**Review Article**

**Carpooling: A sustainable approach to transport system**

**Abstract**

Carpoolingcomes with various benefits for participants to carpool and to the society and our environment as lesser number of vehicles are used in the process. A better understanding of psychological factors has been called by literature for encouraging people to take part in carpool nevertheless an understanding regarding carpooling behavior has not been provided. Many of the research’s outcomes regarding the consistency and future of carpooling activity has been proposed in this article. The outcomes are depended on a systematic review of literature (2010-2021) and some of the main recent changes in carpooling has also been considered, such as changes in lifestyles, carpooling apps and platforms that may be hindering carpooling activities, such as remote work. The sharing of vehicles (mainly car) whether short/long – distanced trips with the ones who are not related by any means of blood (not from same household) for peregrination where the destination has been locked in advance by the driver is what has been termed as carpooling. Carpooling is sometimes free of charge and for most of the times is sharing the total expense of the journey. Three new avenues for research are being proposed after explanation of the corpus choosing method, followed by small feedback of remaining literature: -

Call for huge deliberation of forms of conveyance, which is not carpooling, to be in action, which still is poorly thoughted of.

Suggests the examining of the roles that the current digitalization of carpooling that is to say online carpooling stages and their combination into mobility platforms.

Declares the outcomes of the ascension of combined expenditure and the current pandemic that is to say remotely working habits and realization of shared mobility, may impact carpooling which deserves special scrutiny.

Keywords: Carpooling, Combined Expenditure, Apps, Remote Working, Pandemic, Mobility, Consistency.

**Introduction**

Over the last decade, shared mobility has developed as a viable mode of sustainable transportation. Carpooling is called shared mobility since it is a shared travel in which drivers provide seats in their automobiles to passengers. According to studies, carpooling benefits not only carpoolers (cost savings and time savings), but also the environment and society at large by alleviating traffic congestion and lowering energy consumption and carbon emissions. Policymakers have an incentive to encourage individuals to carpool because of these advantages. Policymakers have recently called for a greater understanding of the psychological aspects that encourage carpooling so that they can better support it.

Carpooling falls into several categories and has been the topic of numerous typologies in the literature. They usually consider the aim of the journey (work or leisure), the technique of matching drivers and passengers (IT-based or casual), and whether the driver and passenger(s) are from the same household or not.

The phrase is employed in this article in a more limited sense because it excludes household and family carpools, which currently account for the majority of carpooling behaviors. As a result, in the rest of the text, carpooling refers to the sharing of car rides between people who are not members of the same family, for a journey (or part of a trip) that has already been booked by the driver, and not for profit (though travel costs may be shared). Both work and non-work carpooling, as well as IT-based and casual carpooling, are taken into account.

Carpooling has piqued the interest of researchers and government agencies for decades when defined this way. The fundamental reason is because carpooling is frequently regarded as a low-cost option for reducing automobile ownership and solo driving, as well as their major environmental consequences, such as traffic and air pollution. Some authors point to societal benefits such as greater accessibility for low-income persons and social cohesion, which are less well demonstrated. However, research has indicated that there are numerous hurdles to carpooling [18] and that its effects on travel behavior, particularly car ownership and use, are unknown. Nonetheless, the recent rise of IT-based carpooling, such as Blablacar, has reignited interest in the topic and, more importantly, offered hope that the negative trend in carpooling seen in Europe and North America will be reversed.

This article presents various new study areas on the future and sustainability of carpooling practises without claiming to be exhaustive. The reflection is based on a systematic assessment of the literature in social sciences (2010–2021) using Google Scholar and a list of relevant keywords, as well as a consideration of some of the most significant recent developments in carpooling and lifestyles that may affect carpooling behaviors.

Following a discussion of the corpus selection approach and a brief assessment of the existing literature, we propose three additional study directions.

The first is a plea for more research into non-work carpooling, or types of carpooling other than carpooling to work (or to school), which are still understudied. The second avenue offers looking at the function that carpoolers' current digitalization, specifically their use of digital tools (online carpooling services, mobility platforms, but also social media) may play in the next years. The third argument contends that the implications of the rise of collaborative consumption and the current pandemic, notably teleworking habits and the impression of shared mobility, may have an impact on carpooling, which requires further research in the near future. Finally, the conclusion summarizes the most important findings and explores the policy implications of these new research directions.

Carpooling is difficult to encourage not only for policymakers but also for businesses. Following the introduction of the Internet and mobile devices, carpooling has grown in popularity. Businesses have gotten engaged by offering matching services through their platforms and utilizing technology to help drivers and passengers who may be strangers or from different homes find each other. Unfortunately, several platforms have shut down because to a lack of critical mass of users, while others have shifted their business models to other modes of transportation, such as carsharing. Understanding carpool incentives is thus one of the important success elements for matching systems in order to retain commercial sustainability and grow the number of members.

One of the most important incentive variables for increasing and maintaining carpool membership is psychological issues. The study of carpooling behavior from a psychological standpoint has lately acquired traction in the literature. However, existing research does not give a comprehensive psychological understanding of carpooling behavior, and carpooling behavior has rarely been researched using a theoretical psychological framework.

The psychological characteristics that encourage drivers and passengers to carpool are discussed in this research. In order to uncover psychological elements and applicable theories mentioned in the carpooling literature, a thorough literature study is done. The fundamental contribution of this paper is the suggestion of a conceptual framework and research propositions as a platform for future research on the psychological elements of carpooling. Identification of characteristics that should enable carpool platforms and policymakers to promote carpooling is a secondary contribution. The tertiary contribution of this work is a narrative synthesis that was utilized to identify future research needs.

