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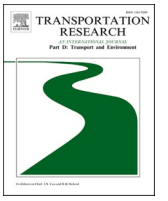

The impact of transport inclusion on active Aging: A perceived value analysis

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ABSTRACT

As global aging accelerates, serving an aging society through transport development is essential. However, the impact of transport inclusion on active aging remains unclear, especially regarding travel satisfaction and capabilities. The present work establishes a relationship model between transport inclusion perceived value (TIPV) and active aging (AA) that accounts for travel satisfaction (S) and travel capabilities (C). A theoretical framework is proposed for TIPV and AA by exploring the mediation mechanism and regulatory factors that affect AA. The data of this study are derived from the survey data of 521 people over 60 years old in Xi'an in 2022. The study identifies four TIPV dimensions: perceived functional, service, emotional, and social values, the latter two of which are often overlooked. It reveals the mediating role of travel satisfaction in the TIPV-AA relationship with an effect on health, social participation, and subjective well-being. This sensitivity analysis of transport-inclusive travel capabilities offers a theoretical foundation for understanding the four transport inclusion dimensions and practical guidance for creating inclusive transport environments.

1. Introduction

Active aging (AA) focuses on older people's physical and psychological states, social integration, and quality of life, with special emphasis on the importance of social security for the sustainable development of an aging society. Transport serves as infrastructural welfare in an aging society, and older people's satisfaction with transport affects their health (Reinhard et al., 2019), social participation (Ma et al., 2016), and well-being (He et al., 2020). Older people tend to be less capable of traveling as they age, which presents more challenges to their cognition and daily mobility (Lucas, 2012). Older people are a vulnerable travel group, and the issue of transport inclusion will become more prominent with the intensification of global aging.

The World Health Organization (WHO) has proposed a policy framework for AA, "Health, Participation, Security", to cope with this development dilemma for an aging society. This framework has changed the negative stance in early aging research that regards aging

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Nomenclature

Glossary

AA	Active aging
AAI	Active Aging Index
EFA	Exploratory factor analysis
ICAA	International Council on Active Aging
PT	Public transport
SEM	Structural equation modeling
TIPV	Transport inclusion perceived value
TRSE	Transport-related social exclusion
TRSI	Transport-related social inclusion
UNECE	United Nations Economic Commission for Europe
WHO	World Health Organization

as an inevitable process of decline. The policy has been widely accepted worldwide. For example, the International Council on AA (ICAA), in which 37 countries participate, works to "significantly improve the quality of old age by remaining active and fully engaged in life" (Pfaller and Schweda, 2019). Similarly, many governments have introduced age-friendly urban quality assessment systems, including criteria for transport, health, subjective well-being, society, civic participation, and tolerance inclusion (Gawlak et al., 2021). Moreover, the UK government has established an inclusive transport strategy to eliminate barriers and open opportunities for everyone regardless of travel capabilities (Swift et al., 2021). Studies in China, Australia, the European Union, Russia, and Finland have developed quantitative measurement tools for AA in the WHO's AA framework (Li et al., 2020a).

China is a fast-aging society, and its urban demographics have been undergoing important changes. It is estimated that by 2035, the number of people aged 60 and above will exceed 400 million, accounting for more than 30 % of the total population; this means that China will soon enter the stage of a severely aging population. The original urban transport system, designed with efficiency as a priority, will not meet the increasing mobility demands of this aging population and may increase their social exclusion. The Chinese government adopted AA as a national development strategy in 2020. Although urban transport currently focuses on improving the construction rate of barrier-free urban road facilities, the development and application of transport assistance technology for older people and the systematic planning and implementation of transport inclusion policies are still in their infancy. Therefore, it is necessary to understand the challenges to transport inclusion posed by urban aging.

Transport inclusion is based on transport equity and focuses on the mobility opportunities of vulnerable groups and the social development policy framework. Through inclusive transport systems, policies, and programs, government tries to remove barriers to travel for vulnerable groups and support their survival, development, and well-being. Transport inclusion cares for vulnerable groups such as elderly individuals, disabled, poor individuals, ethnic minorities, women, and children. The increasing degree of global aging has attracted considerable attention to the problem of transport inclusion for elderly individuals. Previous research has focused on the following aspects.

First, the built transport inclusion environment involves inclusive urban spatial assessment (Gawlak et al., 2021), inclusive streets (Doi et al., 2016; Wang et al., 2021), and inclusive stations (Swift et al., 2021).

Second, transport exclusion and social exclusion involve indicators of transport exclusion (Yigitcanlar et al., 2019), psychological barriers caused by social exclusion in transport (Al-Rashid et al., 2021), digital division and social exclusion in transport (Fields et al., 2019), transport disadvantages, social exclusion, and subjective well-being (Ma et al., 2016).

Third, transport and aging involve older people's satisfaction with public transport (Yuan et al., 2019), transport and primary care (Li et al., 2020b), mobility satisfaction and living quality (Kim et al., 2020), and mobility satisfaction and well-being (He et al., 2020).

Fourth, public transport use and travel capabilities involve older people's public transport use and cognitive functions (Reinhard et al., 2019) and the assessment of accessibility and social exclusion (Bantis and Haworth, 2020). However, no studies have examined the impact of transport inclusion on AA.

Perceived value is the overall evaluation of a customer's perceived utility of a service or product (Parasuraman et al., 1985). It includes the usefulness of products or services and their extended value, such as emotional and social value. Evidence suggests that passenger satisfaction, travel behavior, and loyalty significantly depend on perceived value (Li et al., 2019; Ni et al., 2020). Therefore, travel attitudes and transport behaviors depend on the value that passengers perceive. To improve travel willingness and behavior, it is necessary to improve passengers' consumption experience, emotional experience, and perception of the social value of transport products and services. For elderly individuals, the TIPV may affect their travel attitudes, behaviors, and physical and mental health. These are key concerns of AA. Therefore, based on the theory of perceived value, the relationship between transport inclusion and AA can be effectively analyzed.

Xi'an's aging level is close to the national average. Its transport system is in a stage of scale expansion and facility upgrading, and the practice of transport inclusion is also in an exploratory period. In recent years, Xi'an's subway network has expanded rapidly. Gasoline buses have been replaced with clean energy buses on a large scale, and some lines have begun to operate barrier-free buses; transport stations have improved barrier-free signage; subway spaces have been designed with the cultural theme of "one station, one scene"; and the traffic order of "pedestrians first" has been strictly enforced for cars and buses. Although these measures convey the

people-oriented value of transport inclusion, the operating mechanism by which perceived value affects AA is unclear, making it necessary to understand how older people's perceived value, travel capabilities, and satisfaction are related to their AA status.

The present study aims to explore the theoretical framework of the TIPV and analyze the impact of transport inclusion on AA. Taking a survey of elderly individuals in Xi'an, China, as an example, this study proposes a framework for traffic inclusion based on the theory of perceived value. It analyzes the roles of travel satisfaction and five travel capabilities in the relationship between perceived value and AA. This involves several innovations in transport and AA research.

First, while previous studies have explored the relationship between perceived value and travel attitudes and behaviors in research on transport corporate image and the symbolic value of private cars (Li et al., 2019; Ni et al., 2020), no studies have proposed a theoretical framework of perceived value for transport inclusion. Transport inclusion perceived value (TIPV) is crucial for studying older people's travel attitudes and behaviors and is a key entry point for understanding transport and AA.

Second, previous research on the travel attitudes of older people has mostly involved the satisfactory evaluation of transport attributes (Yuan et al., 2019). Previous studies have evaluated only the objective elements of the built transport environment and has neglected the influence of subjective factors such as passengers' emotional value and social value. These two types of value are important factors that affect attitudes and behaviors. Therefore, based on perceived value, a theoretical model is established to address the gap in previous research on older people's travel satisfaction.

Third, previous research has considered the impact of travel satisfaction only in terms of transport and aging (He et al., 2020). In contrast, the present study comprehensively considers the influence of travel satisfaction and travel capabilities in research on transport inclusion and AA.

Fourth, previous research on transport and AA has used only a single dependent variable (Kim et al., 2020). In contrast, this study incorporates the three important factors of transport-related health, social participation, and subjective well-being. This is conducive to increasing the research's systematic and explanatory power of the research on the relationship between transport inclusion and AA.

Transport inclusion is included in the study of perceived value for the first time, and the scenarios of perceived value research are expanded. From a theoretical viewpoint, research on transport inclusion and AA is enriched and improved, and the mechanism by which travel satisfaction and capabilities influence the relationship between transport inclusion and AA is clarified. The focus is on the TIPV of AA, the proposed dimensions, and the practical reference value for improving the effect of AA. The impact measurement of older people's travel capabilities provides a theoretical basis for improving transport inclusion.

2. Literature review & hypotheses

2.1. TIPV

2.1.1. Transport inclusion

Transport inclusion is a transport policy framework that ensures equal mobility opportunities for vulnerable travel groups under the guidance of the transport equity concept. Through inclusive transport systems, policies, and projects, transport inclusion helps eliminate the adverse social effects of travel barriers on vulnerable groups to support their survival, growth, and well-being.

Enlightened by theories from several subjects (Table 1), studies of transport inclusion include value principles, methodology principles, practical principles, and their social effects to ensure transport fairness for vulnerable travel groups.

