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Investigation of behavioral influences of carpool adoption for educational trips – A case study of Thammasat University, Thailand

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ABSTRACT

Carpooling is emerging as a more appealing "sharing economy" form with promising benefits in reducing carbon emissions, traveling costs, and traffic congestion. However, a thorough understanding of carpooling adoption is lacking for policymakers and transport planners in developing countries due to limited scientific research, specifically in Southeast Asia. Therefore, the present study aimed to understand the behavioral influences of carpool adoption in Thailand by conducting a multivariate analysis on a dataset of 307 observations gathered at Thammasat University, Pathum Thani, Thailand. First, a conceptual model was developed to assess the influence of effort expectancy, perceived safety, hedonic motivation, and social influence on carpool behavior intention. Additionally, two constructs related to COVID-19 and time credits were added to assess their impacts. Then, the sample data were analyzed using Structural Equation Modelling (SEM). It was found that hedonic motivation, social influence, and time credits as payment method factors play statistically significant direct roles in the carpool behavior intention, whereas effort expectancy, perceived safety, and perception towards compliance with COVID-19 guidelines for carpooling did not. However, significant indirect impacts of effort expectancy and social influence through hedonic motivation were discovered. Upon analysis of the findings, policy implications are presented.

1. Introduction

Internet-based technological development is the backbone of the rapid rise of the "sharing economy" concept, and individuals get to share goods and services among the community (Asgari et al., 2017; Genç, 2020). It is a sustainable economic practice developed owing to globalization and many other causes. Carpooling is a more appealing form of the concept as users can receive many advantages, such as monetary savings, travel timesaving, travel comfort, and social exposure. For the community, it contributes to reducing traffic congestion, fuel consumption, and greenhouse gas (GHG) emissions and generating solid social bonds (Librino et al., 2020). Correspondingly, the carpooling platform benefits the economy, society, and the environment. Presently, an interest in carpooling adoption and diffusion research is increasing.

The definition of carpooling has different versions. The general one is that it is an arrangement of two or more people sharing a privately owned car for a trip, and the participants share the expense. The description will aid in distinguishing carpooling from other ride-sharing economy paradigms, such as carsharing, ride-hailing, slugging, etc. Currently, most carpoolers use the digital platform through which matching services are made among strangers for carpooling participation (Adelé & Dionisio, 2020). These developments have made dynamic carpooling more prevalent in urban areas. The conceptual initiation of dynamic carpooling dates back to the early 1990 s (Ciasullo et al., 2018). This technology overcomes the barriers of traditional carpooling through the reduction of matching time (Carrese et al., 2017). Some studies reported that carpooling became popular in the 1970 s due to the oil crisis (Bulteau et al., 2019; Park et al., 2018; Shaheen et al., 2017). According to Olsson et al. (2019), the success was short beyond WWI. It was driven to save rubber and gasoline for the war effort (Neoh et al., 2018). Due to the rise of environmental awareness in the late 1990 s, carpooling became more popular. At present, the popularity of carpooling may be at risk during the COVID-19 pandemic (Chen et al., 2020). However, carpooling is shifting as an alternative way to avoid crowded transport modes during the global pandemic (Molina et al., 2020).

The empirical evidence suggests the commuters' lack of carpool practice (Molina et al., 2020). Therefore, policymakers and transport

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planners need to thoroughly understand the behavioral influences of carpool adoption to introduce carpooling programs for commuters. Factors such as the transport budget, household income, travel mode, travel time, and carpooling service availability were the significant determinants of carpooling choice for work trips (Bulteau et al., 2019). Similar discoveries were also made for educational trips (Park et al., 2018). Further, their results emphasized that low cost, low travel time, and environmental concern as the main reasons for carpooling for work trips. According to studies, the carpooling behavior of family members and colleagues also drives the other family members and coworkers to join carpooling, which is called a subjective norm. Similar findings were elaborated that perceived peer and family pressure is the best predictor of carpooling for work or casual trips (Gheorghiu & Delhomme, 2018). These studies have been conducted in developed countries where carpooling is successfully adopted and diffused in the community.

The lack of sound understanding of the adoption of carpooling makes it difficult for policymakers to promote it in developing countries, specifically in Southeast Asia. In Thailand, the popularity of carpooling began in 1997 due to the Asian financial crisis (Rudjanakanoknad, 2010). As the economy rebounded, no efforts were retaken. The movements started again during 2008–2009 due to the peaked gas prices. The fluctuations in the popularity of carpooling have taken place throughout the years since then. Rudjanakanoknad (2010) conducted a carpool experiment with 213 government officials in Thailand. Most of the participants positively viewed the benefits of carpooling, but the program's success was limited due to the inefficiency of the carpool arrangement. It was reported that many carpooling activities occur in Bangkok due to personal relationships rather than organized campaigns. Tayakee (2017) conducted an experimental study focusing on 100 participants who had already experienced carpooling at least once. The results showed that perceived quality, emotional value, product image, consumer aspiration, and attitude towards the service significantly influenced the intention to participate in carpooling. It was emphasized that proper promotional efforts with enough information could attract Thai people to a new ride-sharing economy paradigm. Vayouphack (2020) reported that due to dissatisfaction with local taxi services, ride-sharing services in Thailand are highly appreciated even though they are not entirely regulated. Sovacool and Griffiths (2020) pointed out that the promotion of carpooling or any smart ride-sharing will require tailoring to the local context. However, there is a shortage of empirical studies on the effects of several behavioral determinants on carpool adoption for educational trips to support policy development in Southeast Asia's emerging nations, particularly Thailand.

Since they are defined by their own community, with a particular set of behaviors and internal circulation networks, university campuses can be seen as small cities (Tomás et al., 2021). Therefore, university campuses have special transportation needs with a high concentration of trips. Due to this, a vast number of vehicles are accessing the university campuses daily. Finding a parking spot is challenging for workers and students due to a lack of parking places (Kamaruddin & Rozlis, 2019). On top of taking longer times to search for free spaces, high emission values and increased traffic volume causing traffic jams are also raising concerns for sustainable mobility options within college campuses. Therefore, universities worldwide are progressively implementing policies to encourage environmentally friendly campus mobility (Hamad et al., 2021). Due to several factors, the demand from young people is currently a target with enormous potential. They are far more inclined to interact and meet new people than older people, they are a lot more aware of climate change, and their economies are not overly strong (Arnauda, 2022). Their daily mobility needs, which are Going to university or commuting to work (König et al., 2021), are another reason that makes young people a potential target group. Because they understand that carpooling is one of the least expensive and most comfortable forms of transportation, young people are particularly drawn to it (Xiao et al., 2021). Gandia et al. (2021) found that students from public institutes are more inclined to offer carpool rides compared to those who belong to private institutes. Another study focused on the university community reported that the longer the trip, the higher the probability of males carpooling (AlQuhtani, 2022). In contrast, Lowe and Piantanakulchai (2021) highlighted that females, married and the 18–39-year group, were more inclined to adopt carpooling than unmarried males and the $\geq$ 40-year group. A study conducted in USA found that one major barrier for the university community to carpool is findings carpool partners (Kaplowitz & Slabosky, 2018). The study further highlights the importance of matching websites. Another study reported that residential distance, parking cost, web application, matching preferences, and service flexibility are significant for the university community to ride-share (Erdoğan et al., 2015).

The universities are better venues to introduce young travelers to sustainable travel practices like carpooling that may be useful to them in the future. Unfortunately, university communities have not attracted significant academic attention because they are underestimated in most travel behavior studies (Khattak et al., 2011). The present study aims to fill this gap by focusing on behavioral determinants of carpool adoption for educational trips.