The following is the structure of this document. Section 2 gives a brief overview of carpooling, carpooling factors, and carpooling factors from a social psychology standpoint. The systematic literature review approach is described in part 3, and the review findings are presented in section 4. Section 5 presents a theoretical framework, research propositions, and future research prospects, while section 6 brings the paper to a close, highlighting theoretical and practical contributions and highlighting shortcomings.

**Background**

Carpooling and considerations are discussed first in this section. This not only clarifies the scope of the research, but it also explains the complexities of carpooling. A basic explanation of social psychology ideas is offered, as well as a characterization of psychological elements, which will be utilized to further investigate the carpooling literature.

1. **Carpooling**

Carpooling is a mode of transportation in which a non-profit driver can share a common route and time in their personal car with passengers. Researchers believe that the characteristics of participants in carpool trips influence carpool formation. Four types of carpooling have been highlighted. Because the participants are family members, family pools, or fampools, are easily constructed. Employees that have known one other from a same workplace create coworker carpooling. Some researchers compared carpooling organized by friends, neighbors, and coworkers to coworker carpooling because participants have some social links, which increases their trust in one another and the likelihood of organizing a successful carpool. Casual carpooling (carpooling without technology) and IT-based casual carpooling are the other two types of informal spontaneous carpooling (carpooling via online platforms). Informal impromptu carpooling is more difficult to create than fampools and carpooling among friends and coworkers since participants are strangers to one another and hence may lack trust in one another. Casual carpooling and carpooling through online platforms are quite similar, however carpooling through online platforms requires the use of technology to match drivers and riders. Matching agencies, which can be for-profit or non-profit organizations, use technology to facilitate contacts between carpooling participants, offer information about them, build trust, and pair them up to form a carpool. The focus of this research is on carpooling among coworkers, friends, neighbors, and colleagues, as well as informal impromptu carpooling. The next hurdle for policymakers and matching agencies attempting to promote drivers and passengers to carpool is an individual's decision to carpool, which is discussed in the next section.

1. **Carpooling Factors**

Situational considerations, third-party interventions, socio-demographics, and psychological aspects are the four categories of elements that encourage carpooling decisions. Previous review studies have found various particular characteristics based on these categories, as shown in Table 1. Early carpooling studies, according to some experts, did not focus on psychological issues, despite the fact that such elements have an impact on people's decisions to carpool. As a result of the dearth of research, this paper focuses on psychological variables. A specific description of 'psychological elements,' based on the theoretical basis of psychology, is required to make this research more robust.

A list of reasons why individuals should carpool (Compiled from Neoh et al., 2017, Olsson et al., 2019).

| **Type of factor** | **Factors** |
| --- | --- |
| Demographic factors | Age, income, household size, marital status, education, and the number of cars in the household are all factors to consider. |
| Psychological factors | Saving money, reducing traffic, ensuring reliability, saving time, preserving the environment/sustainability, comfort, convenience, socialising, and building trust are all benefits of using this service. |
| Interventions (policy intervention) | Parking availability, cost, locating a possible partner, reserved parking, cost subsidy, guaranteed transport home, and high occupancy car lanes are all factors to consider. |
| Situational factors | Work schedule, commute distance, travel time, population density, and fuel expenses are all factors to consider. |

The majority of the psychological elements in Table 1 are not conceptual constructs with theoretical meaning. This could be due to the fact that most carpooling research is empirical rather than theoretical. Another issue is that there may be no agreement on what constitutes "psychological elements." Some researchers in the ridesharing literature defined the word based on theory, while others just provided examples of psychological aspects. The notion of 'psychological factors' in this study is then informed by social psychology ideas.

1. **Carpooling Factors from a perspective of social psychological**

Individual motivation to shift modes of transportation and how decisions to change modes of transportation are made are increasingly being incorporated into transportation research. Individual incentives to pick modes of transportation are commonly represented by the Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB). TPB evolved from TRA, which was initially proposed. Both TRA and TPB believe that a person's intention, which indicates how hard they are willing to accomplish a behavior, is governed by three factors: attitude, subjective norm, and perceived behavioral control.

One flaw in social psychology theories is that they isolate mental activity (such as attitudes, beliefs, and perceptions) from bodily behaviors (i.e., a real use of transport means). People sometimes select modes of transportation depending on their capabilities (e.g., knowledge, experience, resources, habits, and so on) as well as external factors (e.g., availability of transport means, the performances and quality of transport means, time use within certain transport means, locations, distance, and price policy). By extending TPB and integrating two co-determinants: individual skills (and restrictions) and contextual opportunities, the Motivation-Opportunity-Ability (MOA) model was proposed (and constraints). MOA is a meta-theory that can be utilized to build a mid-range theory with a specified research purpose and a constrained scope. This research concentrates on MOA Motivation in order to keep the a priori framework lean and aligned with the study's goals. The review approach is presented in the following section.