First, from the perspective of value principles, traditional utility-oriented theory, which focuses on "efficiency first" in the transport evaluation mechanism, ignores utilization inequity in transport resources due to differences in social resources and travel capabilities. As a result, vulnerable travel groups have few equal opportunities and options. John Rawls' theory of justice is a critique of utilitarianism that establishes the ethical orientation of "equity first" for transport inclusion.

Second, Amartya Sen's capability approach to welfare economics contends that individual capability differences should be considered when evaluating social equality. A similar viewpoint is emphasized by the "hardship principle" in insufficiency philosophy,

Table 1
Theoretical basis and basic views of transport inclusion.

Transport inclusion	Theoretical basis	Core questions on transport inclusion	Basic views on transport inclusion
Value principle	Justice theory	Value principle based on transport equity	Traffic policies should emphasize equal mobility opportunities for vulnerable groups.
Methodology principle	Capability approach	Evaluation based on transport equity	The evaluation of transport fairness should be established from the differences between individual transport resource transition capabilities.
	Hardship principle	Priority principles based on transport equity	Transport priorities should be established on the inclusion of vulnerable groups.
Practical principle	Production of space	Social relations represented by the construction of transport space	Social equity can be represented by constructing an inclusive transport environment and passengers' perceptions.
	Environment psychology	Effects on human behavior and psychology by transport environment	Transport accessibility should be targeted as inclusion for all.
Social effects	Social inclusion	Impacts on social members by transport policy	Policy design based on transport inclusion has a positive effect on social inclusion.

which claims that intervention is needed if people fall below a critical value level (Casal, 2007), even if it means redistribution and a loss of interests in a utilitarian sense. These two theories provide methodological guidelines for transport inclusion and propose that the transport planning and assessment mechanism should consider the different capabilities in transport resource utilization for travelers (Martens, 2018).

Third, transport is a form of the spatial environment, including station space, vehicle space, and walking environment. Space production theory and environmental psychology explain the practical principles of how the spatial environment affects society. One principle is Lefebvre's theory of spatial production, which considers space as a product of social relations rather than a static container (Ye et al., 2011). Lefebvre's "conceptual triad of production of space"—the representation of space, spatial practice, and the space of representation—helps to explain the social mechanism generated by transport inclusion and exclusion. The representation of space is a physical space based on ideas and principles. Spatial practice is people's perception and interaction in the spatial environment. A space of representation means that ideas and principles in physical space can be mapped to social relationships (Wang, 2009). That is, space can produce social relations, and this transmission occurs through spatial practice. If the transport space is constructed following the principle of inclusion priority, the TIPV will be transmitted from travel space to social life, positively impacting older adults' health, social participation, and subjective well-being. In the opposite case, older adults will experience passive aging and will remain excluded from society. Another practical principle is the "people-oriented" environmental design idea proposed by environmental psychology, which also significantly affects transport inclusion for vulnerable groups. Ronald Mace, an architect who used wheelchairs, first proposed universal design. Since then, universal design and inclusive design, which aim to serve "all people", have been widely acknowledged by international communities. Thus, a new inclusive design idea is generated in transport subjects, highlighting the proposal that barrier-free traffic facilities should be provided to vulnerable groups. Accordingly, many countries have published regulations for barrier-free facilities in PT.

Fourth, social inclusion is a key theoretical concept in the sociological assessment of social quality. It highlights whether the current social system can treat vulnerable groups inclusively rather than excluding them. Social inclusion focuses on the relationship between social perception (such as perceived exclusion or inclusion, group gaps, and social equity) and social effects (such as quality of life, well-being, and social integration) (Yi, 2020). Specifically, an inclusive transport system can greatly support an AA society.

Transport inclusion evolved from transport-related social exclusion (TRSE) research. In the initial phase, TRSE research themes were established with a focus on the mobility deprivation of vulnerable populations and the negative externalities of transport (Lucas, 2019). Cost-benefit analysis has long been the mainstream method for evaluating transport projects and policies. The method originated from the hypothesis of the "rational economic man", taking overall social welfare and average welfare as the main criteria for policy evaluation. This means that measures that benefit vulnerable minority groups have not been taken seriously. In the first phase, TRSE entered the research horizon in 2000. Its research topic was formed in 2004. TRSE is a crossover research field between the subjects of transport planning, management, and sociology and addresses the dilemma of public transport in a social research framework (McDonagh, 2006). It involves critical understanding and practical concern for social issues in transport research. Older adults are one of the leading groups in the TRSE study field. In the second phase, the transport-related social inclusion (TRSI) theme appeared in 2016. As proposed by academics, constructing an inclusive transport system is most important for older adults to promote mobility and well-being.

Inclusive transport has been addressed in previous studies. For instance, the vulnerability of public spaces in aging societies should be assessed so that city assessment models can consider transport inclusion (Martens, 2018). Inclusive streets should be designed to consider the demands of disadvantaged groups (Asadi-Shekari et al., 2013). Nighttime traffic services should consider women's safety and provide women with an inclusive travel environment (Plyushteva and Boussauw, 2020). The concept of inclusion has been widely acknowledged as a street design paradigm (Wang et al., 2021). These studies indicate that inclusive transport is attracting widespread attention. However, while inclusive transport is mentioned frequently in traffic application scenarios, it lacks a systematic theoretical explanation.

TRSE is a critical study direction, and TRSI is a constructive direction. The advent of the latter does not replace the former; instead, both are part of transport equity research. The common aims of these studies are to realize equity in the domain of ethics and mobility in the domain of transport. Transport inclusion reflects the development of this concept from "utility" to "equity" in modern transport. With global aging, the concept and policy practice of transport inclusion has gradually been emphasized worldwide.

2.1.2. Dimension identification of TIPV

From the perspective of the rational economic man, value is cost-benefit maximization. On this ground, perceived value is to meet the functional demands of customers for products (Zeithaml, 1988), such as the trade-off between perceived cost and benefits (Day, 1994), perceived earnings and risks (Ulaga and Chacour, 2001) and perceived quality and price (DeSarbo et al., 2001). In contrast to other products, public transport (PT) consumption is characterized by functional and service consumption. That is, it realizes spatial mobility for travelers and simultaneously provides them with travel services. In the consumption process, the psychological experience generates emotional and social value (Sweeney and Soutar, 2001). When the transport environment makes older people perceive friendliness, patience, and courtesy during travel, it generates positive emotional value for them. At the same time, the perception of transport corporation's social effect, responsibility and image is a way for vulnerable people to understand transport corporation's social value and social fairness.

In summary, four dimensions of TIPV can be identified: perceived functional value (PF), perceived service value (PS), perceived emotional value (PE), and perceived social value (PO). First, PF is the appraisal of the combined utility of product quality and price. Second, PS is the appraisal of product-related services. Third, PE is the emotional effect, such as the psychological pleasure produced when people use goods or services. Fourth, PO is the overall assessment of the social impact, social duty, and social image associated

with products or services.

2.1.3. Impact of TIPV on travel satisfaction

In perceived value theory, consumers' perceived value of goods and services determines their behavior and intention to pay (Cheng and Tseng, 2016). Satisfaction mediates this relationship, while individuals' perceived value significantly affects behavioral intention through satisfaction (Lai and Chen, 2011). Hence, perceived value is adopted to evaluate transport service quality or used in travel satisfaction and intention studies. In addition, perceived value is the evaluation of specific consumption scenarios. Transport inclusion is a transport scenario based on transport fairness and humanistic concepts. The transport inclusion perceived value must be assessed in the study of older adults' travel satisfaction and behavior.

In travel satisfaction studies, the indicators of PT service quality attributes usually focus on the functional and service attributes, which are used to measure the passengers' subjective evaluation of PT attributes. These indicators, which are considered crucial indices of travel satisfaction (Olsson et al., 2020; Zhang et al., 2019), can be used to study perceived functional and service values in this study.

In addition, perceived emotional value affects satisfaction. Due to slow movement, elderly passengers sense invisible pressure from younger passengers waiting behind them in line (Liu et al., 2021b). Better emotional experiences in travel, such as friendliness, patience, positivity, and orderliness, can improve older people's satisfaction and encourage more travel behaviors, making them more willing to participate in social activities.

Furthermore, the perceived social effect is proportional to overall satisfaction (Guo et al., 2020). It is proposed that the perceived social value of transport inclusion includes direct and indirect social effects, social responsibility, and corporate image. The direct social effect is older people's perception of living assurance provided by the transport system, such as whether PT meets their needs for daily purchasing, hospital visits, and social participation; it represents perceived social value regarding transport assurance for quality of life. The indirect social effect indicates how transport affects older people's social integration, closely related to travel activities. Therefore, the more older people perceive the social value of PT from the direct and indirect social effects of traveling, the higher their overall satisfaction with PT is. In addition, social responsibility can positively affect customers' recognition of PT (Xiao and Li, 2017). A positive corporate image positively impacts travel satisfaction (Ni et al., 2020). Therefore, the perceived social value of social responsibility and corporate image may affect travel satisfaction. In summary, perceived social value in this study consists of four aspects: direct social effect, indirect social effect, corporate image, and social responsibility.

Thus, the following hypothesis is proposed:

Hypothesis 1. TIPV positively affects travel satisfaction (S).

