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## Article

# Analysing consumer adoption intentions of drone-enabled food delivery services: The moderating role of uncertainty avoidance

Amfiteatru Economic

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*Suggested Citation:* Ahmad, Shakeel; Chaogai, Xue; Shah, Sayed Kifayat; Popp, József; Acevedo-Duque, Angel (2025) : Analysing consumer adoption intentions of drone-enabled food delivery services: The moderating role of uncertainty avoidance, Amfiteatru Economic, ISSN 2247-9104, The Bucharest University of Economic Studies, Bucharest, Vol. 27, Iss. 69, pp. 606-624, <https://doi.org/10.24818/EA/2025/69/606>

This Version is available at:

<https://hdl.handle.net/10419/319827>

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# ANALYSING CONSUMER ADOPTION INTENTIONS OF DRONE-ENABLED FOOD DELIVERY SERVICES: THE MODERATING ROLE OF UNCERTAINTY AVOIDANCE

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## Please cite this article as:

Ahmad, S., Chaogai, X., Shah, S.K., Popp, J. and Acevedo-Duque, A., 2025. Analysing Consumer Adoption Intentions of Drone-Enabled Food Delivery Services: The Moderating Role of Uncertainty Avoidance. *Amfiteatru Economic*, 27(69), pp. 606-624.

DOI: <https://doi.org/10.24818/EA/2025/69/606>

## Article History

Received: 19 December 2024

Revised: 15 February 2025

Accepted: 17 March 2025s

## Abstract

While drone-enabled food delivery continues to gain prominence, a notable research gap exists in comprehending the impact of real-life psychological challenges — specifically autonomy, competence, and relatedness — on consumer adoption intention in various cultural contexts. This study explores the identified research gap by analysing these challenges through the self-determination theory lens, employing partial least squares structural equation modelling to evaluate survey responses from 423 participants in South Korea and China. The results of our study revealed that the autonomy problem has no significant effect, while the competency problem has a significant positive impact on adoption intentions for drone-enabled food delivery services in both South Korea and China. The effect of relatedness was positive and significant in China, but negative and significant in the South Korean context. These data also demonstrated a moderating impact of cultural dimension (uncertainty avoidance) on a relationship between these factors and adoption intention, demonstrating how culture impacts consumer adoption behaviour. Our results in this research are one of the first to contextualise basic issues by filling gaps in the current literature and offering valuable insights for food service businesses. Our study's results will also guide the formation of effective drone-enabled food delivery systems in diverse societies by supporting businesses in tailoring their methods to match consumer behaviours.

**Keywords:** drone-enabled food delivery, uncertainty avoidance, autonomy, competence, relatedness

**JEL Classification:** O33, M31, L66, L1, D81, C83

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## Introduction

A drone is a flying vehicle capable of independent operation using sensors and computers (Hwang et al., 2021; Nunkoo et al., 2024). The drone manufacturing and services industry is valued at over \$528 million and is projected to rise significantly with a compound annual growth rate of 9.49% from 2024 to 2029 (Nunkoo et al., 2024). Nowadays, it has gained interest in its use for delivery in several industries, namely agriculture, entertainment, shopping, and public services (Nunkoo et al., 2024). Accordingly, drone-enabled food delivery (DEFD) services have appeared as a revolutionary force shaping and shifting the economic possibilities and dynamics of the delivery services business (Shahzad et al., 2024). According to Nunkoo et al. (2024), DEFD services offer the benefits of faster delivery and the ability to reach any location. For this reason, many countries are taking the bull by the horns to initiate and set up DEFD services to declare themselves as leaders in this new business model to satisfy consumer demands (Hwang et al., 2021). For example, China began to lead the DEFD business model when Jingdong JD (a major e-commerce platform) first started such services to deliver 5 to 30 kilograms of food packages up to 300 km in 2017 (Choe et al., 2021). Similarly, Meituan, another food delivery platform in China, began operations in 2021 using DEFD services that currently serve over ten thousand customers in Guangdong province (Shahzad et al., 2024). In the same way, the South Korean government also wants to increase the drone market to about \$70.4 million, which is now projected to grasp \$4.4 billion by 2026 (Hwang et al., 2019). For the first time in 2020, South Korea began a test flight of a 3 km DEFD service in Sejong City to respond to the growing demand for efficient delivery services (Fly Dragon Drone Tech, 2024). First time, South Korea increased the financing for drone testing and training from US \$1.5 million in 2017 to US \$3.7 million in 2018, aiming to elevate the capacity and workforce of drone-related personnel to 164,000 by 2026 (Hwang et al., 2019).

A research by Hwang et al. (2019) indicates that over 1,500 individuals get injuries and approximately 30 individuals die each year in food delivery incidents, with over half of the fatalities occurring among those under 29 years of age. DEFDS provide an alternative approach that improves services by mitigating losses and reducing operational expenses (Shahzad et al., 2024). However, in the context of DEFD services, there remains a paucity of research aimed at exploring the issues and risks that affect consumer intent and behaviour (Shankar et al., 2021). For instance, according to the self-determination theory (SDT), the influence and satisfaction of three fundamental psychological needs – autonomy (ATP), competence (CTP), and relatedness (RTP) (Deci and Ryan, 1985) – have yet to be explored. The absence of these prerequisites might give rise to substantial psychological distress, dissatisfaction, and diminished overall pleasure (Allen and Anderson, 2018). Pal and Arpnikanondt (2024) also pointed out that unsatisfactory ATP induces mental tiredness stemming from a perceived loss of control, while insufficient CTP and RTP diminish customer trust and intensify emotions of social isolation. Furthermore, researchers also highlight the inevitability of evaluating consumer intentions and acceptance in different geographical regions to obtain an improved understanding of cultural differences in consumer behaviour (Hwang et al., 2021). These beneficial acumens will help in inducing the design and execution of DEFD services to address consumer worries and broader acceptance.