**Methodology**

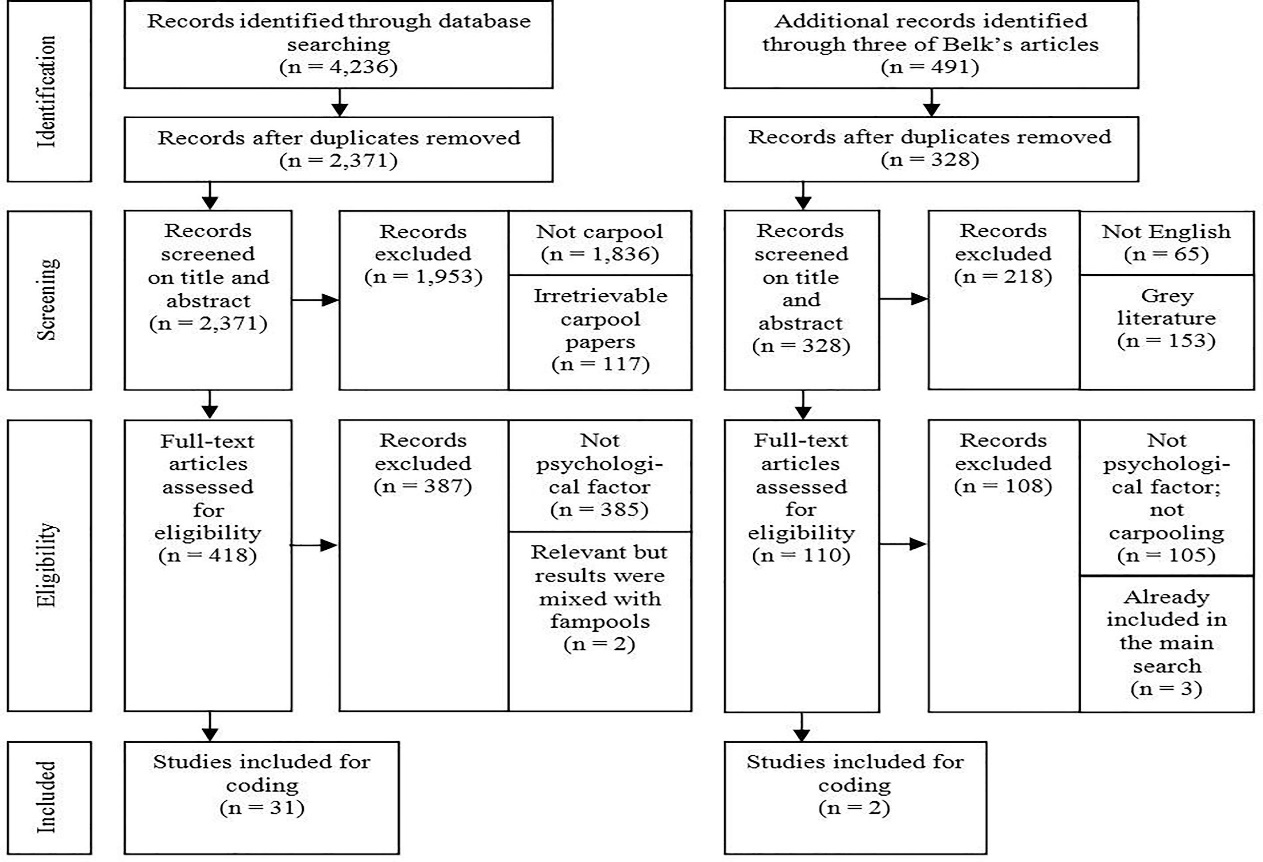
A thorough and transparent synthesis of the literature can be achieved by a systematic literature review. The methodology was conducted by following the guideline suggested by Booth et al. This section begins with a discussion of the preset criteria for including relevant articles. Following that, the procedure for identifying relevant papers and data extraction is described, followed by the review's analytical method.

1. **Inclusion Criteria**

Only peer-reviewed articles were considered for inclusion. Articles that did not empirically study carpooling were eliminated (e.g., review papers). The authors' exploration of the carpooling literature was driven by Table 1 and the definitions of psychological components provided in Section 2.3. Furthermore, only articles published in journals listed in the Web of Science (ISI) or SCImago Journal Rank were considered, allowing Tranfield et al. to rely on journal quality ratings (2003).

1. **Search Strategy**

The review flow is depicted in the diagram below. ISI, Scopus, ProQuest, and Transportation Research International Documentation (TRID), a database provided by the US Transportation Research Board and the OECD's Transport Research Centre, were used to conduct a complete literature search (TRID, 2021). A year of publication filter was applied to include literature published between 1970 and 2019, the year carpool studies began (Ferguson, 1997). The following filters were also used: (1) titles (abstracts, keywords, and titles), (2) English, and (3) journal articles 'carpool\*', 'rideshar\*', 'liftshar\*', and 'carshar\*' were used as keywords recommended by Neoh et al., 2017, and Tahmasseby et al., 2016.



Carpooling is sharing one's personal vehicle, and some recent carpooling research have increasingly acknowledged Belk's foundational works on the sharing economy. To ensure that we included all relevant papers, we used Google Scholar to conduct citation searches using Booth and Carroll's (2015) method. By clicking on 'Cited by' to build a preliminary list of articles, three of Belk's seminal papers were investigated, accounting for nearly 87 percent of his overall citations. Only articles referencing the term 'carpool\*' were returned when the keyword 'carpool\*' was input and 'Search within citing articles' was checked. Predetermined criteria were used to include only publications that investigated carpooling, offered empirical evidence, were written in English, explored 'psychological aspects,' and were included in the ISI or SCImago Journal Rank, similar to the primary search. The last condition was necessary due to widespread criticism on Google Scholar that the articles retrieved might not be scholarly.