2.2. AA

2.2.1. Active aging (AA)

Early research on aging adopted passive study attitudes. Aging was believed to be a universal and inevitable process characterized by a decline in physical capability and gradual detachment from social roles (Foster and Walker, 2015). Social interaction, social duty, and the meaning of life for older adults were framed within a limited scope. After the advent of positive psychology, research on aging took a constructive approach. The World Health Organization (WHO) defines AA as optimizing health, participation, and security opportunities to improve the quality of life for elderly populations. It aims to help them reach their physical, social, and spiritual potential, participate in society based on their needs, and provide adequate protection and care. The AA research framework transforms elderly populations from problematic social groups into problem solvers, creators, and drivers for sustainable social development (Pérez-Cuevas et al., 2015).

AA is an important strategic plan to address the challenges of global aging. It is proposed and practiced as a policy framework (Walker, 2016). AA focuses on the relationship between older adults' individual and social development. One AA policy strategy is centered on "holistic self-development", which focuses on elderly people's healthy lifestyles (Flecha, 2015), well-being (Saz-Gil et al., 2019), and achievements (Russell, 2013). This view highlights humanistic care for elderly individuals. Another view focuses on "economic instrumentalism", which views older adults as constructive societal forces aiming to improve their social participation and alleviate labor shortage pressure in an aging society (Foster and Walker, 2015). This perspective views older adults as vital resources for families and society and requires a social environment that provides opportunities for physical health, psychological growth, and social role development. At the microindividual level, AA aims to enhance older people's quality of life and well-being, while at the macrosocial level, it strives to provide social involvement, integration, and contribution. Transport inclusion, as a basic public service assurance for older adults' lives and social integration, helps realize AA policy goals.

2.2.2. Three aspects of active aging (AA): Health (H), social participation (P), and subjective well-being (B)

Under the WHO policy framework for AA, research organizations in various countries have studied and developed the AA Index (AAI), such as the AAS-Thai 2014 (Thanakwang et al., 2014), AAL-Thai 2016 (Haque et al., 2016), UJACAS 2018 (Rantanen et al., 2018), and AAI-Thai 2007 (Thanakwang and Soonthorndhada, 2007). These indices emphasize health, social participation, well-being, and transport assurance.

The study of AA, based on the WHO's concept, identified three dimensions of health, social participation, and subjective well-being as potential variables. These dimensions were analyzed with regard to the research literature on TRSE, transport social effects, and the existing AAI. The selection criteria included preliminary literature on the relationship between the latent variable and transport and its importance in the AAI. This study clarifies these dimensions of health, social participation, and well-being in relation to transport.

2.2.3. Impact of travel satisfaction (S) on health (H), social participation (P) and subjective well-being (B)

An age-friendly transport environment is a prerequisite for the independent living of senior citizens. PT plays a crucial role in AA policies in China, Australia, the European Union, Russia, Canada, Finland, and other countries (Hsu et al., 2019).

Physical and mental health is an important goal for AA. For older adults, mobility improvement is critical to their physical, economic, and mental health (Ziegler and Schwanen, 2011). Travel positively affects the improvement of cognitive function (Cassarino and Setti, 2016) and particularly helps increase memory scores (Reinhard et al., 2019). Social participation can significantly improve elderly individuals' self-evaluation of their health and reduce their mental stress (Liu et al., 2019). Satisfactory travel experiences can positively impact the health of older adults (Lucas, 2012). Travel satisfaction can affect life satisfaction (Gao et al., 2018) and medical resource visits, ultimately impacting older adults' physical and mental health (Li et al., 2020b).

It has been demonstrated that for older adults, their crumbling social networks and collapsing sense of belonging are closely related to their lessened participation in social activities (Currie et al., 2009). People who travel daily maintain higher levels of social participation, quality of life, and social cohesion (Voss et al., 2016). Older adults' sense of neighborhood and community is intimately linked to their satisfaction with transport systems (He et al., 2020). Positive correlations are demonstrated among their fulfillment with social participation, travel, and life satisfaction (Friman et al., 2017). An age-friendly transport system can help them rebuild or expand social interactions and alleviate social isolation (Hemingway and Jack, 2013).

Subjective well-being is a general expression of life satisfaction. Hedonic subjective well-being focuses on emotional evaluation, while eudaimonic subjective well-being focuses on life goals and meaning and the pursuit of personal growth and self-actualization (De Vos et al., 2013). The latter is the overall evaluation of well-being in the cognitive domain. People are emotionally affected by their daily travel, which directly influences their degree of travel satisfaction and indirectly influences their subjective well-being (Bergstad et al., 2011). For older adults, social participation is crucial to retaining social roles and searching for meaning in life (Heaven et al., 2013). Higher travel rates are related to a lower risk of social exclusion and indirectly promote well-being (Stanley et al., 2011). Transport mobility improves social participation and helps address socially inclusive psychological needs that are essential for well-being (Vella-Brodrick and Stanley, 2013).

Above all, travel satisfaction influences health, social participation, and subjective well-being to improve active aging.

Thus, the following hypotheses are proposed:

Hypothesis 2. Travel satisfaction (S) positively affects health (H), social participation (P), and subjective well-being (B).

2.3. Impact of TIPV on AA

2.3.1. Direct impact of TIPV on AA

Perceived value is people's cognitive evaluation of the external environment. Positive or negative cognitive evaluations can consistently affect corresponding behaviors and personal emotions. Positive perceived value encourages the continuation of related behaviors. When external situations are considered meaningful to individuals, they are usually accompanied by a pleasurable subjective experience (Papadimitriou et al., 2013). Cognitive evaluation is also associated with personal well-being (Bagozzi et al., 1999), and the "cognitive evaluation-emotion-behavior" framework is widely used in marketing, tourism management, and other research fields.

Social inclusion focuses on the relationship between social perception and social effects, which involves people's quality of life, social integration, and well-being (Yi, 2020). Transport inclusion is an integral part of social inclusion. Because transport is an important infrastructure in daily life, evaluating the value of transport inclusion for vulnerable groups may affect travel satisfaction in the short term, and the long-term social effects may be reflected in physical and mental health, social participation, and subjective well-being.

Many TRSE studies have demonstrated the relationship between transport exclusion and social exclusion. To compensate for the loss caused by declining physical mobility due to aging, elderly individuals have to rely more on fundamental public assurance (Choi and DiNitto, 2016). The poor mobility of elderly individuals limits their daily activity range and worsens their physical condition (He et al., 2018). According to data from the WHO, a lack of transport resources prevents them from obtaining necessary health care, especially for low-income elderly individuals (World Health Organization, 2022). Due to a lack of accessibility and mobility, they cannot participate effectively in mainstream society (Lucas, 2012). Elderly individuals' well-being is affected by transport exclusion (Dahlberg and McKee, 2018). Overall, the health, quality of life, cohesion, and equity of an aging society are ultimately affected by TRSE (De Vos et al., 2013).

Thus, the following hypotheses are proposed:

Hypothesis 3. TIPV positively affects health (H), social participation (P), and subjective well-being (B).

2.3.2. Indirect impact of TIPV on AA through travel satisfaction (S)

The study suggests that travel satisfaction plays a mediating role in the relationship between transportation inclusion (TIPV) and active aging (AA) by increasing older people's willingness to participate in outdoor activities and social interactions. This leads to a positive life that includes physical health, psychological self-evaluation, and improved well-being, contributing to active aging and promoting a healthier lifestyle.

Based on the above analysis, the following mediation effects hypotheses are proposed:

Hypothesis 4. Travel satisfaction (S) has a separate mediating effect between TIPV and health (H), between TIPV and participation (P), and between TIPV and subjective well-being (B).

2.4. Travel capabilities of older adults

2.4.1. Five aspects of travel capability (C): Physical adaptability (CH), psychological adaptability (CS), pathfinding capability (CP), smartphone usage capability (CM) and vehicle usage capability (CV)

Physical adaptability and psychological adaptability vary significantly among older adults. The WHO noted that physical travel barriers include movement, audiovisual, and cognitive disorders (World Health Organization, 2011). The decline in physical functions makes older adults more cautious about avoiding the risks of traffic injuries or criminal assaults. Fast-moving traffic and complicated traffic patterns make older adults feel more vulnerable or worried about travel (De Donder et al., 2013), and their weakened sense of control over their environment restricts their willingness to take PT (Downey and Van Willigen, 2005). Due to a lack of travel experience, older adults appear to suffer negative self-assessments and anxieties before travel. Psychologically, older female adults tend to fear being lost (Gayman et al., 2008). Furthermore, declining immunity amplifies their concerns (Liu et al., 2021b).

Pathfinding and smartphone usage are crucial information capabilities for traveling in city. However, older adults often get lost in complex urban public transport routes, particularly in subway stations. Despite the convenience of smartphone apps, older adults feel hard to utilize technological advancements compared with young people, making them appear powerless when using digital transport services (Liu et al., 2021a). Learning ability significantly impacts individual travel characteristics (He et al., 2009), and addressing these challenges is essential for improved transportation efficiency.

The use of a variety of vehicles is beneficial for older people to have flexible travel options and transport connections. Research shows that a driver's license represents the capability to travel (Ryan et al., 2019). The differences in vehicle usage capabilities among older adults are a significant restriction that impact their range of social activity (Dong et al., 2019).

In summary, previous studies have highlighted the significance of transport equity in social development and have emphasized the impact of mobility opportunities on social exclusion. The relationship between perceived value and satisfaction has been verified, and travel satisfaction has been linked to health, social participation, and subjective well-being. However, the mechanism by which transport inclusion influences older adults' travel still remains unclear. This study explores the relationships between TIPV, travel satisfaction, travel capabilities, and older adults' travel.