Travel mode choice would be influenced by both objective and subjective factors (Yum, 2020). Therefore, investigating these subjective influences will aid in identifying key marketing points in promoting carpooling. However, the lack of attention given to some critical determinants regarding carpooling makes it challenging to recognize sound marketing strategies. Therefore, this study will provide close attention to these identified issues. Financial motivation is highly significant in carpooling adoption, according to many studies. However, it risks highlighting the business values of carpooling rather than its social importance. Studies have pointed out that ride-sharing should not be a business but rather proclaim ecological and social values, helping others, and a sense of community (Eskelinen & Venäläinen, 2020). Time banking is emerging as a popular form in the sharing economy, introducing time credit as an alternative currency. In this concept, people provide services and earn time credits instead of money to use those earned time credits to receive benefits. Currently, it is gaining more popularity in the neighbors-helping-neighbors-based currency system that has also received public attention as an example of sharing economy. By adopting the time banking concept into carpooling, the social values of carpooling can be highlighted rather than the business values. However, as no studies have been conducted to assess how people's perception of the time-credit concept as a payment option affects carpooling adoption intention, it is challenging to integrate it into carpooling.

Further, ride-sharing services worldwide are facing a significant drop due to the global pandemic. Although bike- and scooter-sharing businesses were impacted less than ride-hailing or carpooling services, shared mobility systems were nonetheless seen as a high-exposure method to the virus leading to lower usage levels (Kurcharski & Cats, 2020). For example, it was claimed that fewer carpooling vehicles were used in Pakistan during the ongoing lockdowns brought on by the COVID-19 outbreak because of negative perceptions such as a lack of availability and difficulty finding rides, as well as beliefs that ride-sharing is risky or unsafe and expectations of social discomfort (Xu et al., 2021). Another study conducted in New Zealand and Australia found that attitudes towards public transport, carpooling, domestic air travel and international air travel were all negatively affected (Thomas et al., 2021). However, the lack of studies makes it difficult for authorities to bounce back with effective policy responses. Therefore, the present study is driven to increase understanding of influential factors towards carpooling adoption for educational trips. During this pandemic, as many developing countries face economic crises, sound policy responses are essential to countries' well-being. However, no studies have been conducted during this pandemic period to study carpooling adoption specifically from a psychological perspective in the context of educational trips. Therefore, the present study is timely, essential, and exceedingly crucial for the practical world.

2. Methodology

2.1. Conceptual framework of the model

2.1.1. Social influence

The importance of subjective norms in forming intention is highlighted in many psychological theories, such as Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), and Combined Technology Adoption Model (TAM) & TPB (C-TAMTPB). The social influence construct in the Unified Theory of Acceptance and Use of Technology (UTAUT), and Consumer Acceptance and Use of Information Technology (UTAUT2) theories also represent a similar influence. Both factors represent the influence of other people (people who are essential to the individual)—specifically, family, friends, and coworkers. It can be defined as the degree to which individuals value other people's opinions and behavior for carpooling adoption. Empirical evidence suggests that in the context of carpooling, this influence is substantial (Bulteau et al., 2019; Gheorghiu & Delhomme, 2018; Bachmann et al., 2018). It could be due to two reasons. One is the unfamiliarity with the concept of carpooling. When people are unfamiliar with behavior, they tend to rely on others (Bachmann et al., 2018). The second one is extrinsic motivation. Opinions and suggestions of people who are essential to individuals directly influence their intention. Specifically, people rely on family members, friends, and colleagues. Therefore, the positive influence drives individuals to participate in carpooling. Consequently, it can be assumed that,

2.1.1.1. H1: Social influence (SI) is positively related to the intention to participate in carpooling.. Studies have found that SI motivates technology adoption (Siyal et al., 2019). It indicates that encouragement from social surroundings encourages people to adopt new technology. The motivation coming from the social environment could be due to their satisfaction. It was found that satisfied consumers are more inclined to recommend a service (Fan et al., 2005). Regarding the usage of mobile applications for transport services, it was found that SI positively impacts hedonic motivation. Siyal et al. (2020) found that associated SI positively influences hedonic motivation for using mobile taxi booking apps. Since dynamic carpooling is a relatively new experience, especially in Thailand, most potential participants are more likely to follow the perceptions and encouragement of their social environment. Therefore, the present study assumes assumed that,

2.1.2. H2: Social influence (SI) is positively related to hedonic motivation regarding carpooling

2.1.2.1. Hedonic motivation. It was found that hedonic motivation tends to positively affect consumers' propensity to participate in sharing economy (Hossain, 2020). Hedonic motivation is the fun or pleasure of performing a specific behavior (Venkatesh et al., 2012). Hamari et al. (2016) studied the consumer behavior of collaborative consumption in Finland. Findings indicated that perceived enjoyment significantly affected attitude and intention to participate in collaborative consumption services. Therefore it is apparent that people enjoy participating in sharing economy or collaborative consumption. It is a driving factor influencing their tendency to participate in these programs. Since carpooling falls into collaborative consumption and sharing economy, hedonic motivation may be a significant psychological factor related to carpooling behavior. Park et al. (2018) found that people who prefer to be a driver only when carpooling focus on the convenience and entertaining aspects. These imply that carpoolers may enjoy carpooling. It allows people to meet new people and interact comfortably, making carpooling more enjoyable than other travel modes. Therefore, it can be assumed that,

2.1.3. H3: Hedonic motivation (HM) is positively related to the intention to participate in carpooling.

2.1.3.1. Effort expectancy. Perceived ease of use is a significant variable contributing to forming attitudes, according to the TAM. It is the expected ease of using a particular system or service. TPB introduces the "perceived behavior control" term, similar to the ease of use. It is defined as perceived ease or difficulty in performing the behavior. Effort expectancy in UTAUT and UTAUT2 also indicates a similar definition. Adelé and Dionisio (2020) found that dynamic carpooling difficulties keep users from carpooling again. These difficulties lead to misunderstandings between users. Therefore it is evident that challenges in carpooling use act as barriers that prevent them from carpooling again. Not only carpoolers but also potential carpoolers perceive these difficulties as barriers. Park et al. (2018) reported that arrangement barriers influence current and potential carpoolers. The influence of these difficulties seems to be significant despite the role of interest. Therefore, the easier the individuals view carpooling, the less reluctant they are to participate in carpooling. It indicates that lower effort expectations (less complicated) lead to a higher likelihood of carpool participation. As the term describes the easiness of carpooling, it can be assumed that,

2.1.3.2. H4: Effort expectancy (EE) is positively related to the intention to participate in carpooling. The present study focused on dynamic carpooling. Therefore, associated easiness is related to making carpool arrangements using a mobile application. Past studies suggest that associated easiness positively influences hedonic motivation when technology is involved. Salimon et al. (2017) found that EE positively influences hedonic motivation in e-banking adoption. Further, Siyal et al. (2020) found that EE positively influences hedonic motivation for using mobile taxi booking apps. Dynamic carpooling could be socially and emotionally demanding, meaning that users must put some effort into carpooling (Adelé & Dionisio, 2020). Adelé and Dionisio (2020) found that difficulties associated with the application's intelligent functions create fuzzy negative feelings in carpoolers. Therefore when dynamic carpooling becomes more manageable, it could lead to satisfaction. Therefore, since the present study investigates dynamic carpooling, it is assumed that,

2.1.4. H5: Effort expectancy (EE) positively relates to hedonic motivation regarding carpooling.

2.1.4.1. Perceived safety. The associated risk of sharing economy is high (Wu & Neill, 2021). Regarding ride-sharing, it seems that it significantly impacts the carpool participation intention. Even though psychological theories do not highlight the importance of safety aspects, authors have modified the existing models by including safety aspects. Sofi Dinesh et al. (2021) found a significant influence of perceived safety on carpooling adoption as it influences attitude towards carpooling. It implies that the more people perceive carpool applications to be safe, the more likely they will adopt carpooling. A quantitative study conducted in Belgium showed that the insurance, privacy, safety, and security features of carpooling are among the main themes discussed among the participants (Cools et al., 2013). Furthermore, Park et al. (2018) reported that potential carpoolers are more concerned about privacy and system flexibility than current carpoolers. The empirical results revealed that the perceived risk negatively affects consumers' ride-sharing intention (Wang et al., 2019). However, in the present study, "perceived safety" is defined as an individual's perception of safety and security associated with carpooling. The more people view carpooling as a safe travel mode in terms of privacy, security, conflict, and finances, the more people are prone to participate in carpooling. Therefore, it is assumed,