1. **Selection of Studies and data extraction**

After removing duplicates, the systematic search using the four databases yielded 4,236 records (ISI = 1,240; Scopus = 1,720; ProQuest = 294; TRID = 988) that were reduced to 2,371 entries. The titles, keywords, and abstracts of the papers were screened to eliminate 1,953 entries that did not study carpooling. The full-text screening of 418 articles was conducted using the pre-defined inclusion criteria. The majority of the papers that were eliminated were about carpooling technology (such as algorithms and optimization), infrastructure (such as toll lanes and high occupancy vehicle (HOV) lanes), traffic management, and environmental effects. This method yielded a total of 31 articles for coding. Two coders worked separately to extract data using the following coding schemes: IT-based context, countries, study techniques, role choices of participants, and outcomes.

1. **Narrative Synthesis**

Because the study setting for this paper is interdisciplinary, a narrative synthesis was used, which is acceptable for outcomes from various types of empirical research. All authors were given a tabulation of the final coding results. The components were grouped based on the criteria supplied by each study to provide an overview of the many psychological elements and make them comparable. Greenhalgh et al. (2005) provided the following guideline questions: (1) what are psychological factors and the theories that researchers used to conceptualize psychological factors, (2) what are the commonalities of the research findings, conflicting results, and possible explanations, and (3) what are the major gaps and directions for future research. The synthesis questions were answered using triangulation, and the results are provided in later section.

**Findings**

1. **Overview of the Studies**

Horowitz and Sheth's research from 1977 were the first to look into the psychological variables that encourage carpooling. Approximately 85 percent of the publications were published in transportation-related journals, with four-fifths of them appearing in the 2010s. Thirteen publications (39%) looked into the motivations for carpooling in the setting of online platforms. Approximately 82 percent of the research was done in North America and Europe. The majority of the articles relied heavily on self-report surveys (79%). A total of eight articles (24%) used a mixed or multi-methods study strategy.

1. **Psychological Factors**

Except for 'convenience,' which was discovered to have two meanings: (1) convenience in terms of comfort and (2) convenience in terms of location and time, most psychological characteristics could be placed into a single category.

Table 2: Literature-based definitions of psychological elements (Compiled by authors).

| **Factor** | **Definition(s)** |
| --- | --- |
| Convenience in terms of comfort | Having package space; avoiding crowding in public transport; seats are always available; not having to drive; relaxing; perceiving oneself as a customer of a service provided by drivers; comfort when sitting in a large car; softer seats and better temperature than public transport |
| Convenient location and time | Do not have to wait for public transport; more cars available than public transport; flexible and reliable time schedule; less time waiting in traffic; a variety of pickup and drop-off times; many pickup locations, ease of getting to a destination; no need to transfer via or to a public transport link |
| Cost saving | An inexpensive transport means; cheaper than using public transport and owning a private car; reduced operating costs such as fuel, toll and maintenance costs; shared costs between commuters and drivers; gaining benefits that can be expressed numerically as an amount of money |
| Environmental concern | An eco-friendly and sustainable transport means; saved energy consumption; reduced traffic congestion and pollution |
| Empathy | Shared experience |
| Helping others | Altruism; the opportunity to be helpful and to offer neighbourly goodwill; helping neighbours |
| Information sharing | Exchanging opinion; sharing vital information |
| Perceived ease of use | Using a carpooling service is not too difficult |
| Perceived usefulness | Using a carpooling service is useful to obtain personal goals |
| Personal norm | An obligation to be a carpooling driver because of having a driving licence; an obligation towards something moral |
| Pleasant and enjoyment | Enjoying travelling with others; feeling pleasure when carpooling with others |
| Self-determination | A desire to reinforce the community’ value and to do things their own way |
| Sense of belonging | Feeling towards the community; sense of community; sense of unity |
| Social status | Perceiving that carpooling via online platforms is the way to differentiate individuals from those doing casual carpooling; gaining a high status by acting with professionally; social recognition; feeling accepted by society; gaining others’ positive impressions |
| Socialisation | Sociability and socialising; meeting new persons and future good friends; friendship and companionship |
| Subjective norm | People who are important to me like to carpool |
| Time saving | Shortens travel time compared to public transport; save time when using HOV lanes |
| Trust | Car-poolers are truthful and will not take advantage of me; car-poolers keep their promises; people are fair and helpful, do not take advantage and not compromise the wellbeing of others; having confidence in people |

1. **Theories employed to defined psychological factors**

Table 3 summarises the psychological theories employed in the investigations, while Table 2 lists some psychological characteristics that were defined using the model constructions of such theories. Bachmann et al. (2018) investigated the intention to carpool via an online platform using NAM and TPB. Apart from these two social psychology theories, Dickinson et al. (2018) proposed a concept of Social Capital to explain trust and a sense of belonging. To explore the passenger's desire to use an online platform, Wang et al. (2018) used the Technology Acceptance Mode. Finally, Wang et al. (2019a) used Consumer Perceived Value theory to define the benefits of carpooling (pleasant and enjoyable, money savings, time savings, social status, and comfort convenience).

Table 3: Psychological theories employed in the literature on carpooling (Compiled by authors).

| **Factor** | **Theory** |
| --- | --- |
| Subjective norm | Theory of Planned Behaviour (TPB) |
| Personal norm | Norm Activation Model (NAM) |
| Cost saving | Consumer Perceived Value (CPV) |
| Time saving |
| Convenience |
| Pleasant and enjoyment |
| Social status |
| Sense of belonging | Social Capital (SC) |
| Trust |
| Perceived usefulness | Technology Acceptance Model (TAM) |
| Perceived ease of use |

**Conceptual Framework, Review Propositions and Future Review Directions**

1. **Proposed conceptual framework**

Figure 3 depicts a proposed conceptual framework that will serve as the basis for future research on psychological aspects of carpooling. The proposed TPB and NAM components in Bachmann et al (2018)'s a priori theoretical model were expanded to incorporate three theories (CPV, SC, and TAM), which are now presented along with research propositions.