2.4.2. Impact of travel capabilities (C) on the relationship between TIPV and AA

Travel activities are affected not only by age but also by travel capabilities. Older adults who can engage in daily social activities tend to obtain a higher level of satisfaction (Mollenkopf et al., 2011). Those with fewer travel mode choices, less freedom, and limited mobility might be at risk of social exclusion (Ryan et al., 2019). In mobility research on elderly individuals, the capabilities approach is often adopted because it facilitates understanding the degrees of freedom with different resource conversion capabilities (Vecchio and Martens, 2021). Transport resource conversion capabilities impact older people's well-being (Ryan et al., 2015).

Thus, the following hypotheses are proposed:

Hypothesis 5. The relationship between TIPV and health (H) is separately moderated by physical adaptability (CH), psychological adaptability (CS), pathfinding capability (CP), smartphone usage capability (CM), and vehicle usage capability (CV).

Hypothesis 6. The relationship between TIPV and social participation (P) is separately moderated by physical adaptability (CH), psychological adaptability (CS), pathfinding capability (CP), smartphone usage capability (CM), and vehicle usage capability (CV).

Hypothesis 7 The relationship between TIPV and subjective well-being (B) is separately moderated by physical adaptability (CH), psychological adaptability (CS), pathfinding capability (CP), smartphone usage capability (CM), and vehicle usage capability (CV).

Based on the above analyses, a theoretical model of mediation and moderation is proposed in this study (Fig. 1).

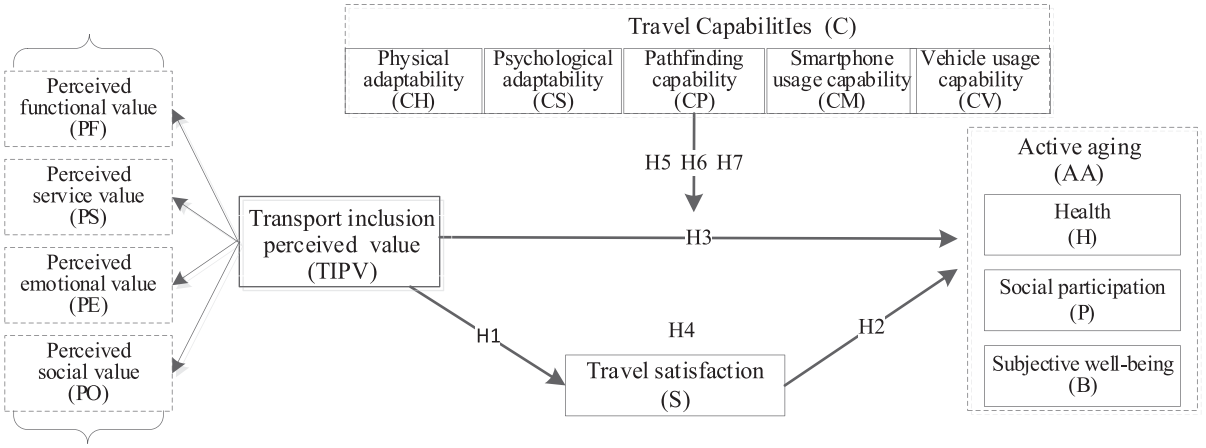


Fig. 1. Theoretical model.

2.5. Measurement development

Some measurement statements of TIPV in this model were developed from prior studies of perceived value (Petrick et al., 2001; Sweeney and Soutar, 2001) and PT service quality attributes in travel satisfaction, including accessibility, reliability, information, safety, economy, comfort, the behavior and attitude of the personnel, and operation service (Ni et al., 2020; Yuan et al., 2019; Lierop et al., 2018; Zhang et al., 2019; Abenoza et al., 2017). Based on these, the statements were modified according to older adults' transport inclusion demands and travel behavioral characteristics. The travel satisfaction measurement statements from prior studies included general satisfaction, comparative satisfaction, and willingness to recommend PT (Zhang et al., 2016; Ingvardson and Nielsen, 2019). The three latent variables of AA—health, social participation, and subjective well-being—were drawn from the AAI and related literature. This study measured health, including physical health, positive mood (He et al., 2020), and self-esteem (Wang et al., 1999). A self-esteem scale was adopted for elderly individuals' self-evaluations on self-identification, self-value, self-reliance, and strengths and importance. Regarding social participation, measurements were explicitly performed on interpersonal, cultural, recreational, consumptive, and productive activities (Li et al., 2020a). The statements to measure subjective well-being were from the eudaimonic subjective well-being scale. All the study variables were measured on a 5-point Likert scale (The latent variables and manifest variables are further detailed in Table A1).

Additionally, elderly people's travel capabilities were measured by five capabilities: physical adaptability, psychological adaptability, pathfinding capability, smartphone usage, and vehicle usage. Physical adaptability was measured by walking, vision and hearing, cognitive and memory capabilities, and other disease risks while traveling. Psychological adaptability was measured by anxious feelings about crowded traffic environments, new travel lines, and entering PT in a limited time. Pathfinding capability was measured by using traffic signs to identify the route. Smartphone usage capability was measured by using different traffic functions on the smartphone. Vehicle usage capability was measured using different travel modes, including bus, metro, train, and airplane. The travel capabilities of older people were self-reported data.

3. Methodology

3.1. Research method

SEM has been widely applied to assess latent variable models in studies of perceived value, travel satisfaction, and subjective well-being (e.g., Li et al., 2019; Ni et al., 2020). Based on the literature, the following latent variables were established: perceived functional value, perceived service value, perceived emotional value, perceived social value, travel satisfaction, travel capabilities, health, social participation, and subjective well-being. SEM was applied to build a hypothetical model including the above latent variables. An empirical study was conducted, and data were collected from questionnaires in Xi'an, China. SPSS and AMOS 23 were applied to test the reliability and validity of the latent variables and the goodness-of-fit and path coefficient of the structural equation model (SEM). After controlling for demographic variables, regression analyses were conducted. Finally, the significance of mediation and moderation were tested with bootstrapping at the 95 % confidence interval level.

3.2. Data sources

To test the theoretical hypotheses, travel information was collected from older people in Xi'an City, China. There were three reasons for this decision. First, the elderly population is 2,075,318 in Xi'an, accounting for 16.02% of the city's population, which is close to the average elderly proportion in national population.[1] Second, in recent years, Xi'an has experienced rapid urban land-scale expansion. Its subway system is increasing, and PT is in a transitional period of extensive upgrading. Third, the aging population in Xi'an is characterized by a combination of aging acceleration and urban–rural population mobility, which challenges transport inclusion development and elderly individuals' integration into urban environments. Therefore, as a sample city, Xi'an is representative and has practical significance for similar cities.

The survey involved, but not only, bus users in PT travel who were over 60 years old and had lived in Xi'an for over six months, in line with the National Bureau of Statistics' definition of elderly age and permanent residents in China. The survey was conducted in two phases in June and July 2022.

In-depth interviews were conducted with 25 elderly individuals during the pre-research stage, with an average interview time of one hour. The interviewees provided feedback and suggestions for the questionnaire's relevance and completeness. After collecting and analyzing the feedback, the questionnaire was optimized for textual expression, structure, and items, and the survey questionnaire was finalized.

This study aimed to address the disparity in urban transport development in Xi'an by using a stratified sampling procedure. The road network in Xi'an's main urban areas is structured with three ring roads around the city center. Fourteen subdistricts were chosen based on their urban transportation locations, with traffic locations categorized into two within the first ring road, two between the first and second ring roads, eight between the second and third ring roads, and two outside the third ring road. The study surveyed four subdistricts in Xi'an, focusing on elderly population densities. The selected subdistricts were classified as high-density, medium–high-

[1] The data is sourced from the 7th National Population Census of China.

density, medium-density, medium–low-density, and low-density (He et al., 2022). The survey points were chosen by considering community differences and high-frequency destinations for elderly individuals in these subdistricts. Chinese communities are affected by both the development of rural urbanization[2] and centralized housing in the "system of units"[3]. The survey was conducted in five community types: old city, village-in-city, commercial, large enterprise, and administrative institution, considering the lifestyles of elderly individuals in various high-frequency destinations.

The study involved distributing questionnaires to elderly individuals and randomly inviting them to participate. Gifts were distributed to boost enthusiasm. To address older people's weaker audio-visual and cognitive abilities, interviewers with professional training and experience in travel surveys conducted face-to-face and one-on-one Q&A interviews with older people and helped them complete the questionnaires.

Five hundred ninety-six questionnaires were sent out and 521 valid questionnaires were received, for a response rate of 87.4 %. Of these, 85.8 % of the older adults' highest education level was below high school. This low level characterizes the population born before the 1960 s in China. The proportion of those who returned to work after retirement was very low, only 8.4 %. This is related to the lifestyle of older people in China, who usually help babysit their grandchildren. For 50.7 % of the elderly interviewees, their average monthly income was less than CNY 3,000, which is lower than urban residents' disposable income of CNY 4,108. This reflects the reality that older people's income generally declines after retirement. The demographic features of the respondents matched those of the Xi'an Bureau of Statistics survey on elderly groups.

The study found that 9.8 % of respondents lived within the first ring, 19.8 % in between the first and second rings, 66.6 % in between the second and third rings, and 3.8 % outside the third ring. The respondents' community types included old city demolition and resettlement (10.7 %), commercial residence (33.6 %), village-in-city demolition and resettlement (16.9 %), large enterprise residence (29.8 %), and administrative institution residence (9.0 %).