To address these gaps, this research seeks to expand our understanding of the influence of ATP, CTP, RTP related factors on consumer adoption intention (CAI), as well as the impact

of a cultural dimension named uncertainty avoidance (UNA) within the context of DEFD services. Bridging these gaps will significantly improve the literature by incorporating consumer behaviour theories in DEFD services and will also give valuable information to food delivery industry specialists, allowing for a better understanding of consumer concerns and attitudes towards DEFD services. Knowing the consumer's psychological perspectives in the DEFD context will further help service providers create user-friendly and emotionally engaging services that can increase trust and satisfaction.

Furthermore, this study is organised in the following style. The second part summarises the theoretical background and proposes hypotheses. Similarly, the third section describes the study methodology and results. The results discussion and implications are provided in the fourth section, while the final section provides conclusions, limitations, and opportunities for further study.

## **1. Theoretical background and hypotheses development**

### **1.1. Theoretical background**

The advantages of employing DEFD and other cutting-edge technologies can be analysed from multiple perspectives. On the one hand, these innovations will eliminate hazardous occupations, allowing people to be free from physically demanding, monotonous, routine and tedious tasks (Shahzad et al., 2024). Recent advancements in robotics and drone technologies hold the promise of enhancing workplace inclusivity and safety (Kwanya, 2023; Lukić Nikolić, 2024). Therefore, these autonomous self-services are considered more reliant than conventional services. On the other side, these innovative technologies foster feelings of isolation and loneliness by reducing human involvement in legitimate social interaction (Pal and Arpikanondt, 2024; Lukić Nikolić, 2024). Therefore, empirical studies, such as those by Lin et al. (2020), Pal and Arpikanondt (2024), Zhu et al. (2024), and Hong and Ahn (2023), illustrate the extensive application and significance of the psychological dimensions of SDT across many technological contexts. The fulfilment of these needs can enhance satisfaction, engagement, and motivation (Yuan et al., 2024b).

For this reason, our empirical research integrates self-determination theory (SDT), providing a detailed framework for interpreting consumer psychology and behaviour by defining real-world issues into autonomy (ATP), competence (CTP), and relatedness (RTP) (Deci and Ryan, 2013). ATP relates to an impulse for self-reliance and control, which may be compromised when consumers confront limited choices or complex procedures linked to technology or services (Guay, 2022). Similarly, an individual's perceived technological resiliency and optimism in their competence and desire to use and trust technology may significantly influence their sense of CTP and RTP (Ahn and Back, 2019). All these problems reveal unresolved psychological demands that substantially affect individual well-being and satisfaction (Allen and Anderson, 2018). On the contrary, when these basic requirements are hindered, people's confidence, ability to withstand setbacks, and perception are all negatively affected (Sherman and Cohen, 2006).

Moreover, Hofstede's uncertainty avoidance (UNA) highlights the extent to which individuals reject ambiguity and incertitude and their preference for a structured environment and clearly defined objectives (Hofstede, 1984). While all six of Hofstede's cultural dimensions offer valuable insights into customer behaviour, prompted a more focused

examination of UNA within this study. Individuals who significantly overlook uncertainty frequently opt for established and reliable approaches. For instance, a culture highly prone to UNA can accentuate the perceived risks and intensify consumer distrust and opposition (Van et al., 2021; Escandon-Barbosa et al., 2021). On the other hand, people living in lower UNA cultural systems tend to be more open and flexible thereby counteracting an adverse impact on behalf of these psychological needs for acceptance. In comparison to other cultural dimensions, China and South Korea demonstrate distinct levels of uncertainty avoidance. Consequently, the degree of comfort individuals experience regarding the inherent risks and unpredictability of the technology will largely influence their willingness to adopt DEFD services. This highlighted the need to align tailored technology with nuanced cultural distinctions to address consumer mindsets and behaviours regarding emerging technologies effectively (Escandon-Barbosa et al., 2021).

## 1.2. Hypotheses development

According to the Self-Determination Theory, real-world problems may be categorised into three types (Deci and Ryan, 1985). The initial kind of autonomy (ATP) related problem pertains to the degree to which persons may experience coercion to engage in certain actions with significantly restricted free choice (Pal and Arpnikanondt, 2024). Increased ATP may diminish purchase and adoption intention by undermining trust and perceived convenience (Guay, 2022). Our study posits that individuals with lower anxiety levels are more likely to accept autonomous DEFD solutions due to their reduced anticipation of negative outcomes. This occurs due to their excessive concern and anticipation of disastrous outcomes (Hamilton, 1959). The introduction of DEFD, like any emerging technology, involves a level of uncertainty that encompasses aspects of operational reliability and adherence to regulatory standards. Research indicates that uncertainty typically triggers anxiety and results in apprehension (Gu et al., 2020). As a result, increasingly anxious customers are less inclined to utilise DEFD due to apprehensions regarding potential issues, including delivery errors, privacy infringements, or even accidents. We also believe that consumers demonstrate a higher prospect of engagement when DEFD service systems allow for straightforward changes to delivery parameters, thereby maintaining their sense of control. When consumers perceive a lack of control over the delivery process – whether regarding timing, specific drop-off locations, or the capacity to make post-order adjustments – they may experience discomfort with adopting and purchasing DEFD services. Accordingly, we hypothesise:

H1. Autonomy problem positively influences consumer adoption intentions to use DEFD services.