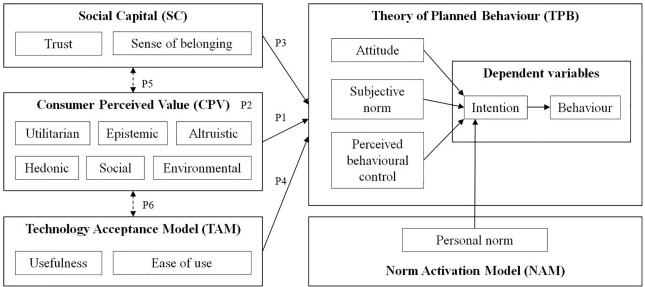


Fig. 3. Proposed theoretical framework (Authors).

1. **Consumer Perceived Value (CPV)**

The concept of CPV comes from the marketing and consumer sciences. It refers to the perceived value that people get from using items or services (Woodruff, 1997). Different paradigms define the term 'value' differently. It is defined in this paper as "value-as-outcome" or "value as a judgement or appraisal of any form of experience or relationship with an object." 'Value' is generally determined in this paradigm as a trade-off between advantages and costs/sacrifices. The findings of Wang et al. (2019a), who proposed CPV as an antecedent to the passenger's intention to carpool, support the inclusion of CPV in the proposed framework.

It is necessary to conduct research utilising CPV to investigate the drivers. Furthermore, Nystrand and Olsen (2020) suggested that CPV was a predictor of attitudes, but this has not been investigated in the context of carpooling. As a result, the following suggestions are made:

Proposition 1a: CPV will influence carpooling intentions;

Proposition 1b: Carpooling attitudes will be influenced by CPV.

CPV is a higher-order (i.e., overall) construct with lower-order constructs representing various forms of benefits and costs/sacrifices (i.e., value dimension). The benefits and costs of carpooling have been highlighted in the literature. The benefits and costs of carpooling were conceptualised by Wang et al. (2019a) as two different higher-order constructs: perceived value and perceived hazards. The benefits of carpooling are examined in this study in terms of a variety of lower-order value dimensions.

Most of the psychological elements listed in Table 3 can be covered by CPV. In a carpooling setting, the first three value aspects recognised are utilitarian, hedonic, and social value. These three value dimensions are defined as follows by Wang et al. (2019a): Hedonic value refers to perceived emotional benefits and affective outcomes obtained from carpooling (e.g., pleasure and enjoyment); social value refers to perceived social status, social prestige, and social approval. utilitarian value refers to perceived functional performance of carpooling and other monetary and non-monetary benefits gained from carpooling (e.g., cost and time savings and convenience). All three value aspects were mentioned in the context of carpooling platforms. We believe social value exists, even though it has been discovered in the context of carpooling without the use of technical platforms. From the standpoint of a passenger, carpooling may be viewed as environmentally friendly transportation and increase their social image among environmentalists. Having one's own private car and using it to assist passengers in sharing seats may be connected with improving a driver's social image in terms of materialism and altruism. As a result, three propositions are made:

Proposition 2a: The intention to carpool will be influenced by utilitarian value;

Proposition 2b: Hedonic value will influence the intention to carpool;

Proposition 2c: The intention to carpool will be influenced by social value.

Epistemic value refers to perceived curiosity, novelty, and information received from consumption in the marketing literature. As a result, 'information exchange' can be thought of in terms of epistemic value. Zhang et al. (2021b) discovered that perceived epistemic value influenced customer purchase intentions in the decision science field. As a result, proposition 2d is as follows:

Proposition 2d: The intention to carpool will be influenced by epistemic value.

A number of studies have shown 'environmental concern' (Table 3). Carpooling, according to the respondents, is an environmentally friendly and sustainable mode of transportation. Zhang et al. (2020) defined environmental value as the perception of how consumption helps to improve the environment, and found that attitudes toward purchasing and customer willingness to pay were influenced by perceived environmental value. As a result, proposition 2e is written as follows:

Proposition 2e: The intention to carpool will be influenced by environmental value.

'Helping others' was mentioned in a few of the studies. For example, Guyader (2018) found that respondents saw carpooling as a method to help others. Previte et al. (2019) conceptualised the perceived experience of helping others as altruistic value in the service literature and discovered that such a value dimension promoted good sentiments about a service. Proposition 2f is written as follows:

Proposition 2f: The intention to carpool will be influenced by altruistic value.

1. **Social Capitalist (SC)**

The suggested conceptual framework includes the second theory, SC. SC, a sociological theory, proposes that community relationships between participants are assets that are stored in and accessed through individuals' relationship networks. SC, according to Nahapiet and Ghoshal (1998), is comprised of three characteristics: structural (i.e., the connections between participants as evidenced by the strength of social ties), relational (i.e., trust, mutual benefit, identification, and reciprocity norms within the participant's social network), and cognitive capital (i.e., shared goals, visions, and language that facilitate a shared understanding of participants' collective goals and actions). These characteristics allow individuals to gain access to more resources and lead to activities such as socialising, social contacts, community engagements, and collective actions.

Individuals with a strong community network can readily access shared automobiles and establish carpools, according to the literature on carpooling. Furthermore, SC strengthens social bonds, which leads to an increase in trust among carpoolers. Dickinson et al. (2018) discovered the impact of social capital on the intention to carpool in terms of sense of community. According to Bachmann et al. (2018), trust has an effect on attitudes toward carpooling and perceived behavioural control, which influences the intention to carpool. As a result, proposition 3 is written as follows:

Proposition 3: The intention to carpool will be influenced by SC.