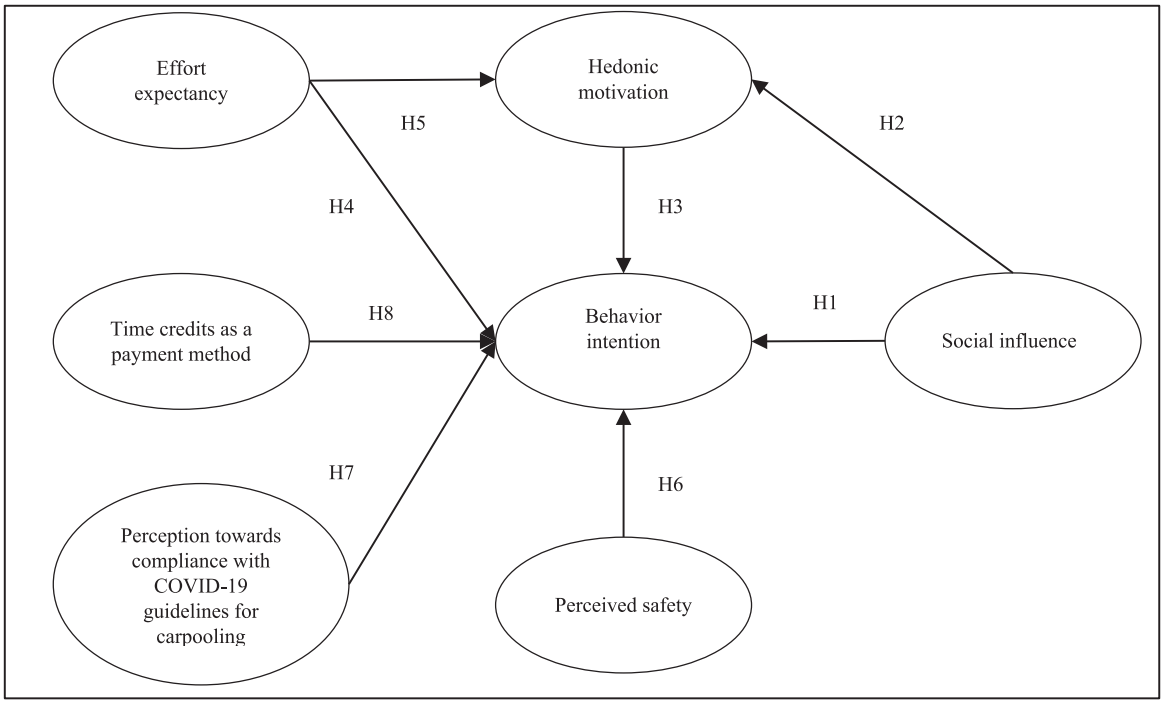

Fig. 1. The conceptual framework of the model.

2.1.5. H6: Perceived safety (PS) is positively related to the intention to participate in carpooling.

2.1.5.1. Perception towards compliance with COVID-19 guidelines for carpooling. The transport sector is one of the leading sectors primarily affected by the COVID-19 pandemic. Abdullah et al. (2020) found that movement restrictions have effectively reduced the mobility of people in many countries. Further, it was observed that people rely more on private cars and active modes than public transport due to the fear of getting infected (Przybylowski et al., 2021). It was reported that internet searches for second-hand (used) cars for sale in the United Kindom increased (Serafimova, 2020). A similar mode share increment was observed in Chinese cities (Riggs & Appleyard). This trend will have a negative impact in the long run. Carpooling seems to be a proper choice for this situation mainly for two reasons. First, it is one way to avoid crowded modes such as public transport, which is perceived as one of the riskiest (Barbieri et al., 2021). Secondly, it will reduce the demand for public transportation, increasing the safety of captive public transport passengers. Studies have shown that the COVID-19 precautionary measures levels were highly significant (Xu et al., 2021). Therefore, people believing that carpooling is not a risky travel mode that could potentially spread COVID-19 if safety guidelines are correctly followed may significantly impact their decision to carpool. The present study attempted to test this relationship by including the "Perception towards compliance with COVID-19 guidelines for carpooling "factor in the conceptual model. The health guidelines provided by the Center for Disease Control and Prevention (CDC)-in the USA for carpoolers during COVID-19 fall under four aspects (NCIRD, 2020). The first piece of advice is to limit the number of participants. Further, it is advised to wear face masks for all participants. The following advice is regarding the sharing vehicle. To provide proper ventilation, CDC recommends carpoolers use open windows whenever they carpool. Further, keeping the shared vehicle disinfected and cleaned all the time is highlighted. Considering these aspects, four measurement items (CO1-CO4) were developed to address them. If guidelines are correctly followed, it is defined as the extent to which individuals believe carpooling is not a venue for COVID-19 spreading. Therefore, it is assumed,

2.1.6. H7: Perception towards compliance with COVID-19 guidelines for carpooling (CO) is positively related to the intention to participate in carpooling.

2.1.6.1. Time credits as a payment method. The time credit concept is getting attention worldwide as an alternative payment option, especially in the sharing economy. It is introduced under the time banking concept, where people exchange services among themselves in exchange for time. Time banking communities are introduced into universities in many countries, and they are getting positive feedback from students. During a 7-week time banking project initiated at the University of Georgia, USA, it was found that transportation (e.g., providing rides) is one of the most common types of exchange (Matthew, 2020). Therefore, in the context of carpooling, offering someone a ride will earn the offeror time credits. The offeror can use the earned time credits to receive free carpool rides. The on-campus time banking program initiated at Dharma Drum university in Taipei, Taiwan, allowed students to earn time credits by performing on-campus jobs such as being a research or teaching assistant, operating the university website, or working at the campus library (Hirwa et al., 2021). Therefore, in the university context, other volunteer services could be offered to earn time credits. Informal tutoring, help with assignments, and helping organize campus events could such voluntary services.

Further, there could be other ways to spend the earned time credits. The feasibility study conducted at the University of Canterbury (UC), New Zealand, found that educational needs, such as informal tutoring, proofreading, grammar and spelling help, and help with assignments as the needs that could be catered for through a time bank at UC (Geary, 2010). Therefore, students may spend earned time credits on activities such as participating in conferences and special workshops. Getting a free parking pass is also a such activity that is more appropriate for universities. As participants get different exchange services, combining the time credit concept with carpooling will shift the cost-saving perception of carpooling to helping others. It highlights social value. The time credit variable is defined in the present study as the extent to which individuals perceive time credit as an alternative payment option for carpooling. The more people believe time credits to be a better