The second category of discontent arises from competence-related problems (CTP). An individual's perception of CTP is realised upon achieving accomplishments, such as task completion, goal fulfilment, or triumph (Martela and Riekk, 2018). CTP denotes a sense of mastery and effectiveness in one's endeavours. Regarding the issue of competence, we contend that anxiety will exacerbate the genuine frustrations experienced by individuals utilising DEFD services within a culture that prioritises uncertainty avoidance. In traditional food delivery systems, delivery personnel encounter challenges including traffic congestion, time constraints, and potential mistreatment by employers. These factors can result in errors, delays, and a deterioration in service quality. Over time, these issues can diminish the personal reputation of the delivery personnel and induce anxiety (Doby and Caplan, 1995). Furthermore, clients may encounter dissatisfaction stemming from variable service quality, delayed deliveries, or miscommunication, which can intensify their concerns.

In conventional food delivery methods, challenges such as traffic congestion, human error, and delivery bias can lead to inconsistent service quality. These challenges are a source of frustration and anxiety for both delivery personnel and customers, highlighting the need for a more reliable solution. A lack of fulfilment will lead to CTP issues, causing the individual to question their skills (Martela and Riekk, 2018; Hong and Ahn, 2023). Elevating the CTP problem may diminish confidence in the service, resulting in increased adoption intentions (Pal and Arpnikanondt, 2024), however, the fulfilment of this problem will lead to the adoption of these services. Accordingly, we hypothesise:

H2. The competency problem positively influences consumer adoption intentions to use DEFD services.

The third type of frustration impacting DEFD uses is the issue of relatedness (RTP), which indicates that an individual perceives connections with others, experiences caring relationships, and feels a sense of belonging within a community (Henz, 2022; Pal and Arpnikanondt, 2024). Furthermore, the aspect of RTP presents social advantages, which can serve as a significant source of intrinsic motivation (Pal and Arpnikanondt, 2024). In the context of this study, consumers may express concerns that utilising drone delivery could create the impression of being impersonal or detached from conventional shopping methods. Additionally, there may be apprehensions regarding the potential disruption drones could cause within their neighbourhood environment. Establishing a socially acceptable perception of drone delivery – by portraying it as environmentally sustainable or community-focused – can mitigate this danger (Shahzad et al., 2024). Elevated RTP risks may repel socially concerned users, diminishing their propensity to utilise the service. Therefore, we hypothesise:

H3. Relatedness problems positively influence consumer adoption intentions to use DEFD services.

### **1.3. Uncertainty avoidance as a moderator**

Recent cultural studies have examined pandemics, national culture, luxury brands, business, tourism, and sustainability in the context of innovations (Escandon-Barbosa et al., 2021). However, this research is the inaugural investigation focusing on Hofstede's Uncertainty Avoidance (UNA) aspect as a moderator in analysing the influence of ATP, CTP, and RTP factors on the buying intention of DEFD services. Hofstede's UNA aspects examine cultural responses to uncertainty as well as vulnerability (Merkin, 2006). This component is necessary for examining cross-cultural disparities since it elucidates how society reacts to various uncertainty (Wang, 2021). For example, countries with high UNA index, such as South Korea (85th), endeavour to mitigate uncertainty via the implementation of robust legal frameworks. These cultures adopt a careful approach to innovation, prioritising predictability, risk management, and reassurance while cultivating trust and confidence. Alternatively, societies characterised by low UNA, such as China, which is ranked 30, demonstrate a significant tolerance for ambiguity and risk. These cultures demonstrate a significant level of adaptability and a readiness to embrace innovation. In this type of society, individuals often exhibit an early adopter mentality and demonstrate the willingness to embrace the potential advantages of innovation, prioritising them over the associated risks. Enhanced emotional connections and social trust can help bridge psychological divides and facilitate adoption behaviour (Pal and Arpnikanondt, 2024). According to our empirical research, the UNA component will turn challenges into opportunities, foster trust, and assist in raising DEFD

service confidence and satisfaction. Therefore, organisations can successfully address consumer concerns and increase adoption rates in different markets by customising strategies based on cultural environments. In response, we propose the following four hypotheses:

H4a. Consumer uncertainty avoidance can positively moderate the relationship between the consumer autonomy problem and the adoption intention of DEFD services.

H4b. Consumer uncertainty avoidance can adoption moderate the relationship between consumer competency and the adoption intention of DEFD services.

H4c. Consumer uncertainty avoidance can positively moderate the relationship between the relatedness and the adoption intention of DEFD services.