The geographical distribution of the respondents' residential communities and traffic locations is shown in Fig. 2.

4. Results

4.1. Reliability and validity analysis

While developing the scale, exploratory factor analysis (EFA), reliability analysis, and validity analysis were used to determine whether the questions were consistent with the relevant concepts. The KMO value was 0.944 ($p = 0.000$), indicating that the data were suitable for factor analysis. The Cronbach's alpha values for the variables were all greater than 0.8 (PF = 0.888, PS = 0.837, PE = 0.836, PO = 0.854, S = 0.877, H = 0.918, P = 0.852, B = 0.875), indicating that the internal consistency of the questionnaire was good.

The model intrinsic structure fit test statistics included factor loading, combination reliability (CR), and average variance extracted (AVE). The factor loading values corresponding to each potential variable were all greater than 0.5, indicating that the subject of each potential variable was highly representative. The AVE of the average variance sampling of each potential variable was greater than 0.5 (PF = 0.617, PS = 0.564, PE = 0.562, PO = 0.596, S = 0.595, H = 0.556, P = 0.592, B = 0.584). The CR of the combination reliability ranges was greater than 0.6 (PF = 0.889, PS = 0.838, PE = 0.837, PO = 0.855, S = 0.880, H = 0.918, P = 0.853, B = 0.875), indicating that the convergent validity of each variable was ideal (more details are presented in Table A1).

The correlation coefficients among the variables were all lower than the AVE square root value of each latent variable, so the discriminant validity of each latent variable was considered good (more details are provided in Table A2).

A second-order model was set up (latent variable TIPV), which included four first-order factors (PF, PS, PE, and PO) to simplify the model and reduce the estimated factors. The corresponding fitness indices of the second-order model were all within the recommended value range ($\chi^2/df = 1.551$, RMSEA = 0.033, GFI = 0.962, AGFI = 0.949, IFI = 0.985, TLI = 0.983, CFI = 0.985). In addition, the chi-square ratio between the first-order four-factor model and the second-order factor model was 0.962 (target coefficient = 0.962). As Marsh HW (Marsh and Hocevar, 1985) recommended, a target coefficient closer to unity reveals that the second-order model has better effects. Therefore, the second-order model for TIPV was acceptable (more details are provided in Table A3).

4.2. SEM and fitting results

SEM was used to verify the hypotheses. AMOS software was used to obtain the relationship between the observed and latent variables and the SEM of the relationship between the latent variables. The path coefficient test obtained significant probability values among the model's latent variables. The SEM diagram is shown in Fig. 3.

The values of the fitting parameters in the SEM all satisfied the criteria ($\chi^2/df = 1.070$, RMSEA = 0.012, GFI = 0.932, NFI = 0.923, IFI = 0.995, TLI = 0.995, CFI = 0.995), indicating that the model fit was good or within an acceptable range (more details are provided in Table A4). The mediation model's direct path coefficient test results indicate that hypotheses H1, H2, and H3 were all supported.

[2] With the city's expansion, according to the needs of the new urban planning, the houses in the old city district will be demolished. Similarly, villages located in the suburbs will also be demolished and become a part of the city, and they are called "village-in-city". Both kinds of demolition have the characteristics of centralized resettlement.

[3] In China, the employees of large units, such as enterprises and administrative institutions, usually live in the same community.

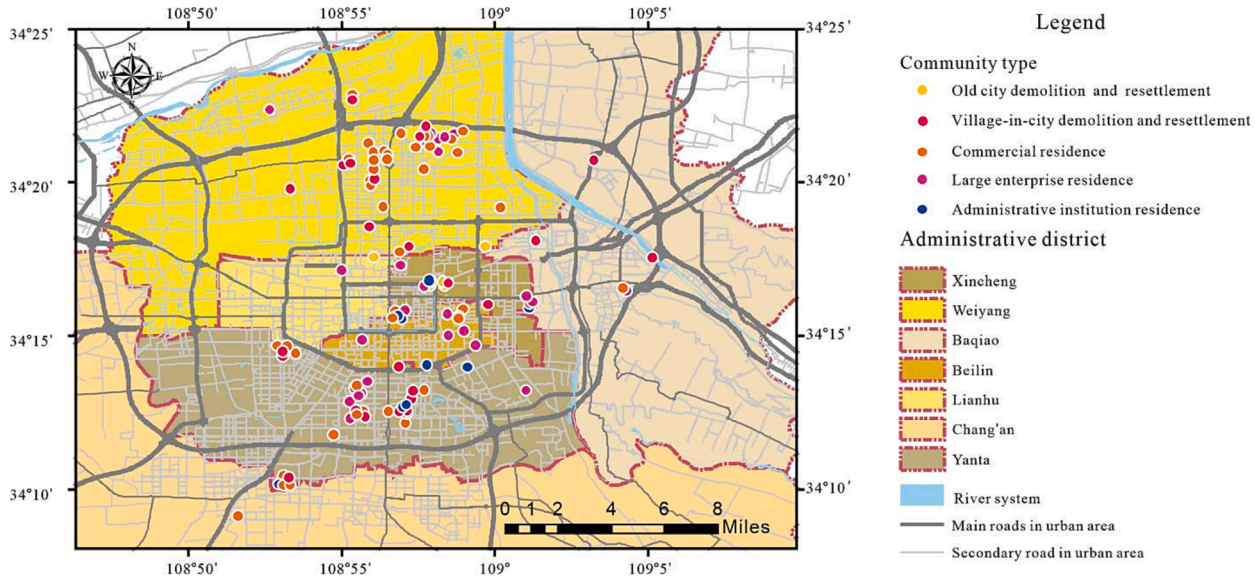
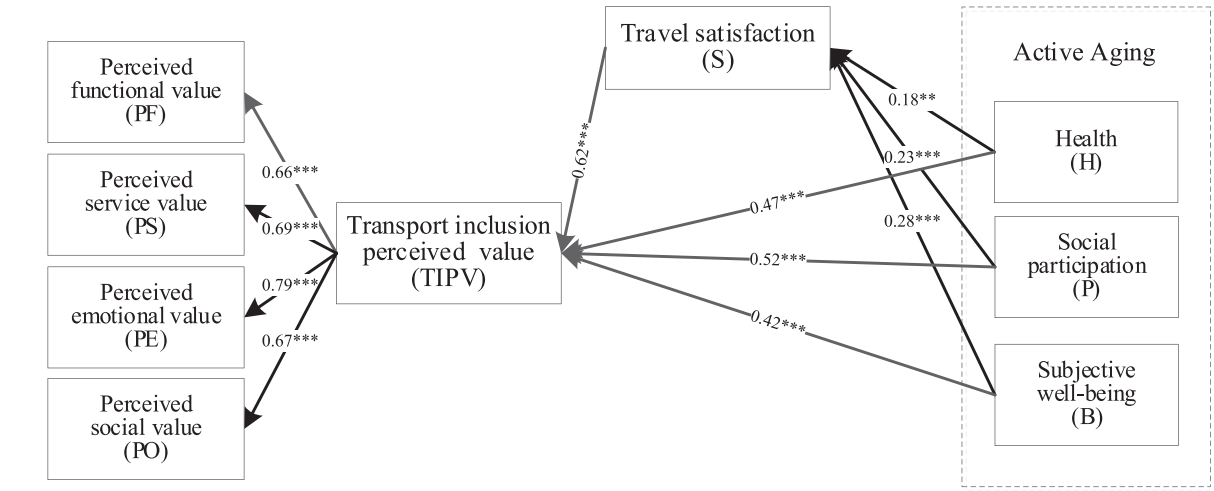


Fig. 2. Respondents' address distribution.



Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Fig. 3. SEM for the mediation model.

4.3. Mediation analysis of travel satisfaction

The bootstrap method was used to test the mediation effect. The number of samples was set to 5000 (more than 1000 is usually required); the confidence level of the interval was set to 95 %. The results of the mediation effect test are as follows. In the three mediation paths of S between TIPV and H (indirect effect = 0.110, $p < 0.05$), TIPV and P (indirect effect = 0.139, $p < 0.01$), and TIPV and B (indirect effect = 0.174, $p < 0.001$), the bootstrap confidence intervals did not contain zero on the upper and lower limits of the 95 % bias-corrected and percentile. The results indicate that the mediation effects of hypothesis H4 were all supported.

4.4. Moderation analysis of travel capabilities

Hayes' Model 5 in the plug-in process and bootstrap method were used. Because Hayes' Model 5 is a single dependent variable model, the moderation effects were tested in three mediation models separately, taking H, P, and B as dependent variables. Specifically, TIPV was the independent variable; CH, CS, CP, CM, and CV were the moderators; S was the mediator; and H, B, and P were the dependent variables. The moderation effects for the five travel capabilities (including CH, CS, CP, CM, and CV) were tested in the paths

from TIPV to H, TIPV to P, and TIPV to B. Based on travel capability scores, the respondents were categorized into high travel capabilities and low travel capabilities by the median method. Separate linear regression was used to obtain the results of the moderation effect test.

