .05$
Notes 2: S = significant; NS = not significant
Notes 3: a. path coefficient for the low product knowledge group, b. path coefficient for the high product knowledge group.

Lee & Lee, 2011). In this regard, this study confirmed and further extended the existing literature by empirically finding the moderating role of product knowledge in the context of drone food delivery services for the first time.

5.2. Managerial implications

First, the data analysis results indicated the variables stemming from the NAM are significantly and positively associated with individuals' environmentally responsible behavioral intentions. In other words, moral obligation plays an essential role in triggering eco-friendly behavioral intentions in the context of drone food delivery services. Therefore, foodservice companies should promote green advertisements to enlighten consumers about the environmental role of drone food delivery services to foster their moral obligation. For example, it is recommended to provide the results of pilot programs that demonstrate the important environmental role of drone-food delivery services through pop-up messages or info graphics for mobile users. In particular, recent studies have shown that green advertisements are the driving force behind increasing public awareness of environmental issues and inducing consumers' pro-environmental attitudes (Hartmann & Apaolaza-Ibanez, 2010; Karna, Juslin, Ahonen, & Hansen, 2001; Muralidharan, La Ferle, & Sung, 2017). Thus, green advertisements would be an effective way to stimulate the moral obligation of consumers when using food delivery services. Moreover, because the data analysis results supported the sequential process of problem awareness and ascribed responsibility in forming personal norm, these types of advertisements are recommended to convey messages not only to propagandize moral but also impress the negative consequences of current food delivery practices with environmental and consumers' responsibility to minimize pollution. By doing so, drone-based food delivery services would be highly recognized as an alternative delivery mode which is developing sustainability.

Second, this study revealed that subjective norm is a critical construct in building eco-friendly behavioral intentions in food delivery services. This can be interpreted that consumers are strongly influenced by the recommendations of friends and family in green activities. Therefore, once the drone-based food delivery services are fully commercialized, foodservice companies should focus more on word-of-mouth, which is known as voluntary advertising. For instance, incentive programs can be utilized by offering value added credits through coupons or discounts to the individuals who promote drone food delivery services on user-generated content (UGC) or social networking service (SNS). These initiatives would provide more opportunities for positive interactions in online communities based on consumer-to-consumer networks. In addition, experts and influencers' endorsements are suggested in order to create social pressure on a person to consume food delivery service in pro-environmental way. These types of efforts would contribute to create an atmosphere that induces consumers' motivation and engagement with eco-friendly behavior in food delivery services.

Lastly, the moderating role of product knowledge was identified in the relationships between ascribed responsibility and personal norm, attitudes and behavioral intentions, and subjective norm and personal norm. These results can be interpreted that the high product knowledge group is more likely to show moral obligation and eco-friendly behavioral intentions than the low product knowledge group in the context of drone food delivery services. Therefore, foodservice companies need customer segmentation according to the level of product knowledge. The concept of customer segmentation refers to "dividing a market into distinct groups who might require separate products and/or marketing mixes" (Kotler, Bowen, & Makens, 2005, p. 262). In addition, it is widely accepted that customer segmentation is a helpful marketing strategy that enhances advertising effectiveness (Wu & Lin, 2005). For instance, it is necessary for foodservice companies to gather customer information on consumers' product knowledge via a survey. Then, the companies can classify their consumers into two groups according to

the level of product knowledge. Given the fact that the level of moral obligation and eco-friendly behavioral intentions to use drone food delivery services is greater for the high product knowledge group, foodservice companies should devote their resources strategically to focus more on this group. For instance, it would maximize marketing effectiveness if foodservice companies sent out promotional materials that emphasize the environmental important role of drone food delivery services for the high product knowledge group.