## 2. Methodology

This study utilised a quantitative survey method to investigate consumer adoption intentions regarding DEFD services in China and South Korea. Our focus was exclusively on organisations in Shenzhen and Sejong cities due to their significance as a centre for high-tech smart cities in China and South Korea (To et al., 2021; Um and Chung, 2021). All measuring items included in this study are derived from prior research such as (Litvin et al., 2004; Escandon-Barbosa et al., 2021; Pal and Arpnikanondt, 2024) and have been significantly changed to meet current study requirements. The three categories of real-world issues (autonomy problem, competence problem, and relatedness problem), uncertainty avoidance, and adoption intentions are assessed using a five-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree).

Given that we modified the syntax of the questions, we decided to check the content and face validity of the items before conducting the main survey. To determine content legitimacy, we talked to two experts with over six years of experience in management information systems and business analytics. Following the content validity assessment, we examined the instrument's face validity with four PhD candidates specialising in information systems and user experience. They assessed each item based on overall readability, clarity, and comprehensibility, resulting in changes to the text of both items.

Ultimately, we conducted a pilot test with a limited sample of 30 respondents (15 from China and 15 from South Korea) to assess the reliability of the items included in the questionnaire. All constructs achieved average variance explained (AVE) values over 0.5 and Cronbach's alpha ( $\alpha$ ) values surpassing 0.7, demonstrating the appropriateness of the items for the current context (Shah et al., 2024).

A total of 550 questionnaires were disseminated to the respondents. In the initial phase, we collected 373 responses from various groups. The sample size has been identified as requiring enhancement. Consequently, we solicited input from individuals who had yet to participate in the initial phase. The questionnaire included attention-check questions along with a modest monetary incentive. The follow-up enabled the collection of further responses, culminating in a total of 450 final responses. We thoroughly reviewed all the responses and removed those that required additional essential information or were incomplete and ultimately retained a final sample of 423 (204 South Korea, 219 China). Based on our proposed model of having five variables, the sample size adhered to the recommendations of Kline (2023) and Shah et al. (2025), who said that a minimum of 100-150 samples is requisite for conducting a

structural equation modelling (SEM) technique. The sample from South Korea included 204 respondents, comprising 66.34% male and 33.65% female participants. The range of ages indicated that 42.30% of individuals were aged 18-30, 29.80% were in the 31-40 age range, and 27.88% were between the ages of 41-55. In terms of educational attainment, 50.96% of the individuals had a bachelor's degree, 29.80% had a master's degree, and 19.23% completed primary education. Regarding the utilisation of DEFD services, 67.31% were non-users, while 32.69% engaged with it in some capacity. Similarly, the sample from China included 219 respondents, primarily male (61.7%), with the majority aged 20-30 years (44.68%), followed by those aged 31-40 years (33.33%), and 41-55 years (21.98%). The data on education levels indicates that a significant majority possess a bachelor's degree (64.53%), while 26.24% have attained a higher, and 9.21% have completed primary education. Furthermore, 38.29% were identified as service users, whereas 61.71% were classified as non-users.

### 3. Results analysis

#### 3.1. Measurement model

The proposed model underwent evaluation utilising the PLS-SEM technique. We began by performing screening and preliminary statistical tests, which included frequency analysis, descriptive statistics, common method bias assessment, and multicollinearity evaluation. The mean values (2.3-4.1, 2.7-4.2), standard deviation (0.77-1.1, 0.65-1.06), variance inflation factor (1.03-2.69, 1.14-2.05), of the variables demonstrate that there are no abnormalities present in our dataset. We analysed the items' cross-outer loading (OL) to determine if each question demonstrated adequate variation in the variable. It is advisable that an item, whether singular or in combination, for a specific variable should achieve a minimum loading of 0.70 (Yuan et al., 2024a). We performed confirmatory factor analysis (CFA) and variance inflation factor (VIF) analysis to assess the model's validity and reliability and our findings in table no. 1 validate all established standards (Yuan et al., 2024a). The results demonstrate that all VIF values are below the threshold of  $VIF \leq 3.3$  which confirms the absence of such issues in the data (Hair and Alamer, 2022, Shah et al., 2023). The minimum standard for establishing convergent validity is 50% (Hair et al., 2017), and has been achieved in table no. 2. Moreover, discriminant validity signifies that the items exhibit distinct distinctions within the specific variable. Based on (Shah et al., 2025) study, values beyond 70% indicate pronounced and substantial volatility in the variable. The results indicate that all variables exhibit positive values, thereby affirming the attainment of discriminant validity. Composite reliability indicates the dependability of items and their accurate interpretations for the particular variable. HTMT has been introduced as a new method for evaluating discriminant validity in business and psychology (Yuan et al., 2024b). HTMT scores that fall below 0.90 confirm the model's validity and indicate the achievement of discriminant validity. The results indicate that a sufficient level of HTMT has been achieved, as illustrated in table no. 3.