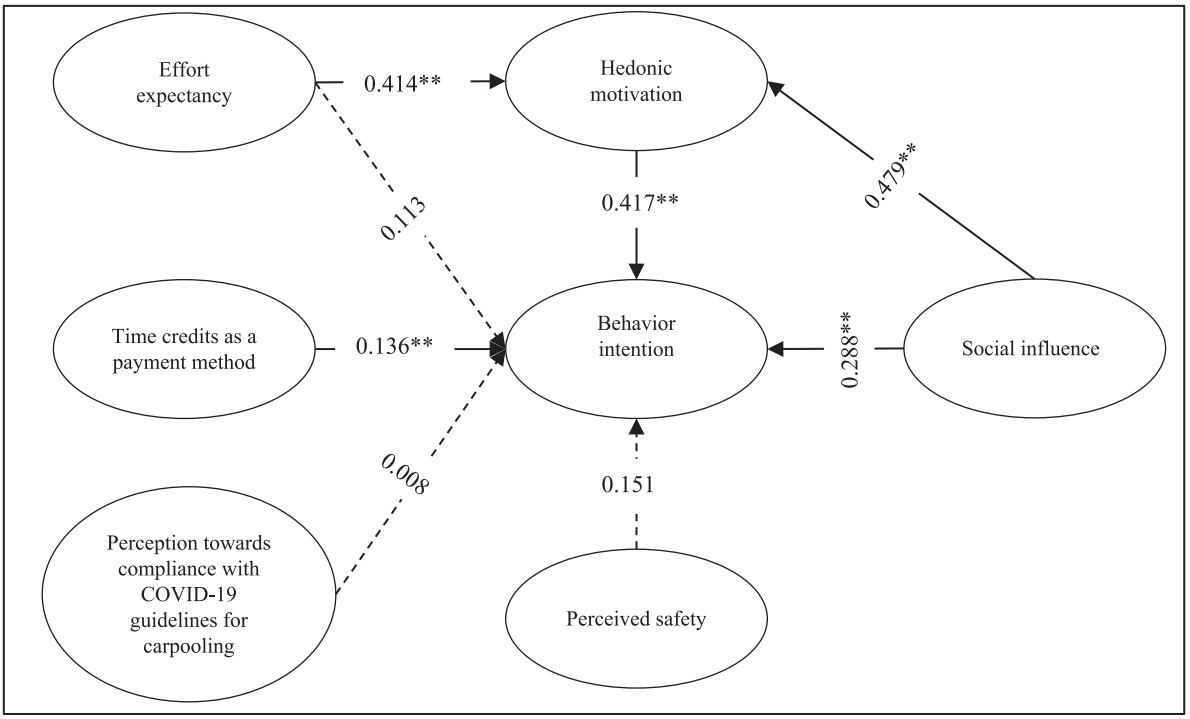

Fig. 2. The model developed with mediating variables.

payment option for carpooling, the more they recognize the social value of carpooling. Therefore, it is assumed.

2.1.6.2. H8: Time credits as a payment method (TC) is positively related to the intention to participate in carpooling. The conceptual model was designed according to the hypothesis developed in this section. Fig. 1 shows it in a graphic form. The survey instrument was developed to measure above discussed constructs using measurement items. It is described in the next section.Fig. 2..

2.2. Statistical model development and analysis

Many mathematical models can be used to explain carpool choice behavior. Depending on the study purpose, and the type of data available, the choice of the model or theory varies. Structural Equation Modelling (SEM) is the most popular and commonly used method for analysis in the presence of psychological factors. SEM can handle measurement models that explain the relationship between measurement items and latent variables and the structural model that simultaneously describes the relations between latent variables. Psychological theories illustrate how these latent variables are related. Many psychological theories highlight the importance of several significant drivers of behavioral intention or actual behavior in relevance to carpooling. The conceptual model was developed by paying attention to these highlighted behavioral influences.

2.2.1. Establishment of the measurement items

The latent variables are measured using measurement items. The measurement items are the responses to questions reflected in the concept of the latent variable. This study's measurement items were designed as questions in the questionnaires (see Appendix A). For example, the four measurement items used to measure the latent variable "social influence" reflect four different aspects of social influence variables. Similarly, for other latent variables, different measurement items were developed. For effort expectancy, social influence, hedonic motivation, perceived safety, and perception toward compliance with COVID-19 guidelines for carpooling factors, four measurement items were developed, and for the time credits as a payment method factor 3 measurement items were developed. Therefore, altogether 27 measurement items were used.

2.2.2. Examination of Non-normality

Severe multicollinearity between measurement items could lead to trouble in SEM analysis. As highly correlated measurement items are so close as to be almost repetitive, they should be eliminated before moving on to SEM. Both univariate and multivariate normality is assessed to grasp the non-normality levels of the data set. The univariate normality distribution can be examined by skewness and kurtosis values of observed variables. Multivariate normality can be assessed using Mardia's test for multivariate normality. In the presence of non-normality within the data set, using the Weighted Least Square Mean and Variance Adjusted (WLSMV) estimator is the best method for estimating the parameters. It is a variant of the Diagonally Weighted Least Square (DWLS) estimator and can handle categorical endogenous and non-normal data (Hair et al., 2017).

2.2.3. Confirmatory factor analysis

Once the data set is assessed, Confirmatory Factor Analysis (CFA) is conducted. It will confirm the measurement model structure which will be used for SEM. The acceptable fit of the model indicates the hypothesis that items reflect the latent variables. It ensures the construct's validity. All the factor loadings is kept above 0.5 for the unidimensionality of the model (Alsheikh et al., 2021). Convergent validity can be achieved as all measurement items are statistically significant. Composite Reliability (CR) values can be evaluated, and all values higher than 0.7 indicate high reliability of the model constructs (Fornell & Larcker, 1981). The correlations and Heterotrait-Monotrait ratio of correlations (HTML) values between the constructs can be used to assess the discriminant validity. Less severe correlations between the exogenous constructs and HTML values less than 0.9 indicate that the measurement model achieves discriminant validity (Alsheikh et al., 2021; Cheung & Wang, 2017).

Table 1
Descriptive statistics of socioeconomic, travel-related, and carpool-related variables.

Variables	Description	% Of responses	Variables	Description	% Of responses
Socioeconomic characteristics					
Gender	Male	31.92	Household car number	Zero cars	5.86
	Female	66.12		One car	26.71
	LGBT	1.95		Two cars	35.18
				Three or more cars	32.25
Household income	Less than 10,000 baht	12.25	Household motorcycles number	Zero motorcycles	24.43
	10,000–19,000 baht	7.17		One motorcycle	31.92
	20,000–29,000 baht	9.77		Two motorcycles	25.41
	30,000 baht or more	45.27		Three or more	18.25
	Do not wish to tell	25.73			
Travel-related variables					
Distance from home to school	Less than 5 km	58.31	Main travel mode to/from the University	Cycling	7.49
	5 km- 10 km	12.38		Walking	18.24
	10 km- 15 km	2.61		Motorcycle taxi	13.36
	15 km- 20 km	4.56		Private motorcycle	7.82
	More than 20 km	22.15		Private car (Passenger)Private car	11.07
Days of travel per week	One day	6.51		(Driver)	16.61
	Two days	8.47		Carpool	3.91
	Three days	17.59		Motor-taxi	1.30 10.42
	Four days	19.87		Public bus	0.65
	Five or more	47.55		Train	8.14
				Shuttle bus/van	0.98
				Songthaew	
Carpool-related variables					
Carpool experience	Carpooled before	10.10	Interested carpool role	Driver only	4.23
	Not carpooled before	89.90		Passenger only	67.75
				Both roles	21.82
				Neither role	6.19

LBGT: Lesbian, Gay, Bisexual, and Transgender.

2.2.4. Model estimation and interpretation

Once the CFA is conducted, the SEM model is estimated based on the proposed conceptual model and the model's fitness is assessed. As there are no specific rules for evaluating the model fit in SEM, it is sensible to use fit indices which are more insensitive to sample size, model misspecification, and parameter estimates: Chi- Square statistic, Degrees of freedom and p-value, Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Residual (SRMR), Comparative Fit Index (CFI) and parsimony fit index such as the Parsimonious Normed Fit Index (PNFI) (Hooper, Coughlan and Mullen, 2008). CFI, TLI, and RMSEA are the most used fit indices. Once fit of the SEM is established, facor loadings of the model can be used to interpreting the model results.

2.3. Data collection procedure

Understanding these determinants' influence on the adoption of carpooling is crucial to building sound policies to promote carpooling. Therefore, the current study focused on the impact of psychological determinants (effort expectancy, social influence, hedonic motivation, perceived safety, perception toward compliance with COVID-19 guidelines for carpooling, and time credits as a payment method) on carpool behavior intention. The survey instrument was developed to measure above discussed constructs using measurement items. The details are shown in the Appendix. The measurement items were measured using a five-point Likert scale. It allows respondents to indicate their levels of agreement with the given statement. The scale is ranked strongly disagree, disagree, agree, and strongly agree, with a neutral point in the middle. The respondents perceive the 5-point scale as relatively quick and easy to use, preventing the respondents from becoming frustrated and demotivated and increasing the response rate and quality (Sachdev & Verma, 2004; Babakus & Mangold, 1992; Devlin et al., 1993).