6. Limitations and future research

Although the present research provides insightful implications based on empirical findings, the following limitations are in need of careful consideration for future studies. First, the survey of this study was conducted only with residents in Korea. A cross-cultural test is essential to improve the validity of the model regarding environmental behavioral intentions (Milfont, Duckitt, & Wagner, 2010), and therefore additional research is necessary to determine whether the study results can be generalized to different areas. Second, this study focused on drone food delivery services, so it is somewhat difficult to apply the results of this study to other industries. Third, despite the wide use of online survey methodology based on the convenience sampling, several disadvantages, which included issues related to sampling frames and participant deception, were raised (Wright, 2005). For this reason, future research needs to use different types of data collection methods, such as a field survey in order to reduce biases. Lastly, the use of drones as a food delivery tool has not been totally commercialized in Korea, so it is recommended to collect data from consumers who have actually experienced drone food delivery services for future research.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jhtm.2019.11.002.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.
Ajzen, I., & Fishbein, M. (1980). *Understanding attitude and predicting social behavior.* Englewood Cliffs, NJ: Prentice-Hall.
Ajzen, I., & Fishbein, M. (2000). Attitudes and the attitude-behavior relation: Reasoned and automatic processes. *European Review of Social Psychology, 11*(1), 1–33.
Alba, J. W., & Hutchinson, J. W. (1987). Dimensions of consumer expertise. *Journal of Consumer Research, 13*(4), 411–454.
Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science, 16*(1), 74–94.
Bamberg, S., Hunecke, M., & Blöbaum, A. (2007). Social context, personal norms and the use of public transportation: Two field studies. *Journal of Environmental Psychology, 27*(3), 190–203.
Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27*(1), 14–25.
Bamburry, D. (2015). Drones: Designed for product delivery. *Design Management Review, 26*(1), 40–48.
Barr, S. (2003). Strategies for sustainability: Citizens and responsible environmental behaviour. *Area, 35*(3), 227–240.
BBC (2018). Takeaways to be delivered by drone in Shanghai. Retrieved March 11, 2019, from https://www.bbc.com/news/technology-44315984 .
Benyamin, A., Djuwita, R., & Ariyanto, A. A. (2018). Norm activation theory in the plastic age: Explaining children's pro-environmental behaviour. *E3S Web of conferences. Vol. 74. E3S Web of conferences* (pp. 08008–). . https://doi.org/10.1051/e3sconf/20187408008 EDP Sciences.
Berenguer, J. (2010). The effect of empathy in environmental moral reasoning. *Environment and Behavior, 42*(1), 110–134.
Berger, I. E., Ratchford, B. T., & Haines, G. H., Jr. (1994). Subjective product knowledge as a moderator of the relationship between attitudes and purchase intentions for a durable product. *Journal of Economic Psychology, 15*(2), 301–314.
Bettman, J. R., & Park, C. W. (1980). Effects of prior knowledge and experience and phase of the choice process on consumer decision processes: A protocol analysis. *Journal of Consumer Research, 7*(3), 234–248.
Byrne, B. M. (2001). *Structural equation modeling with AMOS.* Mahwah, NJ: Lawrence Erlbaum Associates.
Byun, J., & Jang, S. (2019). Can signaling impact customer satisfaction and behavioral

intentions in times of service failure?: Evidence from open versus closed kitchen restaurants. *Journal of Hospitality Marketing & Management,* 1–22.

Carlsson, J. G., & Song, S. (2017). Coordinated logistics with a truck and a drone. *Management Science, 64*(9), 4052–4069.

Chang, C. (2004). The interplay of product class knowledge and trial experience in attitude formation. *Journal of Advertising, 33*(1), 83–92.

Chen, K., & Deng, T. (2016). Research on the green purchase intentions from the perspective of product knowledge. *Sustainability, 8*(9), 943.

Chiou, J. S. (1998). The effects of attitude, subjective norm, and perceived behavioral control on consumers' purchase intentions: The moderating effects of product knowledge and attention to social comparison information. *Proceedings of the National Science Council, Republic of China, Part C, 9*(2), 298–308.

CNN Money (2013). Domino's tests drone pizza delivery. Retrieved March 11, 2019, from https://money.cnn.com/2013/06/04/technology/innovation/dominos-pizza-drone/ .

Cordano, M., Welcomer, S., Scherer, R. F., Pradenas, L., & Parada, V. (2011). A cross-cultural assessment of three theories of pro-environmental behavior: A comparison between business students of Chile and the United States. *Environment and Behavior, 43*(5), 634–657.

De Groot, J. I., & Steg, L. (2009). Morality and prosocial behavior: The role of awareness, responsibility, and norms in the norm activation model. *The Journal of Social Psychology, 149*(4), 425–449.

De Groot, J., & Steg, L. (2007). General beliefs and the theory of planned behavior: The role of environmental concerns in the TPB. *Journal of Applied Social Psychology, 37*(8), 1817–1836.

Doole, M., Ellerbroek, J., & Hoekstra, J. (2018). Drone Delivery: Urban airspace traffic density estimation. *8th SESAR innovation days, Salzburg, Austria*.