#### 3.2. Structural model

To test the hypotheses of the study, we performed a structural model in SmartPLS using a bootstrapping method of 5000 resampling, which provides initial support and an idea of the directional relationship among the variables (Hair et al., 2017). Looking at our results (as shown in Table no. 4 and figure no. 1), we found that, in countries with a low and high level of UNA such as South Korea and China, hypothesis 1 related to ATP was found insignificant



( $\beta = 0.080$ ;  $p > 0.614$ ,  $\beta = -0.134$ ;  $p > 0.110$ ) respectively. Regarding hypothesis 2, in low and high UNA culture, the CTP has a positive and significant ( $\beta = 0.609$ ;  $p < 0.00$ ,  $\beta = 0.155$ ;  $p < 0.00$ ) impact on adoption intentions (CAI), while in terms of RTP in H3, this relationship is negatively significant ( $\beta = -0.245$ ;  $p < 0.00$ ) for high and insignificant ( $\beta = 0.015$ ;  $p < 0.387$ ) for low level of UNA culture. In terms of moderation (as shown in table no. 4 and figure no. 2), the H4a hypothesis was found insignificant ( $\beta = -0.035$ ;  $p < 0.0589$ ), H4b was found positively significant ( $\beta = 0.125$ ;  $p < 0.010$ ) and H4c was found negatively significant ( $\beta = -0.141$ ;  $p < 0.038$ ) in South Korean context, while H4a (0.169;  $p < 0.005$ ) was found positively significant, H4b ( $\beta = -0.147$ ;  $p < 0.001$ ) was found negatively significant and H4c was found insignificant ( $\beta = -0.050$ ;  $p < 0.182$ ) in China context. These results provide an interesting base for the discussions below:

**Table no. 1. VIF, mean, standard deviation, outer loadings values**

Items	South Korea				China			
	VIF	M	SD	OL	VIF	M	SD	OL
ATP1: I feel freedom and a sense of choice when engaging in DEFD service.	1.915	2.878	0.908	0.802	1.719	2.982	1.018	0.755
ATP2: I feel stressed during DEFD service.	1.393	3.756	0.989	0.842	1.193	3.866	0.818	0.824
ATP3: DEFD service offers me with exciting options.	1.555	2.458	0.951	0.81	1.581	2.821	1.062	0.724
ATP4: There is little possibility for me to determine how to utilise the DEFD service.	1.428	2.374	0.968	0.796	1.727	2.750	1.039	0.719
CTP1: I think I am pretty good at DEFD service.	1.699	3.191	0.926	0.79	1.353	3.339	0.872	0.747
CTP2: In comparison to others, I did well at DEFD services.	1.242	4.145	0.773	0.712	1.208	4.232	0.654	0.818
CTP3: I felt competent after ordering at DEFD.	1.827	3.046	1.033	0.815	1.292	3.411	0.95	0.716
CTP4: I couldn't do very well on DEFD service.	1.41	3.198	1.115	0.721	0	0	0	0
RTP1: I enjoy a variety of food options at DEFD.	1.428	3.702	0.826	0.68	1.658	3.875	0.825	0.796
RTP2: I feel close to restaurants through DEFD.	1.885	3.298	0.871	0.856	1.76	3.375	1.021	0.851
RTP3: My friends at DEFD provide me with assistance.	2.077	2.847	0.912	0.781	1.891	3.821	0.924	0.772
RTP4: I experience a significant sense of disconnection in the absence of DEFD service.	1.959	3.206	0.986	0.794	1.84	3.866	0.955	0.77
CAI1: I intend to adopt DEFD services.	1.032	3.672	1.08	0.899	2.501	3.964	0.918	0.864
CAI2: I will often use the DEFD service in the future.	1.655	3.756	0.989	0.945	1.904	4.232	0.818	0.916
CAI3: I plan to adopt using the DEFD service.	1.71	3.809	0.958	0.938	1.385	3.964	0.79	0.949
CAI4: I would like to use DEFD as much as possible.	1.721	4.145	0.773	0.756	1.941	2.821	0.654	0.814

Items	South Korea				China			
	VIF	M	SD	OL	VIF	M	SD	OL
UNA1: It is important to have instructions for using DEFD services.	2.69	3.809	0.958	0.926	1.147	3.384	0.79	0.876
UNA2: I don't like ambiguous services.	2.409	3.672	1.08	0.904	1.765	3.375	1.062	0.648
UNA3: It is vital to carefully follow directions and procedures.	1.605	2.908	0.937	0.765	1.857	3.821	1.046	0.727

**Table no. 2. Reliability and validity results**

South Korea			
Variables	C- <i>α</i>	CR	AVE
ATP	0.851	0.886	0.661
CTP	0.757	0.846	0.579
UNA	0.837	0.901	0.754
RTP	0.784	0.861	0.609
CAI	0.908	0.937	0.788
China			
Variables	C- <i>α</i>	CR	AVE
UNA	0.693	0.798	0.572
ATP	0.801	0.842	0.572
CTP	0.649	0.805	0.58
RTP	0.813	0.875	0.637
CAI	0.909	0.937	0.787

**Table no. 3. Discriminant validity through HTMT**

South Korea					
Variables	UNA	ATP	CTP	RTP	PI
UNA	0.831				
ATP	0.915	0.812			
CTP	0.798	0.769	0.764		
RTP	0.746	0.805	0.746	0.78	
CAI	0.843	0.785	0.895	0.706	0.888
China					
Variables	ATP	CTP	UNA	RTP	PI
ATP	0.813				
CTP	0.833	0.761			
UNA	0.857	0.904	0.868		
RTP	0.806	0.766	0.746	0.78	
CAI	0.789	0.897	0.953	0.71	0.888