1. **Technology Acceptance Model (TAM)**

TAM is the final theory in the proposed conceptual framework, and it should be employed in future study on carpooling through online platforms. The Theory of Reasoned Action inspired TAM, a theory in the field of information systems. It consists of two components: perceived usefulness (PU) and perceived ease of use (PEOU), and it has been used to explain why people want to utilise technology.

TAM has been used in the carpooling literature to explain the desire to use online carpooling platforms. PU refers to how people think a carpooling platform can help them achieve their goals, whereas PEOU refers to how people think the platform is straightforward and easy to use. As a result, two propositions are made:

Proposition 4a: PU will use an internet platform to influence carpooling intentions.

Proposition 4b: PEOU will use an internet platform to encourage carpooling intentions.

1. **Interrelationships**

Apart from the direct relationship mentioned above, there may be two interrelationships between the theories, as shown by the dotted lines in Fig. 3. SC and CPV have the first interrelationship. SC and CPV are linked by looping effects. According to Stewart-Loane and Webster (2017), the activities and collective actions people take to establish and maintain SC produce a wide range of perceived value dimensions, which encourages more collective activity. The community in their study, for example, gave individuals the ability to express themselves to other participants.

The participants engaged in SC-building activities (e.g., revealing a personal tale to an understanding cohort in the community) that led them to sense social support and recognition of status (i.e., social value), while other participants reacted with admiration.

According to SC, social ties formed via interactions among participants bond people together and may be measured in terms of time and intimacy. The collective and mutual perceived worth of collective acts rose as more community encounters occurred and social relationships were strengthened significantly. The dynamic interaction between carpooling participants varies with time in the setting of carpooling. Participants in O'Brien and Dunning's (2014) study said they didn't know each other and saw each other as strangers at first, but that as time went on, they became mutual friends. Furthermore, Gheorghiu and Delhomme (2018) discovered that when the number of journeys grew, perceived environmental concern became more essential. Based on this information, it is reasonable to assume that as the amount of intimacy between carpooling participants grows, so would their assessments of the benefits obtained from their exchanges. As a result, proposition 5 is presented:

Proposition 5: SC will change people's minds regarding the benefits of carpooling.

The second interaction is that which exists between CPV and TAM. Barnes and Mattsson (2017) found that the perceived value of carsharing (i.e., economic, enjoyable, and social) was positively connected with the customer's perceived usefulness of the carsharing platform in the information systems literature. Bike-sharing consumers who see the benefits of time and cost savings from utilising bike-sharing are more likely to consider the platform's usefulness, according to Li and Wen (2019). Perceived usefulness in the context of online carpooling is described as the platform's ability to assist individuals in achieving personal goals. This indicates that if a platform cannot assist its users in achieving their objectives, it should be considered useless. According to Guyader (2018), some informants disliked the platform (i.e., had negative sentiments) because it prevented them from achieving their altruistic goals. There have also been instances where users have failed to meet their cost-cutting objectives. Täuscher and Kietzmann (2017) discovered that users of a platform became enraged and quit using it after having to pay a previously free service fee. The following proposition 6 is offered based on the prior evidence:

Proposition 6: The perceived utility of carpooling is influenced by its perceived value.

In addition to the proposed conceptual framework and research propositions, the outcomes of this study also indicate future research topics, which will be described next.

1. **Future Research Directions**

Table 4 provides a review of prospective research directions. Future study should, first and foremost, validate the suggested conceptual framework and investigate the six research propositions. Researchers, matching agencies, and policymakers interested in carpooling interventions and campaigns need this knowledge. The proposed framework is not the only psychological theory utilised to describe carpooling behaviour. Future research could extend parts or all of the proposed framework. Aside from this, the following study directions are suggested.

Table 4. Future research directions (Authors).

| **Aspect** | **Future research directions** |
| --- | --- |
| Theoretical | -  Validate the proposed conceptual framework  -  Conceptualise ‘Socialisation’, ‘Empathy’ and ‘Self-determination’ |
| Methodological | -  Employ alternative methods  -  Use a mixed-methods research design |
| Contextual | -  Explore cultural differences  -  Investigate carpooling platforms in other countries |
| Factors-related | -  Determine carpooler segments based on levels of perceived cost saving  -  Explore the meaning of time saving in a country having no HOV lane  -  Investigate psychological factors under dynamic and longitudinal circumstances  -  Test a moderating effect of distance on psychological factors  -  Explore multidimensional concepts of trust |
| COVID-19 | -  Investigate how people balance the benefits of carpooling and social distancing  -  Investigate what make people using carpooling platforms during the outbreak  -  Explore how the users of platforms perceive the benefits of measures regard sanitary guidelines, from the perspective of TAM  -  Investigate motivations to carpool after issues of COVID-19 cease their impact |

1. **A need to employ a variety of data collection methods.**

Only 12 papers (36 percent) in Appendix B used other research methodologies to study carpooling psychological aspects. Guyader, 2018, and Haerewa et al., 2018 used ethnography to uncover respondents' interpretations of psychological elements and derive new ones. Alternative methods of inquiry are required to uncover more psychological aspects. A number of data collection strategies are required to investigate carpooling reasons (Nielsen et al., 2015). Mixed-methods research should be used in future studies. Margolin et al., 1978, and Shaheen et al., 2016 are two examples of this type of study.