The questionnaire consisted of five subsections. At the beginning of the questionnaire, an introduction is given to carpooling for respondents who are unaware of carpooling (by watching a short video with an explanation by the interview staff). The first subsection of the questionnaire collects information related to psychological factors. The second section is dedicated to viewing respondents' perceptions of COVID-19. The third section was devoted to gathering information about the perceptions of the time-credit concept and carpooling. Since the time-credit concept is new in Thailand, an introduction to the time-credit concept is given to familiarize the respondents to the concept before answering the questionnaire (by watching a short video with an explanation by the interview staff). The respondents' socioeconomic backgrounds, such as age, gender, income, etc., were gathered in the fourth section. The final section is used for travel patterns.

For SEM, determining sample size is not as straightforward. A smaller sample size could lead to concerns with insufficient convergence, boundary or Heywood solutions (where the parameters are outside the acceptable range), the inability to place limits on the parameters, and challenges with estimating standard errors (Bentler & Chou, 1987). Anderson et al. (1984) stated that any SEM requires approximately 150 responses for models where constructs comprise three or four indicators. For robust DWLS estimators with binary or ordinal variables, which is the case in the present study, it is recommended to have an overall sample size higher than 200 (Bandalos, 2014; Forero et al., 2009). Nunnally (1967) recommended ten cases per variable, a widely used criterion. Tinsley and Tinsley (1987) suggested a ratio of 5 to 10 participants per item for $N = 300$. Accordingly, for the present study, 270 is the minimum sample size required (27 measurement items, as discussed in section 2.2.1). Researchers have recently recommended using power analysis to decide the minimum sample size (Hair et al., 2017; Hair et al., 2019; Kline, 2015; Uttley, 2019). For business and social science researchers, G*Power (Faul et al., 2007, 2009) software tool is frequently the first choice for power analysis (Ali Memon et al., 2020). The power study is conducted using the G*Power software tool with specifications of the effect size at 0.15 (medium effect), alpha at 0.05, and power at 0.80, as suggested by Ali Memon et al. (2020). By applying the number of predictors (latent variables) results in the minimum number of samples of 93. Therefore, considering all concerns, the questionnaire survey was targeted at 300 responses.

Table 2
ANOVA table for travel mode influence analysis.

Source	DF	Sum Sq	Mean Sq	F- value	Pr(>F)
Main travel mode	11	15.73	1.430	1.453	0.149
Residuals	295	290.27	0.984		

3. Results

3.1. Data source and descriptive statistics

The online questionnaire survey was conducted from 20/02/2022 to 29/03/2022. During this period, Thailand did not appear to be experiencing a big surge of COVID-19 cases as in some other countries. However, the average number of new community-acquired COVID-19 cases reported per day continues to increase (WHO- Thailand, 2022). At the same time, the vaccination rate was also increasing. Therefore, key locations such as educational institutions were partially reopened. The survey took place at Thammasat University, Rangsit Campus, Pathum Thani, Thailand. The questionnaire survey was done online using google forms. A simple random sampling technique was applied to gather the data because this technique allows each respondent an equal probability of being selected and provides a data sample to represent the whole population. However, the distribution of samples by faculties and gender (male/female) was attempted. Therefore, the responses from students were correctly distributed based on the actual number of students by each faculty at Thammasat University, Rangsit campus. They are all local undergraduate students who study full time.. Furthermore, the actual proportion of males to females in Thammasat University is ½, which is close to our survey. Therefore, the responses from undergraduate students were collected representing all 24 faculties at Thammasat University, Rangsit campus. The actual proportion of males to females is 32.6 %/67.4 %, which is quite a close ratio for the survey data. Toward the end of the survey, 341 responses were collected. After cleaning, 307 remain valid responses for the analysis, satisfying the minimum number of responses required. Table 1 summarizes the characteristics of the respondents.

Regarding gender, the sample contains 31.92 % male, 66.12 % female respondents, and 1.95 % LGBT (Lesbian, Gay, Bisexual, and - Transgender) respondents. Regarding age, they are all university students whose ages are between 18 and 29 years old. Then the household vehicle ownership was considered by vehicle type. 26.71 % of the respondents have one car in their household, while only 5.86 % do not have any cars in their houses. The remaining sample (67.43 %) have two or more cars in their families. Therefore, in terms of car ownership, the majority have cars in their household.

Regarding motorcycles, 75.58 % of the sample have at least one motorcycle in their household. About 24.43 % of the respondents do not have motorcycles, while 31.92 % have one motorcycle. However, 18.25 % do have three or more motorcycles in their households. Household monthly income data reveal that 45.27 % of respondents' household incomes are 30,000 baht or above, whereas the average monthly income per household in Thailand in 2021 amounted to approximately 27,000 baht (Statista Research Department, 2022). Regarding the main travel mode, the majority (18.24 %) travel by walking, while 16.61 % and 11.07 % travel by private cars as drivers and passengers, respectively. Together it is about 27 %, indicating high usage of private cars to travel to school. Motorcycle taxis and public buses are also popular travel modes among students. The percentages of students who use cycling, personal motorcycles, and shuttle buses or vans are almost the same (7.49 %, 7.82 %, and 8.14 %). The lack of popularity of carpooling among students is evident here, as only 3.91 % carpool to school.

One way ANOVA test is performed to determine whether there is difference in the latent score of the behavior intention (carpool adoption) among different travel modes. Results indicated no significant difference in behavior intention among different travel modes (Table 2).

Table 3
Descriptive statistics of the latent variables regarding behavior intention, COVID-19, and time credits.

Variables	% Of responses Agree/ Strongly Agree	% Of responses Neutral	% Of responses Disagree/ Strongly Disagree
Carpool behavior intention			
(BI1) I consider carpooling as a good transport option.	77.20	15.96	6.84
(BI2) I am curious (want to know more about) to carpool	68.73	23.45	7.82
(BI3) I will carpool to work/school if it is available.	70.68	20.85	8.47
(BI4) I think I will carpool and recommend carpooling as a transportation mode to others	59.28	32.90	7.82
COVID-19 influence on carpool decision			
(COD1) COVID-19 does not affect my decision to use Carpooling.	27.69	16.29	56.03
Perception towards compliance with COVID-19 guidelines for carpooling			
(CO1) Carpooling is not a venue for COVID-19 spreading if the sharing car is well disinfected.	41.04	33.88	25.08
(CO2) Carpooling is not a venue of COVID-19 spreading if all participants (including the driver) wear facemasks properly.	50.49	28.99	20.52
(CO3) Carpooling is not a venue for COVID-19 spreading if the sharing car uses open windows.	37.46	32.25	30.29
(CO4) Carpooling is not a venue of COVID-19 spreading if participants are limited to a driver and a passenger.	55.05	28.34	16.61
Influences of COVID-19 vaccination on carpool decision			
(COV1) I will use Carpooling if all participants (including the driver) are required to be fully vaccinated at least two doses) against COVID-19.	73.29	19.22	7.49
Time credits as a payment method			
(TC1) I think time credits would be an interesting form of payment method for carpooling.	80.46	14.01	5.54
(TC2) I think it is convenient to use time credits as a payment method for carpooling rather than money.	54.40	25.08	20.52
(TC3) I think time credit is an acceptable payment method for carpooling.	72.96	22.48	4.56
Social value of Time credits			
	73.62	18.89	7.49

(continued on next page)

Table 3 (*continued*)

Variables	% Of responses Agree/ Strongly Agree	% Of responses Neutral	% Of responses Disagree/ Strongly Disagree
(STC1) I think carpooling with time credits will be a better way to help others without expecting money in return.			
(STC2) I think carpooling with time credits helps create a better-connected campus society.	75.57	17.92	6.51

When traveling distance is considered, 58.31 % of the respondents travel less than 5 km to school, while the rest travel more than 5 km. As carpooling considered in the present study is from home to school, this is the travel distance they imagine carpooling. Students who commute less than 5 km may live on campus or in nearby dormitories. Among these students, 20 % use cars, 28 % use motorcycles, 28 % walk, 12 % use bicycles, and the rest use other forms of transportation. Even with a short commuting distance, carpooling is a viable option for students who use cars as it reduces travel costs and demand for parking spaces on campus. This is evident in the responses, as 72 % of students who use cars and live within 5 km of the campus are willing to consider carpooling to school. Interestingly, 66 % of students who currently walk to the university stated that they would carpool if it were available. In Thailand, the hot climate may cause students to prefer carpooling over walking. Carpooling offers a more comfortable travel experience compared to other modes of transportation such as walking, motorcycles, and motorcycle taxis. Most (60.91 %) of the respondents travel at least four days per week. The respondents who travel one and two days are 6.51 % and 8.47 %, respectively, while 17.59 % travel three days per week.