Table no. 4. Structural model hypotheses analysis

Hypotheses	South Korea					China				
	B value	T statistics	P values	2.5%	97.5%	B value	T statistics	P values	2.5%	97.5%
H1: ATP → CAI	0.080	0.507	0.614	-0.270	0.383	-0.134	1.235	0.110	-0.243	0.111
H2: CTP → CAI	0.609	7.076	0.00	0.435	0.764	0.155	2.673	0.004	0.039	0.238
H3: RTP → CAI	-0.245	3.165	0.002	-0.385	-0.112	0.015	0.287	0.387	-0.092	0.101
UNA → CAI	0.509	4.851	0.000	0.346	0.727	0.942	10.022	0.000	0.762	1.046
Moderation										
H4a: UNA x ATP → CAI	-0.035	0.542	0.589	-0.174	0.071	0.169	2.596	0.005	0.052	0.258
H4b: UNA x CTP → CAI	0.125	2.641	0.010	0.045	0.225	-0.147	3.053	0.001	-0.204	-0.053
H4c: UNA x RTP → CAI	-0.141	2.108	0.038	-0.258	-0.010	-0.050	0.913	0.182	-0.157	0.037

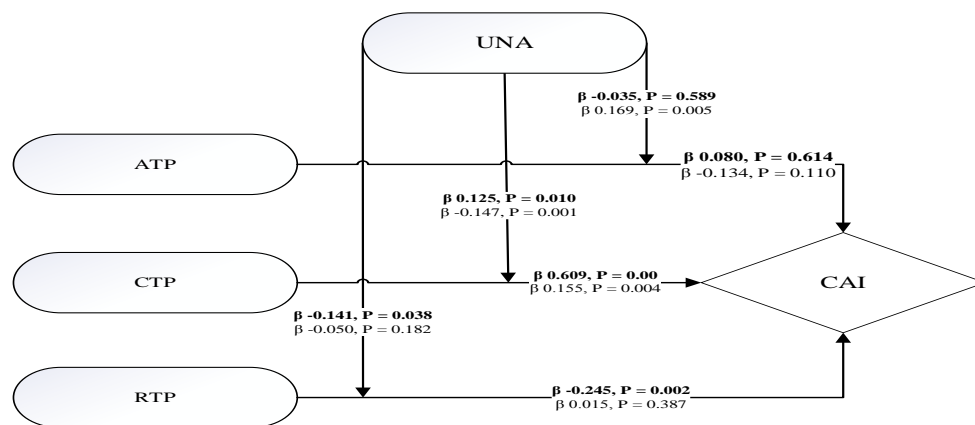
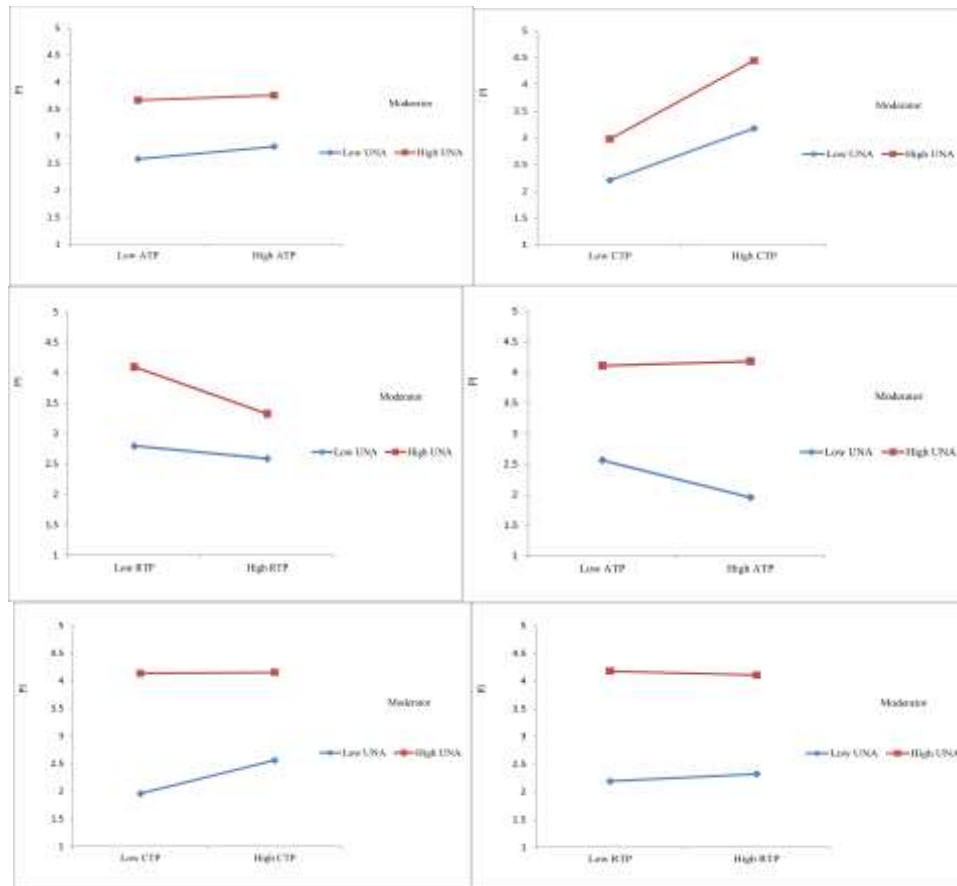


Figure no. 1. Structural model analysis

Note:  $R^2 = 0.931, 0.871$ ;  $SRMR = 0.911, 0.817$ ;  $NFI = 0.736, 0.706$ , where the bold values represent the South Korean Sample and the normal represents the Chinese sample.