First, H was used as the dependent variable. The control variables included age, gender, education, job before and after retirement, monthly income, traffic location, and community type. The explanatory variables were TIPV, CH, CS, CP, CM, and CV. The product interaction terms between TIPV and CH, TIPV and CS, TIPV and CP, TIPV and CM, and TIPV and CV were standardized and used as the independent variables. The interaction term between TIPV and CH had a significant negative effect on H (coeff. = -0.098, $p < 0.05$), which explained 20.9 % of the H variation (adjusted $R^2 = 0.209$), indicating that CH had a significant negative moderation effect on the influence path of TIPV on H. The interaction term between TIPV and CS had no significant effect on H (coeff. = -0.034, $p > 0.05$), indicating that CS had no significant moderation effect on the influence path of TIPV on H. The interaction term between TIPV and CP had a significant negative effect on H (coeff. = -0.160, $p < 0.001$), which explained 22.4 % of the H variation (adjusted $R^2 = 0.224$), indicating that CP had a significant negative moderation effect on the influence path of TIPV on H. The interaction term between TIPV and CM had a significant negative effect on H (coeff. = -0.181, $p < 0.001$), which explained 22.4 % of the H variation (adjusted $R^2 = 0.224$), indicating that CM had a significant negative moderation effect on the influence path of TIPV on H. The interaction term between TIPV and CV had a significant negative effect on H (coeff. = -0.147, $p < 0.001$), which explained 26.2 % of the variation in H (adjusted $R^2 = 0.262$), indicating that CV had a significant negative moderation effect on the influence path of TIPV on H.

Second, P was the dependent variable, and the above control variables were added. The interaction term between TIPV and CH had a significant negative effect on P (coeff. = -0.134, $p < 0.001$), which explained 29.5 % of the variation in P (adjusted $R^2 = 0.295$), indicating that CH had a significant negative moderation effect on the influence path of TIPV on P. The interaction term between TIPV and CS had no significant effect on P (coeff. = -0.069, $p > 0.05$), indicating that CS had no significant moderation effect on the influence path of TIPV on P. The interaction term between TIPV and CP had a significant negative effect on P (coeff. = -0.126, $p < 0.01$), which explained 30.9 % of the variation in P (adjusted $R^2 = 0.309$), indicating that CP had a significant negative moderation effect on the influence path of TIPV on P. The interaction term between TIPV and CM had a significant negative effect on P (coeff. = -0.108, $p < 0.01$), which explained 28.5 % of the variation in P (adjusted $R^2 = 0.285$), indicating that CM had a significant negative moderation effect on the influence path of TIPV on P. The interaction term between TIPV and CV had a significant negative effect on P (coeff. = -0.159, $p < 0.001$), which explained 32.7 % of the variation in P (adjusted $R^2 = 0.327$), indicating that CV had a significant negative moderation effect on the influence path of TIPV on P.

Table 2
The moderated mediation bootstrap test results.

Mediation path	Moderator	Direct effect						Indirect effect			
		Effect	SE	t	p	LLCI	ULCI	Effect	SE	LLCI	ULCI
TIPV-S-H											
	Low-CH	0.363	0.060	6.051	***	0.245	0.481	0.117	0.027	0.066	0.174
	High-CH	0.198	0.070	2.828	**	0.060	0.335				
	Low-CS	0.305	0.064	4.776	***	0.180	0.431	0.127	0.027	0.077	0.184
	High-CS	0.239	0.077	3.128	**	0.089	0.389				
	Low- CP	0.453	0.062	7.298	***	0.331	0.575	0.118	0.028	0.067	0.176
	High-CP	0.147	0.060	2.440	*	0.029	0.265				
	Low -CM	0.440	0.057	7.738	***	0.328	0.552	0.119	0.027	0.068	0.174
	High -CM	0.140	0.067	2.082	*	0.008	0.272				
	Low -CV	0.417	0.072	5.836	***	0.277	0.558	0.103	0.026	0.054	0.157
	High -CV	0.171	0.054	3.183	**	0.065	0.276				
TIPV-S-P											
	Low-CH	0.472	0.081	5.821	***	0.313	0.631	0.133	0.027	0.084	0.190
	High-CH	0.238	0.072	3.321	**	0.097	0.379				
	Low-CS	0.398	0.088	4.539	***	0.226	0.571	0.140	0.028	0.089	0.197
	High-CS	0.260	0.082	3.171	**	0.099	0.421				
	Low- CP	0.481	0.073	6.573	***	0.337	0.625	0.124	0.029	0.071	0.184
	High-CP	0.246	0.072	3.421	**	0.105	0.387				
	Low -CM	0.439	0.071	6.214	***	0.300	0.578	0.138	0.028	0.084	0.191
	High -CM	0.283	0.078	3.633	***	0.130	0.435				
	Low -CV	0.500	0.075	6.679	***	0.353	0.648	0.121	0.027	0.073	0.177
	High -CV	0.237	0.062	3.847	***	0.116	0.359				
TIPV-S-B											
	Low-CH	0.426	0.059	7.214	***	0.310	0.542	0.127	0.026	0.077	0.178
	High-CH	0.162	0.075	2.169	*	0.038	0.329				
	Low-CS	0.346	0.074	4.662	***	0.200	0.492	0.156	0.028	0.105	0.213
	High-CS	0.227	0.093	2.448	*	0.045	0.410				
	Low- CP	0.416	0.058	7.240	***	0.303	0.529	0.163	0.029	0.112	0.225
	High-CP	0.231	0.081	2.859	**	0.072	0.389				
	Low -CM	0.457	0.070	6.558	***	0.320	0.593	0.148	0.027	0.098	0.206
	High -CM	0.160	0.074	2.168	*	0.015	0.304				
	Low -CV	0.512	0.069	7.432	***	0.377	0.647	0.140	0.027	0.092	0.197
	High -CV	0.162	0.065	2.477	*	0.033	0.290				

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Third, B was used as the dependent variable, and similar moderation steps were taken. The interaction term between TIPV and CH had a significant negative effect on B (coeff. = -0.186, $p < 0.001$), which explained 31.2 % of the variation in B (adjusted $R^2 = 0.312$), indicating that CH had a significant negative moderation effect on the influence path of TIPV on B. The interaction term between TIPV and CS had no significant effect on B (coeff. = -0.060, $p > 0.05$), indicating that CS had no significant moderation effect on the influence path of TIPV on B. The interaction term between TIPV and CP had a significant negative effect on B (coeff. = -0.104, $p < 0.01$), which explained 23.9 % of the variation in B (adjusted $R^2 = 0.239$), indicating that CP had a significant negative moderation effect on the influence path of TIPV on B. The interaction term between TIPV and CM had a significant negative effect on B (coeff. = -0.185, $p < 0.001$), which explained 26.2 % of the variation in B (adjusted $R^2 = 0.262$), indicating that CM had a significant negative moderation effect on the influence path of TIPV on B. The interaction term between TIPV and CV had a significant negative effect on B (coeff. = -0.207, $p < 0.001$), which explained 27.7 % of the variation in B (adjusted $R^2 = 0.277$), indicating that CV had a significant negative moderation effect on the influence path of TIPV on B.

All independent variable tolerances were above 0.1, and all VIF values were below 10, showing no collinearity problem between the independent variables.

4.5. Additional analyses

This study investigated the mediating role of travel satisfaction on AA and the moderating effect of travel capabilities on the TIPV-to-AA link. It found that travel satisfaction, except for CS, moderated the relations between TIPV and AA when mediated by travel satisfaction. The study also examined the individual effects of travel capabilities on the mediation effects of travel satisfaction on the links between TIPV and AA.

The study used 5000 bootstrap samples and 95 % confidence intervals for bias correction. The results showed significant moderators at both high and low levels in the three direct paths "TIPV to H", "TIPV to P", and "TIPV to B". Additionally, under the influence of moderators CH, CP, CM, and CV, the confidence intervals did not contain zero in the three mediation paths of "TIPV-S-H", "TIPV-S-P", and "TIPV-S-B", indicating significant moderated mediation effects (more details are provided in Table 2). The confidence intervals for both high and low levels of CS did not contain zero. However, due to insufficient interaction effect results, CS cannot be considered to moderate the three mediation paths.

5. Discussion

Previous research highlights the impact of perceived functional value and perceived service value on travel satisfaction.The factors that influence travel satisfaction mainly involve the functional and service attributes of transport, such as safety, convenience, reliability, comfort, economy, and rapidity (Li et al., 2019; Ni et al., 2020). In this study, the results further demonstrate the importance of perceived emotional value and perceived social value. The emotional feelings of older people during travel and their perception of the social value of the transport industry affect their overall evaluation of travel. In Xi'an, a promotion policy for perceived emotional value is based on the "priority to pedestrians" principle at traffic intersections, effectively conveying transport inclusion. With this principle, older people feel respected, relaxed, and orderly when crossing the road. Therefore, people-oriented transport inclusion measures effectively improve perceived emotional value in human-vehicle traffic conflict. A typical example of perceived social value promotion is that key subway stations are designed with different landscapes to display Xi'an's cultural sights and historical relics. These stations have attracted many passengers to take photos. It enhances the metro spatial cultural function and shows the transport industry's social responsibility and corporate image. Therefore, this policy has enhanced passengers' perceived social value of transport enterprises.

TIPV had a significant positive correlation with travel satisfaction, and travel satisfaction played a mediating role between TIPV and AA. After adding the mediation variable, the explanatory power of TIPV on health, social participation, and subjective well-being increased by 0.35, 0.47, and 0.40, respectively. The TIPV and AA models supported and expanded the original travel satisfaction model. A previous study showed mobility opportunities could spill over into overall life satisfaction (Ma et al., 2016). In this study, the mediation model results entirely echo this view, showing that the positive psychological transmission mechanism in an aging society ranges from positive spatial environment perception to positive environmental evaluation, and then to a positive life state. Compared with previous studies with a single dependent variable (He et al., 2020; Kim et al., 2020), this study shows the combined spillover effect of transport inclusion on AA, including health, social participation, and subjective well-being. The findings suggest that age-friendly transport environments can provide an active aging society with multidimensional support.