Environmental Technology (2018). How does drone delivery impact the environment? Retrieved March 11, 2019, from https://www.envirotech-online.com/news/environmental-laboratory/7/breaking-news/how-does-drone-delivery-impact-the-environment/46595.

Figliozzi, M. A. (2017). Lifecycle modeling and assessment of unmanned aerial vehicles (drones) CO2 e emissions. *Transportation Research Part D: Transport and Environment, 57*, 251–261.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior.* Reading, MA: Addison-Wesley.

Forbes (2018). Uber plans to launch food-delivery drones. Retrieved March 11, 2019, from https://www.forbes.com/sites/lanabandoim/2018/10/23/uber-plans-to-launch-food-delivery-drones/#7e79fd7ce147 .

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50.

Fu, F. Q., & Elliott, M. T. (2013). The moderating effect of perceived product innovativeness and product knowledge on new product adoption: An integrated model. *Journal of Marketing Theory and Practice, 21*(3), 257–272.

Gharehgozli, A., Iakovou, E., Chang, Y., & Swaney, R. (2017). Trends in global E-food supply chain and implications for transport: literature review and research directions. *Research in transportation business & management, 25*, 2–14.

Goodchild, A., & Toy, J. (2018). Delivery by drone: An evaluation of unmanned aerial vehicle technology in reducing CO2 emissions in the delivery service industry. *Transportation Research Part D: Transport and Environment, 61*, 58–67.

Gracia, A., & de-Magistris, T. (2007). Organic food product purchase behaviour: A pilot study for urban consumers in the South of Italy. *Spanish Journal of Agricultural Research, 5*(4), 439–451.

Groening, C., Sarkis, J., & Zhu, Q. (2018). Green marketing consumer-level theory review: A compendium of applied theories and further research directions. *Journal of Cleaner Production, 172*, 1848–1866.

Haidari, L. A., Brown, S. T., Ferguson, M., Bancroft, E., Spiker, M., Wilcox, A., ... Lee, B. Y. (2016). The economic and operational value of using drones to transport vaccines. *Vaccine, 34*(34), 4062–4067.

Hair, J. F., Jr., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Upper Saddle River, NJ: Prentice-Hall.

Han, H. (2014). The norm activation model and theory-broadening: Individuals' decision-making on environmentally-responsible convention attendance. *Journal of Environmental Psychology, 40*, 462–471.

Han, H., & Hwang, J. (2016). Cruise travelers' environmentally responsible decision-making: An integrative framework of goal-directed behavior and norm activation process. *International Journal of Hospitality Management, 53*, 94–105.

Han, H., Hwang, J., Kim, J., & Jung, H. (2015). Guests' pro-environmental decision-making process: Broadening the norm activation framework in a lodging context. *International Journal of Hospitality Management, 47*, 96–107.

Han, H., Hwang, J., Lee, M. J., & Kim, J. (2019). Word-of-mouth, buying, and sacrifice intentions for eco-cruises: Exploring the function of norm activation and value-attitude-behavior. *Tourism Management, 70*, 430–443.

Han, H., & Hyun, S. S. (2017). Drivers of customer decision to visit an environmentally responsible museum: Merging the theory of planned behavior and norm activation theory. *Journal of Travel & Tourism Marketing, 34*(9), 1155–1168.

Han, H., Meng, B., & Kim, W. (2017). Emerging bicycle tourism and the theory of planned behavior. *Journal of Sustainable Tourism, 25*(2), 292–309.

Hartmann, P., & Apaolaza-Ibanez, V. (2010). Beyond savanna: An evolutionary and environmental psychology approach to behavioral effects of nature scenery in green advertising. *Journal of Environmental Psychology, 30*(1), 119–128.

Huijts, N. M., Molin, E. J., & Steg, L. (2012). Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. *Renewable and Sustainable Energy Reviews, 16*(1), 525–531.

Hwang, J., Cho, S. B., & Kim, W. (2019a). Consequences of psychological benefits of using eco-friendly services in the context of drone food delivery services. *Journal of Travel & Tourism Marketing,* 1–12.

Hwang, J., & Kim, H. (2019). Consequences of a green image of drone food delivery services: The moderating role of gender and age. *Business Strategy and the Environment, 28*(5), 872–884.

Hwang, J., Kim, H., & Kim, W. (2019b). Investigating motivated consumer innovativeness in the context of drone food delivery services. *Journal of Hospitality and Tourism Management, 38*, 102–110.