**Figure no. 2. Moderation analysis plots South Korea and China**

#### 4. Discussion

The research into innovations in DEFDD convenience remains in its preliminary phases. Efforts have been focused on comprehending consumer CAI within this developing delivery system across different cultures (Shahzad et al., 2024). This research examines consumer behaviour and psychology related to DEFDD in China and South Korea. Utilising real-world problems and Hofstede's cultural dimensions, we explore the CAI of DEFDD services. Consequently, we have categorised the perceived problems derived from the Self-Determination Theory (SDT) into three distinct types: autonomy, competence, and relatedness (Ryan and Deci, 2024).

The hypothesis (H1) derived from the South Korean and China samples was deemed insignificant to consumer CAI when examined in the context of uncertainty avoidance (UNA). In general, a plausible explanation is that in a highly organised society characterised by significant UNA, consumers are inclined to believe that firms and regulatory bodies have

established safe and trustworthy mechanisms for drone operations (Hwang and Choe, 2019), thereby alleviating worries over ATP.

In this context, South Korea's position as a technologically sophisticated country, characterised by the extensive use of cutting-edge technologies such as robotics, artificial intelligence, and automation, has promoted familiarity and acceptance of automated services (Nam et al., 2024). This extensive familiarity with technology diminishes the significance of ATP concerns or the moderation of this relationship (Ahmad Husairi and Rossi, 2024). Similarly, Chinese consumers frequently exhibit a strong trust in government regulations and corporate systems, particularly in urban areas (Wong et al., 2015). This trust alleviates concerns regarding ATP, as individuals consider the systems to be constructed with safety and efficiency. Drone delivery systems in both these countries may be viewed as enhancing societal efficiency, potentially diminishing the emphasis on individual control. Compared to high UNA countries like South Korea, it is observed that while high UNA often amplifies concerns, in China, the focus on government control and technological innovation may overshadow concerns related to ATP. The outcome indicates that UNA positively moderates the effect, yet it does not make the autonomy risk significant (Al-Okaily et al., 2020).

Similarly, the potentially significant influence of H2 within the South Korean and China context is characterised by consumers' elevated expectations regarding service reliability, precision and high expectations for service reliability in urban and technology-savvy regions. Similar to the research study of (Pal and Arpikanondt, 2024), in our results, concerns regarding drone performance – such as delays, delivery errors, or functional glitches – can increase CTP risk. In terms of moderation, individuals tend to favour predictable and reliable technologies in high UNA culture. When drone delivery systems show their effectiveness through clear performance metrics, it builds consumer confidence and encourages positive adoption intentions (Abbasi et al., 2024). However, at a low level such as China, the negative moderation arises from the demand for reliable performance, where increased sensitivity to potential failures can significantly amplify CTP concerns, thereby influencing intentions more critically.

Furthermore, a significant negative impact arises in H3 from the absence of human involvement in DEFD services, which may result in feelings of detachment or alienation, thereby fostering a negative perception of the service (Choe et al., 2021). Consumers might link conventional delivery methods with the potential for polite interactions or tailored service. Eliminating these elements in DEFD may create a disconnect with user expectations, potentially adversely affecting adoption intentions. In this context, the negative moderation at high levels of UNA culture, such as in South Korea, intensifies concerns regarding the impersonal nature of drone delivery. Consumers may experience an increased demand for trust and emotional connection in service delivery, aspects that drone systems do not adequately provide (Choe et al., 2021). However, in comparison, China does not significantly impact RTP concerns, as these are of lesser importance within the practical and efficiency-oriented perspective of Chinese consumers. In this context, social connection during service delivery is crucial, as Chinese consumers tend to prioritise efficiency and utility over relational elements in transactional services such as delivery. This reduces the significance of RTP concerns. For instance, the extensive adoption of digital platforms such as Alibaba and JD.com has made consumers familiar with automated and impersonal service delivery methods, thereby diminishing the significance of RTP risks.

#### 4.1. Theoretical implications

The findings presented here have significant theoretical implications for the literature on consumer psychology in the context of DEFD services. This study is the inaugural effort to offer cross-cultural insights into the real-world problems that impede consumers' adoption of DEFD services. Although earlier studies have conceptually examined many such obstacles (Hwang and Choe, 2019; Choe et al., 2021; Sohn, 2024), they have neglected to address the influence of such concerns in the DEFD context. This study is the first to define and examine these concerns through the lens of STD theory. While other technology adoption models (TAM, UTAUT, TOE) focus on technology-related variables, SDT allows a more profound examination of the distinct psychological components associated with the service. This investigation is crucial, as such technologies possess distinct characteristics compared to other consumer-facing technologies across various cultures. SDT emphasises both extrinsic and intrinsic human motives, therefore, studying them in a focused manner is essential (Bellis and Venkataramani Johar, 2020). Therefore, our findings present a comprehensive overview encompassing the factors influencing DEFD services in the real world.

Like other studies such as those (Escandon-Barbosa et al., 2021; Sohn, 2024), this study provides a conceptual basis for expanding traditional adoption frameworks to incorporate the cultural dimension of the UNA moderator. The findings emphasise the importance of cultural dimensions, especially UNA in shaping the relationship between ATP, CTP, RTP, and CAI in China and South Korea. This adds to the wider conversation surrounding global technology acceptance and the theories related to consumer behaviour. As far as we know, no research has been conducted examining a comprehensive model within the DEFD context. This study explores an overlooked area in current research with STD theory and an emphasis on consumer segmentation to encourage sustainable purchasing practices.