Characteristics related to carpooling reveal exciting information. The questionnaire asks respondents to state which carpool role they are interested in and whether they have carpooled before. The majority (89.9 %) do not have experienced carpooling before. Only 10.1 % have stated that they have carpooled before. Therefore, information from inexperienced carpoolers could be extensively valuable to developing and presenting sound policy implications that can increase carpool adoption in Thailand. It was observed that most of the respondents (93.8 %) were interested in carpooling. Coming from a young generation indicates that universities and other educational institutes will be perfect candidates to initiate carpool programs in Thailand to diffuse carpool adoption. However, in the specific role, 67.75 % stated they were interested in carpooling as passengers only, while only 4.23 % showed interest in the driver role only. Regarding both roles, 21.82 % showed interest in both roles, while 6.19 % were not interested in either role.

A descriptive analysis was conducted to get an oversight of the responses for different latent aspects related to carpooling. The questionnaire asks respondents to rate their agreement on four statements regarding behavior intention to carpool from home to school. Table 3 illustrates the distribution of the responses on them.

The majority (77.20 %) consider carpooling a good transport mode, while 68.73 % stated that they are curious about carpooling and want to know more about it. In addition, many (70.68 %) said they would carpool to school if available. Furthermore, 59.28 % think they will also recommend carpooling to others. Therefore, overall, respondents have viewed carpooling positively.

One of the most critical latent aspects that are considered in the present study is the perception towards COVID-19 and carpool. The questionnaire asked respondents to state their agreement on six different statements regarding COVID-19 and to carpool. According to Table 3, the majority (56.03 %) said that they believe their decision to carpool is affected by COVID-19. However, 73.29 % think they will use carpooling if all participants (including the driver) are requested to be fully vaccinated (at least two doses) against COVID-19. It is interesting as carpooling faced a risk of decreasing during the lockdown period. Further majority of the respondents believe that carpooling is not a venue for COVID-19 spreading if proper guidelines are followed. Of 307 respondents, 43.01 % believe carpooling is not a venue for COVID-19 spreading if the shared car is well disinfected. The proportion of respondents (37.46 %) who say that carpooling is not a venue of COVID-19 spreading if the sharing car use open windows is slightly higher than the proportion of respondents (30.29 %) who do not believe that. Furthermore, more than 50 % of the respondents believe carpooling is not a venue of COVID-19 spreading if all participants (including drivers) wear

Table 4
Factor loadings, Correlations, HTML values, and CR values of the constructs.

Latent variable	Items	Loadings	CR	EE	HM	SI	PS	BI	CO	TC
Effort expectancy (EE)	EE2	0.599	0.759	1						
	EE3	0.821								
	EE4	0.718								
Hedonic motivation (HM)	HM1	0.702	0.839	0.730	1					
	HM3	0.879		*0.680*						
	HM4	0.805								
Social influence (SI)	SI1	0.705	0.830	0.648	0.743	1				
	SI2	0.721		*0.616*	*0.720*					
	SI3	0.856								
	SI4	0.677								
Perceived safety (PS)	PS1	0.638	0.718	0.817	0.708	0.714	1			
	PS2	0.727		*0.833*	*0.672*	*0.698*				
	PS4	0.667								
Behavioral intention (BI)	BI1	0.615	0.752	0.812	0.881	0.841	0.814	1		
	BI3	0.739		*0.796*	*0.873*	*0.821*	*0.779*			
	BI4	0.789								
Perception towards compliance with COVID-19 guidelines for carpooling (CO)	CO1	0.794	0.860	0.551	0.448	0.458	0.543	0.560	1	
	CO2	0.870		*0.552*	*0.455*	*0.446*	*0.583*	*0.566*		
	CO3	0.740								
	CO4	0.639								
Time credits as a payment method (TC)	TC1	0.748	0.847	0.677	0.489	0.489	0.612	0.637	0.498	1
	TC2	0.762		*0.661*	*0.441*	*0.448*	*0.608*	*0.605*	*0.503*	
	TC3	0.727								

Correlation between latent variables.
Italic and underlined values are the Heterotrait-Monotrait ratios of correlations (HTML).

Table 5
Standardized effects between the latent variables of the model.

Hypotheses relationship		Standard effect	P-value	Results
H1	Social influence -> Behaviour intention	0.288**	0.002	Accepted**
H2	Social influence -> Hedonic motivation	0.479**	0.000	Accepted**
H3	Hedonic motivation -> Behaviour intention	0.417**	0.000	Accepted**
H4	Effort expectancy -> Behaviour intention	0.113**	0.435	Rejected
H5	Effort expectancy -> Hedonic motivation	0.414**	0.000	Accepted**
H6	Perceived safety -> Behaviour intention	0.151**	0.306	Rejected
H7	Perception towards compliance with COVID-19 guidelines for carpooling -> Behaviour intention	0.008**	0.892	Rejected
H8	Time credits as a payment method -> Behaviour intention	0.136**	0.016	Accepted**

facemasks properly and if participants are limited to drivers and passengers. Therefore, looking overall, it is quite clear that the younger generation considers carpooling as a safe travel mode during this COVID-19 pandemic if safety guidelines are correctly followed. Further, they are willing to carpool if all participants are vaccinated, including the driver.

Another newly introduced important aspect considered in the present study is the "time credits." It is a sharing economy concept gaining popularity as an alternative to monetary payment. Time credits are used to develop well-connected and sustainable communities in developed countries. The present study asked respondents to state their level of agreement with five statements regarding carpooling and time credits. Many (80.46 %) believe that time credits would be an interesting form of payment method for carpooling. Furthermore, 72.96 % think it would be an acceptable payment method. However, when it comes to convenience, the portion of respondents who agreed that time credits would be a convenient payment method was reduced to 54.4 %. Still, it is more than 50 % of the respondents. Furthermore, most respondents see the social value of using time credits instead of money, as 73.62 % recognize that carpooling with time credits will be a better way to help others without expecting cash in return. Moreover, 75.57 % believe carpooling with time credits helps create a better-connected campus society. Therefore, looking at the overall outcome, it is pretty clear that students positively view time credits. As this comes from a university community, it opens the possibility of introducing the time credit concept among the university community and developing a well-connected society.

3.2. Structural Equation Modelling

The maximum correlation between observed variables was 0.701, and the minimum correlation was 0.028, which can be considered less severe as they are less than 0.85 (Weston & Gore, 2006). Therefore, none of the measurement items were removed. Values of skewness range between −1.68 to 0.19, while kurtosis values range from −0.70 to 3.69 for all observed variables. Absolute skewness values less than or equal to 1.25 and kurtosis values less than 3.75 indicate moderate non-normality (Flora & Curran, 2004). Conversely, skewness values higher than 3 indicate severe non-normality. Therefore, the sample can be considered moderately non-normal in univariate normality. For both statistics regarding Mardia's test, p-values were less than zero, indicating the presence of multivariate non-normality in the data set. Therefore, the Diagonally Weighted Least Square (DWLS) estimator was used for analysis. All the investigations have been conducted using R studio. For SEM, the *lavaan* package has been utilized in the present study.