This study responds to the capability approach and justice theory. Some scholars have proposed that transport causes physical, psychological, and technological exclusion to vulnerable travel groups (Church et al., 2000). These exclusions are also observed in the current results. Moderation effects of travel capabilities exist in the relationship between TIPV and AA. Specifically, physical adaptability, pathfinding capability, smartphone usage capability, and vehicle usage capability negatively moderate the relationship between TIPV and health.

Similarly, the moderation effects of the four travel capabilities occur in the relationship between TIPV and social participation and the relationship between TIPV and subjective well-being. Here, evidence is provided that travel capability differences are important considerations for building an inclusive transport environment. Previous studies focused more on physical adaptability (Swift et al., 2021) and digital division (Fields et al., 2019) in transport, while this study's conclusions confirm the moderation effects of these two capabilities. Furthermore, pathfinding capability and vehicle usage capability are found to be moderators. All these reveal the new travel barriers that older people may face in developing countries. Xi'an built its first metro line in 2011. With the formation of the

metro network, the metro has gradually become one of the leading travel options. However, metro travel requires new skills that challenge older people's capabilities. In this survey, many older people complained that the complex spatial design of metro interchange stations challenged their pathfinding capability. Various vehicle (such as metro, train, and airplane) usage capabilities can assist older people to travel further. However, these capabilities are higher challenges to older people too. This study shows that older people's differences in travel capabilities are the factors that influence AA. Inclusive transport system should be provided for older people to compensate the negative impacts by their lower travel capabilities.

Psychological characteristics are determinants of the mobility and accessibility of elderly individuals (Mifsud et al., 2019). However, studies have shown that with significant support from others, travelers' psychology and behavior are positively changed (Skarin et al., 2017). In this study, the results showed that the moderation effect of psychological adaptability was not significant. This demonstrates that compensatory behaviors and other social support might interfere with the moderation effect of psychological adaptation, which might lead to a small range of values between the high and low levels, showing a nonsignificant moderation effect. Older people can positively adopt alternatives to ease their anxiety, such as taking off-peak PT, arriving at stations earlier, traveling with friends, or relying on their children to drive.

6. Contributions

6.1. Theoretical contributions

This study focuses on the impact of travel inclusion perceived value (TIPV) on older people's travel capabilities and finds that TIPV enhances travel satisfaction and promotes health, social participation, and subjective well-being. However, travel capabilities such as physical adaptability, pathfinding, smartphone usage, and vehicle usage have negative moderation effect on the links between TIPV and AA. This theoretical framework has significant implications for transport-related social inclusion and perceived value.

First, the study introduces perceived value theory to research on transport inclusion, expanding its application and providing a new perspective. It proposes four dimensions of TIPV: perceived functional value, perceived service value, perceived emotional value, and perceived social value. The good reliability and fitness of the second-order model reflect the appropriateness of using the four dimensions to measure TIPV. In addition, emotional and social values should receive more attention, although they have rarely been addressed in previous studies on transport inclusion and travel satisfaction.

Second, the study presents a comprehensive research framework for AA by systematically analyzing the effects of TIPV and AA. It integrates health, social participation, and subjective well-being variables and reveals that travel satisfaction mediates TIPV and AA. The results show that the higher TIPV is for older people, the more satisfied they are with traveling. Promoting travel satisfaction is an effective and positive action to increase the spillover effect of transport inclusion in social life. Furthermore, this study explores the research path of transport equity and social effects that are different from traditional TRSE theories. The difference between the two is that TRSE research focuses on identifying vulnerable groups in transport and the factors that influence social exclusion. In contrast, transport inclusion research focuses on the positive impact mechanism of the transport environment on social spillover effects.

Third, travel capabilities have an important impact on older people's travel. This study considers travel capabilities in the model, which refines the transport inclusion scenario study. Travel capabilities have moderating effects on the relationship between TIPV and AA. The results show that transport inclusion policies should fully consider the travel barriers caused by capability differences. For older people with higher travel capabilities, the impact of the transport inclusion perceived value on AA is weaker. However, TIPV has a more significant impact on AA for those with less mobility. The moderation effects show that older people enjoy more travel freedom with higher travel capabilities and, correspondingly, are less sensitive to the external environment. Travel capabilities affect their health, social participation, and subjective well-being. Conversely, people with lower travel capabilities are more susceptible to inclusive environments. This conclusion not only emphasizes the issue of transport inclusion among low travel capability groups but also provides theoretical enlightenment for understanding other groups with apparent differences in mobility capabilities.

6.2. Policy implications

6.2.1. Policy implications based on the four TIPV dimensions

This study's model proposes an age-friendly transport policy framework that enhances satisfaction and active aging through four dimensions. Future initiatives should focus on functional, service, emotional, and social inclusiveness to enhance the perceived value of transport.

To enhance perceived functional value (PF), transportation network layouts for elderly travel destinations should be optimized and barrier-free facilities should be improved. Strengthening PT function will make it useful, easy to use, and safe. To improve perceived service value (PS), the concept of public transport services should be shifted from "serving everyone without distinction" to "perceiving difference and serving everyone". Focus should be placed on travel difficulty identification systems and service mechanisms for vulnerable groups. To enhance perceived emotional value (PE), transport service staff should focus on providing friendly, positive, patient, and orderly service to older people. This will create positive experiences and foster an agreeable social environment. Additionally, to improve perceived social value (PO), actions should be taken to meet the travel needs of older people and create a positive social image for transport enterprises.

6.2.2. Policy implications based on the five travel capabilities

Further research indicates that travel capabilities moderate the relationship between TIPV and AA for elderly individuals. The varying levels of physical, pathfinding, smartphone usage, and vehicle usage indicate different effects of TIPV on AA. To address these differences, it is crucial to identify travel difficulties, adapt policies, and improve travel experiences for elderly individuals. This can enhance their physical and mental pleasure, social integration, and well-being.

This study suggests that physical barriers can be overcome by popularizing barrier-free environments such as walking channels and buses. It also emphasizes the importance of providing psychological support to older people during travel because they may be unable to rely on their children in future due to declining fertility rates in China. An age-friendly transport information system can be established to address difficulties in pathfinding and smartphone usage for older people. Customized travel chain services can also be developed to cater to vulnerable groups.

7. Conclusions and future work

7.1. Conclusions

This study aimed to develop a policy framework for transport inclusion by focusing on the travel capability levels of older people to address the practical problem of limited mobility, particularly considering the global population's aging acceleration, and to adapt to the goal of active aging. This study examines the structural dimensions of transport inclusion perceived value (TIPV), its impact on active aging (AA), and the effects of travel capabilities (C) on the relationship between TIPV and AA. Data were collected from 521 older people over 60 in Xi'an to test the hypotheses and models.

The study found that transport inclusion perceived value (TIPV), which consists of functional, service, emotional, and social values, significantly impacts health, social participation, and subjective well-being in active aging through the positive mediation effect of travel satisfaction, thereby enhancing active aging.

The study explored the relationship between travel capabilities, including physical, psychological, pathfinding, smartphone and vehicle usage, and active aging. These travel capabilities, with the exception of psychological adaptability, negatively moderate the transport inclusion perceived value (TIPV) and active aging (AA). The study also found significant mediation effects for both low (Mean-SD) and high (Mean + SD) moderation variables.

This study provides a theoretical foundation for understanding the dimensions of transport inclusion and emphasizes its importance in the psychosocial aspects of active aging. It constructs a transport inclusion policy framework to create age-friendly environments for older people with different travel capabilities, thereby facilitating the realization of active aging goals.

7.2. Limitations and future research

Although the insights gained from this research are important, some research limitations should be addressed by future investigations.

First, this study analyzed the traffic location and community type as control variables. However, it was found that older people might have different perceptions of traffic inclusion. Future research should compare subsamples from different locations and community types to uncover more interesting findings. Future studies should conduct multigroup analysis to clarify the specific impacts of these variables.

Second, there are differences in older people's mobility and lifestyles in different countries. For instance, there are fewer older adults over 60 years old who drive cars in China than in developed countries. In addition, in China, older adults are more likely to babysit their grandchildren or be cared for by family at home, which differs from customs in Europe and America. With regard to China, this study provides a representative evaluation of the social benefits of transport inclusion, but it may not give a valid extrapolation for countries with different customs. Future research can examine the theoretical framework of this study in the context of other cultural backgrounds.

Third, this study explores transport inclusion for older adults, and highlights similar travel challenges to other vulnerable groups. However, limitations in the research focus necessitate further study of the characteristic variables of other vulnerable groups to fully understand their experiences.

CRediT authorship contribution statement

Na Zhang: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Visualization, Writing – original draft, Writing – review & editing. **Jingxiao Zhang:** Methodology, Resources, Validation. **Qi Yang:** Supervision. **Martin Skitmore:** Writing – review & editing. **Nanxi Yang:** Data curation. **Baixi Shi:** Data curation. **Xiaodong Zhang:** Data curation. **Xuanlong Qin:** Data curation.

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 A1
Reliability and convergence validity.