Finally, this research contributes to the existing literature by including uncertainty avoidance, demonstrating how cultural variables may alter the consequences of risks, and offering insights that go beyond universal models. In China, the emphasis on guanxi and societal expectations highlights the need to develop technology that improves social connections (Daskalopoulos and Machek, 2024), offering a detailed perspective on competency and relatedness risks. In South Korea, confidence in laws and a practical approach toward technology adoption suggest that traditional notions of autonomy may be less important in organised, tech-oriented communities. As a result, by addressing these cultural variations, the study addresses the gaps in the literature on cross-cultural consumer behaviour and technological acceptability, offering a culturally conscious viewpoint for future research.

#### 4.2. Practical implications

This study also provides important insights into consumer psychological issues in the form of ATP, CTP, and RTP in DEFD services in China and South Korea. Realising these concerns may become a significant obstacle for consumers to use DEFD services, leading businesses to actively seek solutions. As both China and South Korea are countries where consumers are concerned about losing control over the delivery process, building trust is crucial to overcome consumer hesitation. As people become more accustomed to using technology, they find that its risks are decreasing, so they will adopt and use it more often. These efforts, which are designed for the cultural and technological backgrounds of China and South Korea, may greatly increase the consumer acceptance of drone delivery services. In this study,

efforts to target the cultural and technological backgrounds of China and South Korea will help service providers significantly increase consumer acceptance of DEFD services.

According to Khalil et al. (2022), illuminating emotional problems and worries in people's everyday lives gives key clues to improvement in their interactions with novel services. Drone service providers need to establish excellent personalised experiences to meet consumer needs and build loyalty. Due to the fact that each consumer may have different preferences or concerns, customised recommendations can be made based on individual needs to increase decision-making ability (Xiao and Benbasat, 2018). The results of this study will not only reduce uncertainty but also ensure the need for customised strategies. Drone service providers may cultivate client trust and confidence by effectively managing the customised delivery process. These technologies may enhance customer acceptance and satisfaction with drone delivery services.

Finally, the findings of this study emphasised a major concern for DEFD service providers concerning the potential risks of overreliance on this service to address legitimate grievances. Although DEFD is convenient to use, it is important to note that relying on this service as a regular base may lead to problems. Existing studies suggest that the conflict to implement and stifle consumer thoughts or social responsibility swiftly can turn into an unhealthy dependence on technology or service (Zeuge, 2020). Therefore, DEFD will become a simple choice to compress other issues, such as financial management or social use, which is evident in poor purchasing habits or social disconnection from real life. Therefore, drone service providers need to examine this trend and provide value to address these challenges and ensure that their services do not harm the overall well-being of consumers.

## **Conclusions**

This research investigated the significance of attaining three primary perceived psychological problems: autonomy (ATP), competence (CTP), and relatedness (RTP) within the DEFD services framework in South Korea and China. The research also examined the moderating influence of cultural factors, particularly uncertainty avoidance (UNA), on these problems. The primary objectives of this research are the identification of strategies that provide essential insights for food service enterprises considering the introduction of this service across various cultures through an in-depth comparison. CTP has been demonstrated as a crucial positive inspiration that influences adoption rates consistently across both high and low UNA contexts. Similarly, our research revealed contrasting trends concerning RTP, as it served as a positive adoption factor in Chinese markets (low UNA) while exhibiting a negative impact in South Korean markets (high UNA). Moreover, UNA establishes distinct trends in the adoption of innovative technological solutions by consumers. Moreover, the study emphasises the significance of comprehending the distinct cultural dynamics that shape consumer adoption perceptions in China and South Korea. The results provide significant insights for food service developers and stakeholders by emphasising distinct psychological issues in the acceptance of DEFD services. Considering cultural differences allows companies to customise their strategies, address consumer concerns, and enhance the overall success of DEFD systems in these markets more effectively.

This study does have certain limitations. Initially, due to the data being collected in South Korea and China, generalising the findings of this study to other developed regions may present specific challenges. Consumer attitudes toward new technology-based services differ

significantly between developed and developing regions. Therefore, we suggest that future studies gather data from additional regions. Other cultural dimensions are also highlighted as significant moderators in accepting technology-mediated services. Future studies are recommended to consider demographic characteristics when explaining consumer behaviour. Secondly, our findings regarding consumer behaviour toward DEFD services may evolve. Consequently, future research should examine consumer behaviour regarding DEFD services that incorporate the latest innovations. Thirdly, we emphasise that while SDT offers a valuable paradigm for understanding intrinsic and extrinsic motivations, several factors beyond RTP and ATP influence the actual adoption of DEFD. The adoption process may be significantly affected by factors such as perceived risk, convenience, and other cultural values, hence diminishing the effect size of these particular SDT features. Moreover, consumers have yet to fully perceive their ability to satisfy the requirement for RTP (personal contact) or ATP (process control); therefore, future studies should consider these factors. Lastly, this study simultaneously assessed independent and dependent variables, which may result in common method bias. Therefore, to assess independent and dependent variables, it is advisable to gather data over a period of time.

### **Funding and acknowledgements**

This work is supported by the Humanities and Social Science Research Projects of the Ministry of Education (No. 23YJC630090, 19YJA630096).

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