The values of CFI (0.998), TLI (0.997), and RMSEA (0.024) values indicated that the measurement model fit the data well (Hu & Bentler, 1999; Steiger & Lind, 1980). It ensured the construct validity of the model. All the factor loadings were kept above 0.5 for the unidimensionality of the model (Alsheikh et al., 2021). Table 4 contains all CR values of each construct. All CR values were higher than 0.7 indicating the reliability of the model constructs (Fornell & Larcker, 1981). It also includes correlations and the Heterotrait-Monotrait ratio of correlations (HTML) values between the constructs. Correlations between the exogenous constructs were not severe (less than 0.85). Further, HTML values were less than 0.9, indicating that the measurement modes achieve discriminant validity (Alsheikh et al., 2021; Cheung & Wang, 2017).

Table 6
Standardized effects between the latent variables of the model.

Latent variables	Hedonic motivation (mediating variable) Direct effect	Behavior intention Direct effect	Indirect effect	Total effect
Effort expectancy (EE)	0.414 (5.560)**	0.113 (0.780) **	0.506 (-6.254) **	0.285 (2.143) **
Perceived safety (PS)	–	0.151 (1.023) **	–	0.151 (1.023) **
Perception towards compliance with COVID-19 guidelines for carpooling (CO)	–	0.008 (0.135) **	–	0.008 (0.135) **
Social influence (SI)	0.479 (6.730)**	0.288 (3.036) **	0.200 (3.709)**	0.487 (5.718) **
Hedonic motivation (HM)	–	0.417 (4.412) **	–	0.417 (4.412) **
Time credits as a payment method (TC)	–	0.136 (2.404) **	–	0.136 (2.404) **

Summary of model estimation.
Iterations: 61 times; Estimator: DWLS; Optimization method: NLMINB.
Comparative fit index (CFI) = 0.998.
Tucker-Lewis index (TLI) = 0.997.
Root mean square error of approximation = 0.024.
'–' defines no parameter estimate.
Significance codes: '**' 0.05; '*' 0.1.
Parameter estimate (Z-vales are within brackets).

The parameters of the structural model were estimated after 61 iterations. CFI (0.998), TLI (0.997), and RMSEA (0.024) values indicated that the structural model fit the data well. Table 5 contains the summary hypotheses tested. According to the table, it can be observed that all the relationships showed a positive impact on behavior intention to carpool despite its statistical significance. However, as shown in Table 5, three out of the eight hypotheses developed were not backed up statistically. They are the direct impact of effort expectancy, perceived safety, and COVID-19 factor on behavior intention.

Table 6 describes the summary of the model output. Social influence, hedonic motivation, and time-credit factors significantly positively influenced behavior intention in a direct manner. The direct positive impact of social influence indicates that the effect of family members, friends, and colleagues is vital for carpooling. The positive impact of hedonic motivation suggests that when forming an intention to carpool, people give more attention to the enjoyment and pleasure associated with carpooling. The effect of time credits shows the possibility of adopting time credits for carpooling. The effort expectancy component had no significant effect on behavior intention directly. Perceived safety factor also did not significantly influence behavior intention. It indicates that the young generation may not be concerned about the safety associated with carpooling when they intend to carpool. The Perception towards compliance with COVID-19 guidelines for carpooling factor also did not significantly impact behavior intention; its effect on behavioral

intention is very low.

Investigation of mediated influences allows us to find both direct and indirect effects of exogenous variables. According to the model results, effort expectancy indirectly affects behavior intention through hedonic motivation. It did not have a significant direct impact on behavior intention. Its indirect impact is 0.173, while the total effect is 0.258. The significant full effect of effort expectancy is higher than the effect of time credits. Model results also show social influence has a significant indirect impact of 0.200 hedonic motivation.

The respondent's profiles may influence the intention to use carpool, for example, active mode users vs motorized mode users, male vs female, travel distance less than 5 km vs higher than 5 km and drive car and do not drive car. Multigroup analysis (Hair et al., 2017) was carried out to investigate difference between groups of respondents. However, the results were not significant and are not included in this paper.

4. Discussion

4.1. Summary and interpretation of findings

The first hypothesis (H1) was confirmed, showing that carpooling depends on the influence of friends, family, and coworkers. Further, the more carpooling becomes general to the people, the more people will carpool. Previous studies have reported similar results (Gheorghiu & Delhomme, 2018; Lanzini & Khan, 2017; Bachmann et al., 2018). For example, a survey of the working community in France found that the effect of family members and colleges is essential for carpooling (Bulteau et al., 2019). The positive impact of hedonic motivation indicated that the third hypothesis (H3) is confirmed. It implies that people focus more on the delight and pleasure of carpooling when deciding to do so. Especially this young generation is more concerned about the joyfulness of carpooling than other aspects when they intend to carpool. Even though it is not specific to carpooling, past studies have shown that hedonic motivation tends to have a significant positive effect on consumers' propensity to participate in sharing economy and collaborative consumption services (Hossain, 2020), which is consistence with the present study findings. The impact of the time-credit factor is relatively low compared to the other two elements. Still, time credit's direct positive impact shows eighth hypothesis (H8) is acceptable. It suggests that time credits for carpooling may be adopted. It shows that the young generation is willing to consider time credits as an alternative payment option, and the more they think about it, the more they are likely to adopt carpooling. Therefore, adopting time credits for carpooling will effectively highlight the social values of carpooling. Even though studies have investigated and initiated time banking communities within universities (Hirwa et al., 2021; Geary, 2010), no studies have investigated time credits in the context of carpooling. As the present study findings showed, if time credit is introduced as a payment option for carpooling, a positive response from university students can be expected.

Confirming the fifth hypothesis (H5), effort expectancy indirectly affected behavior intention through hedonic motivation. It did not significantly affect behavior intention directly, leading to rejecting the fourth hypothesis (H4). It suggests that the easier it becomes for people to make carpool arrangements through mobile applications, they are more likely to view carpooling as a joyful travel mode and, therefore, more inclined to adopt carpooling. Even though it may not be tricky for the young generation to use mobile applications for carpooling, increasing the easiness associated with it will indirectly attract more people to carpool. Its direct effect is 0.173, whereas its overall impact is 0.258. More so than the impact of time credits, effort expectancy has a substantial complete effect. Due to its solid indirect impact, effort expectancy's influence is comparatively more significant than time credits, even if it did not directly change behavior intention. Model results demonstrate a substantial indirect impact of the social effect on the hedonic motivation of 0.200, supporting the second hypothesis (H2). It implies that the higher the encouragement they would receive from social surroundings to carpool, the more individuals are likely to view carpooling as a joyful travel mode and, therefore, more inclined to adopt carpooling. Due to the significant indirect impact, the total effect of social influence on behavior intention is higher than the direct impact of hedonic motivation. This tells us that compared to hedonic motivation, social influence is vital for potential carpoolers to consider carpooling for educational trips.

Perceived safety factor did not significantly influence behavior intention, which led to rejecting the sixth hypothesis (H6). It suggests that when young people decide to carpool, they may not be worried about the safety implications of doing so. This mimics a finding of a recent study conducted in Bangkok. Tsai et al. (2021) also reported that risks do not affect carpool intention for the younger generation. Therefore, it is evident they pay less attention to the safety aspects of carpooling. As descriptive statistics showed, many people believe COVID-19 will affect their decision to carpool. However, the perception towards compliance with COVID-19 guidelines for carpooling factor did not significantly impact behavior intention rejecting the seventh hypothesis (H7). It indicates that when the COVID-19 guidelines for carpooling are strictly followed, people's behavioral intention to adopt carpooling is unaffected by their belief that carpooling is a venue for COVID-19 spreading, especially the young generation. Studies have shown that commuters are more conscious of COVID-19 preventive measures (Xu et al., 2021). During the survey period, Thailand was partially re-opened, and people traveled cautiously. Therefore, it is possible that, believing it or not, carpooling is a venue of COVID-19 spreading and has no significant direct effect on behavior intention.

4.2. Policy implications

It is observed from the descriptive statistics that most people believe that they will use carpooling if all participants (including the driver) are requested to be fully vaccinated (at least two doses) against COVID-19. It is interesting as carpooling faced a risk of decreasing during the lockdown period. Since the vaccinations started, people have been traveling with less fear. Therefore, regulations or policies that request all carpool participants to be vaccinated will be beneficial in increasing carpool adoption in Thailand. The guidelines should be consistent with the public health protocols.