Hwang, J., & Lee, J. (2018). Relationships among senior tourists' perceptions of tour guides' professional competencies, rapport, satisfaction with the guide service, tour satisfaction, and word of mouth. *Journal of Travel Research.* https://doi.org/10.1177/0047287518803199.

Josiassen, A., Lukas, B. A., & Whitwell, G. J. (2008). Country-of-origin contingencies: Competing perspectives on product familiarity and product involvement. *International Marketing Review, 25*(4), 423–440.

Karna, J., Juslin, H., Ahonen, V., & Hansen, E. (2001). Green advertising: Greenwash or a true reflection of marketing strategies? *Greener Management International, 33*, 59–71.

Kesteloo, H. (2018). The 2018 winter olympics close with another spectacular "shooting star" drone show from Intel, Drone DJ. Retrieved September 11, 2019, from https://dronedj.com/2018/02/25/2018-winter-olympics-shooting-star-intel-drone-show .

Kim, Y. J., Njite, D., & Hancer, M. (2013). Anticipated emotion in consumers' intentions to select eco-friendly restaurants: Augmenting the theory of planned behavior. *International Journal of Hospitality Management, 34*, 255–262.

Koiwanit, J. (2018). Contributions from the drone delivery system in Thailand to environmental pollution. *Journal of Physics, 1026*(1), 12–20.

Kotler, P., Bowen, J. T., & Makens, J. C. (2005). *Marketing for hospitality and tourism* (4th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Laroche, M., Vinhal Nepomuceno, M., & Richard, M. O. (2010). How do involvement and product knowledge affect the relationship between intangibility and perceived risk for brands and product categories? *Journal of Consumer Marketing, 27*(3), 197–210.

Lee, B. K., & Lee, W. N. (2011). The impact of product knowledge on consumer product memory and evaluation in the competitive ad context: The item-specific-relational perspective. *Psychology and Marketing, 28*(4), 360–387.

Meng, B., & Choi, K. (2016). Extending the theory of planned behaviour: Testing the effects of authentic perception and environmental concerns on the slow-tourist decision-making process. *Current Issues in Tourism, 19*(6), 528–544.

Meng, B., & Han, H. (2018). Investigating individuals' decision formation in working-holiday tourism: The role of sensation-seeking and gender. *Journal of Travel & Tourism Marketing, 35*(8), 973–987.

Milfont, T. L., Duckitt, J., & Wagner, C. (2010). A cross-cultural test of the value–attitude–behavior hierarchy. *Journal of Applied Social Psychology, 40*(11), 2791–2813.

Moreau, C. P., Lehmann, D. R., & Markman, A. B. (2001). Entrenched knowledge structures and consumer response to new products. *Journal of Marketing Research, 38*(1), 14–29.

Muchiri, N., & Kimathi, S. (2016). A review of applications and potential applications of UAV. *In proceedings of sustainable research and innovation conference* (pp. 280–283). .

Muralidharan, S., La Ferle, C., & Sung, Y. (2017). Are we a product of our environment? Assessing culturally congruent green advertising appeals, novelty, and environmental concern in India and the USA. *Asian Journal of Communication, 27*(4), 396–414.

Nex, F., & Remondino, F. (2014). UAV for 3D mapping applications: A review. *Applied Geomatics, 6*(1), 1–15.

Nordlund, A., Jansson, J., & Westin, K. (2016). New transportation technology: Norm activation processes and the intention to switch to an electric/hybrid vehicle. *Transportation Research Procedia, 14*, 2527–2536.

Nunnally, J. C. (1978). *Psychometric theory.* New York, NY: McGraw-Hill.

Onwezen, M. C., Antonides, G., & Bartels, J. (2013). The norm activation model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour. *Journal of Economic Psychology, 39*, 141–153.

Park, J., & Ha, S. (2014). Understanding consumer recycling behavior: Combining the theory of planned behavior and the norm activation model. *Family and Consumer Sciences Research Journal, 42*(3), 278–291.

Park, J., Kim, S., & Suh, K. (2018). A comparative analysis of the environmental benefits of drone-based delivery services in urban and rural Areas. *Sustainability, 10*(3), 888.

Paul, J., Modi, A., & Patel, J. (2016). Predicting green product consumption using theory of planned behavior and reasoned action. *Journal of Retailing and Consumer Services, 29*, 123–134.

Qiao, G., & Gao, J. (2017). Chinese tourists' perceptions of climate change and mitigation behavior: An application of norm activation theory. *Sustainability, 9*(8), 1322.