Carpooling via online platforms differs from casual carpooling in that carpooling matches take place online, while actual carpooling takes place offline. This phenomena is referred described as online-to-offline (O2O) service, which is made possible by mobile Internet and GPS technology. While informal carpooling can use face-to-face data gathering methods, research into carpooling via online platforms should use a method that is specifically built to capture face-to-face data and watch what happens in an online world.

1. **A need to collect more data from non-Western countries.**

According to Olsson et al. (2019), motivational elements appear to be country and cultural dependent. The majority of the studies, according to this research, were undertaken in Western countries. It's probable that non-Westerners have various levels of social incentives, such as a sense of belonging, altruism, and socialising. However, the present literature lacks sufficient examples for such a comparison. Future research on cultural variations could be interesting.

Previous research on carpooling via online platforms was conducted in China, as well as North America and Europe. It is necessary to collect data on user motives from carpooling systems that operate in various nations. Each country's underlying conditions, such as economic development and transportation networks, may differ. People's attitudes toward carpooling via internet platforms may vary by country.

1. **A need to conceptualise further psychological factors.**

Because no theoretical background was presented in the selected papers, three elements (Socialisation, Empathy, and Self-determination) could not be conceptualised in the proposed conceptual framework. This study offers the following path ahead.

'Socialisation' was defined as a personal desire or a carpooling activity like socialising, social engagement, and establishing friends. Socialisation refers to the process by which individuals internalise patterns of thinking and acting that are distinctive to their primary group, whereas socialising refers to actions such as meeting and talking to others that occur during travel and commuting. Socialising can be used not just for socialisation (as a process), but also for creating a sense of belonging and determining hedonic and social values of consumption. In this research, the proposed framework in terms of SC and CPV includes' socialisation' (as activities) (Fig. 3). However, knowledge of socialisation (as a process) is limited, and further research is required.

The word 'empathy' was used without mentioning any hypothesis. Empathy is a multi-dimensional phenomenon that can be conceptualised in terms of feelings, perception outcomes, or emotional reactions in theory. In the context of carsharing, Hwang and Griffiths (2017) investigated the links between empathy, CPV, and attitudes. Future carpooling study should delve deeper into such ideas.

Finally, the phrase "self-determination," which is stated in Haerewa et al. (2018) but lacks a theoretical meaning, should be conceptualised using Self-determination theory. The review of Self-determination theory by Gilal et al. (2019) should be an excellent starting point for future carpooling research looking into Self-determination and TPB. Aside from these three aspects, there are a number of psychological factors that need to be investigated further.

1. **A need to better define cost saving.**

We discovered that cost savings apply to both drivers and passengers when it comes to carpooling. According to Park et al., 2018, and Tahmasseby et al., 2016, only passengers were concerned with cost savings. Some carpooling drivers appeared to be less economically motivated, according to other researchers, and Buliung et al. (2010) concluded that cost savings were not statistically significant. This could be due to the fact that carpoolers have varied perspectives on cost reductions. Some drivers may believe that they must travel regardless of whether or not they have passengers. According to Guyader (2018), some users accused a platform for encouraging drivers to demand a fee. Cost savings levels were rarely defined in most research. Determining these levels may aid in classifying carpooling participants into distinct segments and improving carpool participation prediction.

1. **A need to investigate time saving in a country having no HOV lane.**

In studies conducted in the United States, users of HOV lanes emphasised the advantages of saving time. HOV lanes provide such benefits to drivers and passengers when compared to other modes of transportation that are not permitted to use the lanes. However, from the perspective of carpooling participants residing in a country without HOV lanes or where such lanes are not popular, present understanding lacks the meaning of such benefits. Passengers may sense time savings only when comparing carpooling to taking a public bus that is supposed to stop at every station. People's views of time savings may be influenced by the transportation infrastructure in each country.

1. **A need to investigate dynamic relationships between carpooling participants.**

We have seen in previous sections, there may be a correlation between SC and CPV because the interaction between carpooling participants is dynamic. As a result, these hypotheses may be best researched in dynamic and longitudinal settings. The number of trips made and the amount of time spent in a carpool could be influencing factors. The number of trips and time spent in a carpool may be the strongest indicators of psychological issues. Long-distance carpooling participants had more contact with other participants and reported benefits such as socialising and establishing friends, according to Mote and Whitestone (2011). Future research could look into whether distances (such as long-distance carpooling versus commuting) have a moderating effect on people's perceived environmental concern as well as their social capital in terms of trust and sense of community.

1. **A need to investigate multidimensional concepts of trust.**

Trust has a beneficial effect on carpooling intention, according to Arteaga-Sánchez et al., 2018 and Bachmann et al., 2018. However, trust had no influence on Dickinson et al. (2018). When applying the trust idea in future study, caution should be exercised. Individuals' perceptions about others, a tendency to be willing to rely on others, and a generalised trust are all multidimensional concepts. When carpooling participants had trust in each other, were comfortable being around strangers, and had a friendly disposition, trust could be a motivator.

1. **A need to investigate the impact of COVID-19.**

The psychological aspects discussed in this study are based on research done prior to the coronavirus (COVID-19) pandemic. Following the emergence of COVID-19, evidence suggests that travellers' attitudes toward carpooling changed. COVID-19 may have an influence on individuals by increasing psychological stress and decreasing motivation to carpool, which is a significant difficulty. When social separation is required, carpooling may not be appropriate or advised, despite the benefits of socialising and a sense of community. Carpooling can be considered a mode of transportation that minimises the number of social encounters due to benefits such as avoiding crowded on public transportation. If the crisis persists, it will be fascinating to see how people balance such disparate benefits.