Due to the positive feedback from university students on time credits as an alternative payment method for carpooling, it is possible to initiate time banking programs through universities. Therefore, Carpooling can be highlighted as the main action of the programs. With time banking programs offering and receiving carpool rides occur without monetary involvement. It will help create a well-connected campus society and a sense of helping others among students. With more background studies, it can be expanded from universities to the community. It will aid people in seeing the social values of carpooling instead of monetary values.

According to empirical findings, social influence has a positive impact on carpooling. Previous studies also have reported similar results. For example, a survey of the working community in France found that the effect of family members and colleges is essential for carpooling (Bulteau et al., 2019). Therefore, promotional efforts should highlight that carpooling is possible with friends, family, and coworkers and encourage them to carpool. Further, its indirect effect will lead participants to view carpooling as a pleasurable experience, effectively increasing carpool adoption in Thailand. In addition, previous studies found that descriptive norms (Following most others do) are significant for carpooling (Lanzini & Khan, 2017), mimicking the present study's findings. Therefore, the promotional effort should highlight carpooling as people's travel mode and its widely used by others. As a result, it will increase the likelihood of people using carpooling for educational trips.

Past studies have shown that hedonic motivation tends to positively affect peoples' propensity to participate in sharing economy. Furthermore, a recent study in Bangkok found that enjoyment predicts perceived value, which influences the intention to carpoo (Tsai et al.,

2021). Although their study did not reveal a direct link between behavioral intention and enjoyment, the present study found that hedonic motivation significantly positively affects carpool adoption. Therefore, the campaigns could promote carpooling as an existing experience. Also, carpooling is interesting, and the participants would enjoy it. Thus, promotional efforts highlighting these enjoyment aspects of carpooling will effectively increase carpool adoption in Thailand. Further, as Tsai et al. (2021) proposed, carpooling companies should focus on making the carpool service engaging and pleasurable, as enjoyment is one of the key factors driving the intention to use carpooling.

The present study found that effort expectancy indirectly influences the behavioral intention to carpool for educational trips through hedonic motivation. Therefore, carpooling campaigns should promote dynamic carpooling is easy in terms of paying and arranging a convenient carpooling. Consequently, it will increase the joyfulness of the carpool experience and lead to higher adoption of carpooling for educational trips. Also, carpooling service providers should make dynamic carpooling as simple as possible. For example, they could provide more accessible payment methods.

Furthermore, they could give a program that could ease planning the rides according to the user's schedule. Also, a good and straightforward mapping program could offer convenient travel routes according to user requirements. These actions will increase carpool adoption for educational trips in Thailand.

5. Conclusions and recommendations

Sharing economy concepts like carpooling are more prevalent in developed countries and have been widely adopted by daily commuters. However, due to a lack of understanding and background studies, it has received less attention in developing countries. Therefore, the present study aims to understand the determinants and behavioral influences of carpooling adoption in Thailand. A conceptual model was proposed primarily based on the behavioral factors from psychological models and introduced additional constructs named "perception toward compliance with COVID-19 guidelines for carpooling" and "Time-credits." A sample of 307 respondents from Thammasat university was gathered through an online survey for SEM analysis.

It was observed that despite the statistical significance, all the model relationships are positive. Further, it was found that hedonic motivation, social influence, and time credits positively influence carpool behavior intention directly in a statistically significant manner. In contrast, effort expectancy, perceived safety, and "perception toward compliance with COVID-19 guidelines for carpooling" do not. However, the mediation analysis suggests that effort expectancy positively affects behavior intention through hedonic motivation. Further, social influence also indirectly influences behavior intention through hedonic motivation. Finally, based on the empirical findings, policy implications are presented. As the popularity of carpooling is lacking in Thailand, these policy implications will aid respective authorities and service providers in improving carpool adoption in Thailand. Further, time banking programs can be initiated, primarily focusing on university students.

This study is limited to the statistical analysis of data at the disaggregated level with 307 observations. The sample represents the young generation as the responses were collected from Thammasat University, Rangsit center. The study considered only tertiary educational trips featuring the case of Thammasat University, Thailand. It should be recognized that the interpretation of findings obtained from this study is limited to the particular situation of COVID-19 when the survey was conducted. These limitations create a lot of room for future research, as follows. First, while it is essential to understand the young generations, especially the students' perception of carpooling as they are daily travelers, it is also vital to understand the perception of working commuters who are also daily travelers. Therefore, future studies could consider different samples and compare student and non-student

Table A7

Latent variable	Questionnaire items	
Effort expectancy	EE1	Carpooling using a mobile application would seem clear and understandable.
	EE2	Carpooling seems easy in terms of making payments.
	EE3	Carpooling seems easy in terms of planning rides according to my schedule.
	EE4	Carpooling seems easy as it will provide me a convenient travel route according to my needs.
Hedonic motivation	HM1	I think carpooling would be exciting.
	HM2	I think carpooling would allow me to meet new people and travel together.
	HM3	I think carpooling would be interesting.
	HM4	I think that I would be satisfied with the carpooling experience.
Social influence	SI1	I think I will use carpool if my friends use it
	SI2	I think I will use carpool if my family uses it.
	SI3	I think I will use carpooling if my colleagues/coworkers use it.
	SI4	I think I will use carpool if the general public uses it.
Perceived safety	PS1	I think I will feel safe disclosing personal information to the carpool application.
	PS2	I think carpooling rides will be safe (crime-free, no physical harm).
	PS3	I think carpooling accidents will be properly compensated for.
	PS4	I think that I will feel safe in my transactions through the carpool application
Behavioral intention	BI1	I consider carpooling as a good transport option.
	BI2	I am curious (want to know more about) to use carpooling.
	BI3	I will carpool to work/school if it is available.
	BI4	I think I will carpool and recommend carpooling as a transportation mode to others.
COVID-19 influence on carpool decision	COD1	COVID-19 does not affect my decision to use Carpooling.
perception toward compliance with COVID-19 guidelines for carpooling	CO1	Carpooling is not a venue of COVID-19 spreading if the sharing car is well disinfected.
	CO2	Carpooling is not a venue of COVID-19 spreading if all participants (including the driver) wear facemasks properly.
	CO3	Carpooling is not a venue of COVID-19 spreading if the sharing car uses open windows.
	CO4	Carpooling is not a venue of COVID-19 spreading if participants are limited to a driver and a passenger.
Influences of COVID-19 vaccination on carpool decision	COV1	I will use Carpooling if all participants (including the driver) are vaccinated against the COVID-19
Time credits as a payment method	TC1	I think time credits would be an interesting form of payment method for carpooling.
	TC2	I think it is convenient to use time credits as a payment method for carpooling rather than money.

(*continued on next page*)

Table A7 (*continued*)

Latent variable	Questionnaire items	
Effort expectancy	EE1	Carpooling using a mobile application would seem clear and understandable.
	TC3	I think time credits is an acceptable payment method for carpooling.
Social value of Time credits	STC1	I think, through carpooling with time credits, I will be able to help others.
	STC2	I think carpooling with time credits helps create a better-connected campus society.

commuters. Also, other trip purposes should be investigated as well. Future studies should perform with a larger sample size to reduce the margin of error and include more psychological factors and transport policy to improve directions for policymakers, planners, and transport practitioners. Furthermore, as a lack of interest in the driver role was discovered, future studies should focus on studying what makes car drivers offer carpool rides. Finally, as students have recognized the importance of time credits, in-depth studies could be conducted to introduce the time-credits concept with carpooling for the university community. It should be recognized that the interpretation of findings obtained from this study is limited to the particular situation of COVID-19 when the survey was conducted.

CRediT authorship contribution statement

Warnakulasooriya Umesh Ashen Lowe: Data curation, Formal analysis, Investigation, Writing – original draft, Visualization, Software, Writing – review & editing. **Mongkut Piantanakulchai:** Conceptualization, Methodology, Validation, Resources, Writing – review & editing, Supervision.

Declaration of Competing Interest

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

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Appendix A

Table A7..

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