Rao, A. R., & Sieben, W. A. (1992). The effect of prior knowledge on price acceptability and the type of information examined. *Journal of Consumer Research, 19*(2), 256–270.

Saqib, M., Mahmood, A., Khan, M., & Hashmi, M. (2015). Impact of consumer inertia on purchase intention under the influence of subjective product knowledge. *International Journal of u-and e-Service, Science and Technology, 8*(2), 293–298.

Schwartz, S. H. (1977). Normative influences on altruism. In L. Berkowitz (Vol. Ed.), *Advances in experimental social psychology. Vol. 10. Advances in experimental social psychology* (pp. 221–279). New York, NY: Academic Press Vol.

Schwartz, S. H., & Howard, J. A. (1981). A normative decision-making model of altruism. In J. P. Rushton, & R. M. Sorrentino (Eds.). *Altruism and helping behavior.* Hillsdale, NJ: Lawrence Erlbaum.

Shavarani, S. M., Nejad, M. G., Rismanchian, F., & Izbirak, G. (2018). Application of hierarchical facility location problem for optimization of a drone delivery system: A case study of Amazon prime air in the city of San Francisco. *International Journal of Advanced Manufacturing Technology, 95*(9–12), 3141–3153.

Song, B. D., & Ko, Y. D. (2017). Quantitative approaches for economic use of emerging technology in the tourism industry: Unmanned aerial vehicle systems. *Asia Pacific Journal of Tourism Research, 22*(12), 1207–1220.

Statista (2019). Online food delivery. Retrieved March 11, 2019, from https://www.statista.com/outlook/374/100/online-food-delivery/worldwide.

Steg, L., & De Groot, J. (2010). Explaining prosocial intentions: Testing causal relationships in the norm activation model. *British Journal of Social Psychology, 49*(4), 725–743.

Stolaroff, J. K., Samaras, C., O'Neill, E. R., Lubers, A., Mitchell, A. S., & Ceperley, D. (2018). Energy use and life cycle greenhouse gas emissions of drones for commercial package delivery. *Nature Communications, 9*(1), 409.

The Guardian (2018). Express delivery: Use drones not trucks to cut carbon emissions, experts say. Retrieved March 11, 2019, from https://www.theguardian.com/environment/2018/feb/13/drones-trucks-climate-change-carbon-emissions.

Vaske, J. J., Jacobs, M. H., & Espinosa, T. K. (2015). Carbon footprint mitigation on vacation: A norm activation model. *Journal of Outdoor Recreation and Tourism, 11*, 80–86.

Verain, M. C., Dagevos, H., & Antonides, G. (2015). Sustainable food consumption. Product choice or curtailment? *Appetite, 91*, 375–384.

Verma, V. K., & Chandra, B. (2018). An application of theory of planned behavior to predict young Indian consumers' green hotel visit intention. *Journal of Cleaner Production, 172*, 1152–1162.

Vicente-Molina, M. A., Fernández-Sáinz, A., & Izagirre-Olaizola, J. (2013). Environmental knowledge and other variables affecting pro-environmental behaviour: Comparison of university students from emerging and advanced countries. *Journal of Cleaner Production, 61*, 130–138.

Wall, R., Devine-Wright, P., & Mill, G. A. (2007). Comparing and combining theories to explain proenvironmental intentions: The case of commuting-mode choice. *Environment and Behavior, 39*(6), 731–753.

Wright, K. B. (2005). Researching internet-based populations: Advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. *Journal of Computer-Mediated Communication, 10*(3) JCMC1034.

Wu, J., & Lin, Z. (2005). Research on customer segmentation model by clustering. *Proceedings of the 7th international conference on Electronic commerce* (pp. 316–318). ACM.

Wu, J. M. L., Tsai, H., & Lee, J. S. (2017). Unraveling public support for casino gaming: The case of a casino referendum in Penghu. *Journal of Travel & Tourism Marketing, 34*(3), 398–415.

Zuo, J., Rameezdeen, R., Hagger, M., Zhou, Z., & Ding, Z. (2017). Dust pollution control on construction sites: Awareness and self-responsibility of managers. *Journal of Cleaner Production, 166*, 312–320.

The Times of Israel (2018). Israel's Flytrex set to supply half of Reykjavik with food by drone. Retrieved September 11, 2019, from https://www.timesofisrael.com/israels-flytrex-set-to-supply-half-of-reykjavik-with-food-by-drone/.