During the early COVID-19 epidemic, platforms like France's BlaBlaCar and DiDi saw the biggest drop in traffic and lost drivers and passengers. Future research should look into the impact of COVID-19 on platform users' perspectives. However, not all travellers ceased using carpooling services as a result of the outbreak. It would be fascinating to learn what motivates people to use carpooling services. BlaBlaCar had established many steps regarding sanitary requirements for carpooling, claiming that it would be able to endure the issue (BlaBlaCar, 2020). Future research might look into how platform users view the benefits of such policies from the standpoint of TAM.

If COVID-19-related concerns fade away, it will be fascinating to see if people still desire to carpool. Some analysts predicted that in the post-COVID-19 period, car dependence would become increasingly visible. It'll be fascinating to see if drivers still want to share seats, or if they're afraid of carpooling and would rather drive alone. It would also be fascinating to see how social distance norms affect people's value orientation and carpooling behaviour in the future.

**Conclusion**

This study provides three theoretical contributions. To begin, the report presented a comprehensive examination of psychological characteristics that motivate drivers and passengers to carpool. Based on the involvement of carpooling participants, previous research did not discover such characteristics. The observed elements were conceptualised into 18 key factors in this paper. The prior review studies did not cover eleven of these criteria.

Previous research has also pointed out a scarcity of literature relating psychological theories to carpooling. A proposed conceptual framework for future study on psychological aspects of carpooling is the second contribution of this paper. The suggested framework is multidisciplinary in character, as it incorporates ideas from Social Psychology (Theory of Planned Behaviour and Norm Activation Model), Marketing and Consumer Behaviour (Consumer Perceived Value), Sociology (Social Capital), and Information Systems (Information Systems) (Technology Acceptance Model). The suggested paradigm should lead to a better understanding of carpooling decision-making mechanisms and provide a more solid theoretical platform for future studies examining carpooling incentives. Because the results of a systematic literature analysis encompassed both types of carpooling studies, the proposed conceptual framework is offered for both casual carpooling (i.e., without technology) and carpooling via online platforms. The Technology Acceptance Model is very important to include if a study wants to investigate carpooling via online platforms. To improve our understanding of carpooling reasons, we will need to test the framework and its six propositions in the future. Finally, this study suggested eight new research directions. Researchers who want to learn more about carpooling psychological aspects in the context of informal carpooling and carpooling via online platforms should follow these guidelines.

The identified factors had an impact on carpooling participants in terms of practical ramifications. Researchers, carpooling platforms, and transportation policymakers can utilise these variables as a guide to (1) understand why drivers and passengers are driven to carpool, and (2) create messaging that highlight the benefits of carpooling to their audiences.

Campaigns should be directed towards the appropriate audience. Promoting the benefits of carpooling based on role preferences appears to be a cost-effective approach to spend a limited budget. The observed factors could be leveraged to create marketing points for drivers and passengers. Such indicators may be used by carpooling platforms and policymakers to determine if they have given a satisfactory service that meets users' needs. If platforms have a good understanding of what their drivers and passengers want, they may be able to make money. This will also aid policymakers and governments in reviewing, guiding, and monitoring carpooling efforts to ensure that drivers, passengers, and platforms have consistent and high-quality services.

There are several practical contributions of the identified factors that enterprises and policymakers can utilise to promote carpooling. The advantages of carpooling should be made known to drivers. Apart from financial savings, perceived pleasure and happiness, as well as a sense of belonging, may be the most effective ways to encourage carpooling in communities where people trust each other and have comparable destinations (e.g., their kids studying in the same school and participants working in the same areas). Providing seats to neighbours, acquaintances, and even strangers could be another method for single drivers to practise altruism. Single-driver campaigns could also raise awareness of how they can lessen their environmental effect by sharing carpool seats or stopping driving and becoming passengers. Policymakers may be interested in community-based campaigns such as partnering drivers and rearranging their responsibilities. A government-led carpooling initiative could start in government buildings. Matching platforms may work with the government to help car-poolers find each other.

Beyond the academic knowledge that such studies will produce, they will also provide information for public authorities, who may have a tendency to jump to conclusions about carpooling and decarbonization of travel when data suggests that caution is required. The association between different types of carpooling, automobile ownership, and car use, in particular, need more research. Future study should also contribute to a greater understanding of the social aspects of carpooling (in terms of accessibility, social cohesion, and discrimination), which are frequently overlooked or assumed to be self-evident by authorities.

Finally, policymakers will be better able to implement more appropriate policies if they take into account the consequences of carpooling's digitalization and the development of new lifestyles, particularly teleworking and collaborative consumption, as well as the impact of the pandemic on the perception and use of shared mobility.

This paper, like all research, has some limitations. First, it focuses on psychological variables that encourage people to carpool, and future research should look at any psychological barriers to carpooling as well as the sacrifices and expenses involved. Second, because TPB is a "rational choice" model, future study should take into account illogical behaviour such as habits. In the context of the Motivation-Opportunity-Ability (MOA) model, the focus of this work is on MOA motivation, which must be integrated with the other two co-determinants of MOA because decisions are influenced by both individual abilities (e.g., experience and habits) and external circumstances (e.g., distances and time use in certain transport means). To strengthen the rigour and completeness of the proposed conceptual framework, future research should examine existing carpooling literature and conceptualise findings in terms of the two co-determinants. Finally, only peer-reviewed literature was used in this study. Proceedings from well-known transportation conferences may potentially provide useful material that can be used to expand on the conclusions of this paper.