Latent Variable	Symbol	Manifest variable	Standardized factor loading	CR	AVE	Cronbach's Alpha
Transport inclusion perceived value (TIPV)						
Perceived functional value						
Usefulness	PF1	My destinations are well accessible by PT.	0.795	0.889	0.617	0.888
	PF2	I can arrive at destinations on time by PT.	0.775			
Ease of use	PF3	I feel barrier-free when walking to stations and taking PT.	0.702			
	PF4	I feel barrier-free in getting PT information.	0.795			
Safety	PF5	PT travel is safe.	0.853			
Perceived service value						
Response	PS1	PT service is in quick response.	0.743	0.838	0.564	0.837
Economy	PS2	PT tickets are economical compared to its service.	0.774			
Perfection	PS3	PT provides thoughtful and helpful service.	0.748			
Comfort	PS4	PT provides comfortable service facilities.	0.738			
Perceived emotional value						
Friendly	PE1	The personnel are friendly.	0.715	0.837	0.562	0.836
Positive	PE2	The personnel adopt positive ways when handling conflicts.	0.765			
Patient	PE3	The staff is patient with the elderly.	0.724			
Orderly	PE4	I feel a sense of order in PT travel.	0.793			
Perceived social value						
Direct social effect	PO1	PT effectively ensures meeting the travel demands of older people.	0.734	0.855	0.596	0.854
Indirect social effect	PO2	PT effectively makes older people feel integrated into society.	0.819			
Social responsibilities	PO3	PT enterprises undertake social responsibilities.	0.766			
Corporate image	PO4	PT enterprises show a good social image.	0.767			
Travel satisfaction (S)						
General satisfaction	S1	The satisfaction degree to which PT meets your travel needs.	0.805	0.880	0.595	0.877
	S2	The satisfaction degree to PT service in general.	0.757			
Compared satisfaction	S3	The satisfaction degree to which PT is expected.	0.789			
	S4	The satisfaction degree of PT in comparison with alternatives.	0.737			
Recommend willingness	S5	The willingness that you recommend others traveling by PT.	0.766			
Active aging (AA)						
Health (H)						
Physical Health	H1	I feel in good physical health.	0.696	0.918	0.556	0.918
	H2	My physical health degree does not affect my outside social activities.	0.727			
Positive mood	H3	I have been in good spirits for the past two weeks.	0.772			
	H4	I have been relaxed and peaceful in the past two weeks.	0.700			
	H5	I have been vigorous in the past two weeks.	0.740			
Self-esteem	H6	I can create value for society.	0.724			
	H7	I can live independently.	0.798			
	H8	I have many virtues.	0.723			
	H9	I feel respected.	0.822			
Social participation (P)						
Interpersonal activities	P1	Outgoing frequency of visiting relatives and friends.	0.84	0.853	0.592	0.852

(*continued on next page*)

Table A1 (*continued*)

Latent Variable	Symbol	Manifest variable	Standardized factor loading	CR	AVE	Cronbach's Alpha
Cultural and recreational activities	P2	Outgoing frequency of learning, fitness, tour, and club activities.	0.719			
Consumptive activities	P3	Outgoing frequency of daily and medical consumption.	0.764			
Productive activities	P4	Outgoing frequency of working, volunteering, and caring for others.	0.750			
Subjective well-being (B)						
	B1	I am living very well now.	0.778	0.875	0.584	0.875
	B2	My life is full of targets and meanings.	0.705			
	B3	I often get help from social relations.	0.752			
	B4	I can bring happiness to others.	0.769			
	B5	I am optimistic about the future.	0.814			

Table A2
Discriminant Validity and Pearson correlation analysis.

	PF	PS	PE	PO	S	P	H	B
PF	**0.785**							
PS	0.355**	**0.751**						
PE	0.468**	0.495**	**0.750**					
PO	0.393**	0.437**	0.441**	**0.772**				
S	0.367**	0.381**	0.416**	0.358**	**0.771**			
P	0.397**	0.369**	0.409**	0.379**	0.473**	**0.746**		
H	0.346**	0.278**	0.406**	0.286**	0.415**	0.427**	**0.769**	
B	0.365**	0.334**	0.350**	0.366**	0.472**	0.355**	0.442**	**0.764**

Notes: 1. The value in bold is the square root of AVE.
2. The other data are the correlation coefficients between the variables.
3. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table A3
Goodness-of-fit test of second-order confirmatory factor analysis for TIPV.

	χ2	df	χ2/df	RMSEA	GFI	AGFI	IFI	TLI	CFI
Standard value			< 3	< 0.08	> 0.90	> 0.90	> 0.90	> 0.90	> 0.90
The first order	171.609	113	1.519	0.032	0.964	0.951	0.986	0.984	0.986
The second order	178.339	115	1.551	0.033	0.962	0.949	0.985	0.983	0.985
Objective coefficient	0.962								

Notes:1. TIPV is the latent variable of transport inclusion perceived value.
2. The closer the objective coefficient is to 1, the better the effect of the second-order model is.

Table A4
Mediation model goodness-of-fit.

	χ2	df	χ2/df	RMSEA	GFI	NFI	IFI	TLI	CFI
Suggested value			< 3	< 0.08	> 0.90	> 0.90	> 0.90	> 0.90	> 0.90
Result value	780.249	729	1.070	0.012	0.932	0.923	0.995	0.995	0.995

References

Abenoza, R.F., Cats, O., Susilo, Y.O., 2017. Travel satisfaction with public transport: Determinants, user classes, regional disparities, and their evolution. Transp. Res. A Policy Pract. 95, 64–84.

Al-Rashid, M.A., Goh, H.C., Harumain, Y.A., Ali, Z., Campisi, T., Mahmood, T., 2021. Psychosocial barriers of public transport use and social exclusion among older adults: Empirical evidence from Lahore, Pakistan. Int. J. Environ. Res. Public Health 18 (1), 185.

Asadi-Shekari, Z., Moeinaddini, M., Shah, M.Z., 2013. Disabled pedestrian level of service method for evaluating and promoting inclusive walking facilities on urban streets. J. Transp. Eng. 139 (2), 181–192.

Bagozzi, R.P., Gopinath, M., Nyer, P.U., 1999. The role of emotions in marketing. J. Acad. Mark. Sci. 27 (2), 184–206.

Bantis, T., Haworth, J., 2020. Assessing transport related social exclusion using a capabilities approach to accessibility framework: A dynamic Bayesian network approach. J. Transp. Geogr. 84, 102673.

Bergstad, C.J., Gamble, A., Gärling, T., Hagman, O., Polk, M., Ettema, D., Friman, M., Olsson, L.E., 2011. Subjective well-being related to satisfaction with daily travel. Transportation 38 (1), 1–15.

Casal, P., 2007. Why sufficiency is not enough. Ethics 117 (2), 296–326.

Cassarino, M., Setti, A., 2016. Complexity as key to designing cognitive-friendly environments for older people. Front. Psychol. 7, 1329.

Cheng, Y.H., Tseng, W.C., 2016. Exploring the effects of perceived values, free bus transfer, and penalties on intermodal metro–bus transfer users' intention. Transp. Policy 47, 127–138.

Choi, N.G., DiNitto, D.M., 2016. Depressive symptoms among older adults who do not drive: Association with mobility resources and perceived transportation barriers. Gerontologist 56 (3), 432–443.
Church, A., Frost, M., Sullivan, K., 2000. Transport and social exclusion in London. Transp. Policy 7 (3), 195–205.
Currie, G., Richardson, T., Smyth, P., Vella-Brodrick, D., Hine, J., Lucas, K., Stanley, J., Morris, J., Kinnear, R., Stanley, J., 2009. Investigating links between transport disadvantage, social exclusion and well-being in Melbourne—preliminary results. Transp. Policy 16 (3), 97–105.
Dahlberg, L., McKee, K.J., 2018. Social exclusion and well-being among older adults in rural and urban areas. Arch. Gerontol. Geriatr. 79, 176–184.
Day, G.S., 1994. The capabilities of market-driven organizations. J. Mark. 58 (4), 37–52.
De Donder, L., Buffel, T., Dury, S., De Witte, N., VertÉ, D., 2013. Perceptual quality of neighbourhood design and feelings of unsafety. Ageing Soc. 33 (6), 917–937.
De Vos, J., Schwanen, T., Van Acker, V., Witlox, F., 2013. Travel and subjective well-being: a focus on findings, methods and future research needs. Transp. Rev. 33 (4), 421–442.
DeSarbo, W.S., Jedidi, K., Sinha, I., 2001. Customer value analysis in a heterogeneous market. Strateg. Manag. J. 22 (9), 845–857.
Doi, K., Sunagawa, T., Inoi, H., Yoh, K., 2016. Transitioning to safer streets through an integrated and inclusive design. IATSS Res. 39 (2), 87–94.
Dong, R., Li, Z.W., Yu, G.H., He, M., 2019. Impact of travel ability on travel choice of the elderly leisure activities. In: Wang, W., Bengler, K., Jiang, X. (Eds.), Green Intelligent Transportation Systems. Springer, Singapore, pp. 517–527.
Downey, L., Van Willigen, M., 2005. Environmental stressors: The mental health impacts of living near industrial activity. J. Health Soc. Behav. 46 (3), 289–305.
Fields, N., Cronley, C., Mattingly, S.P., Murphy, E.R., Miller, V.J., 2019. "You are really at their mercy": Examining the relationship between transportation disadvantage and social exclusion among older adults through the use of innovative technology. Transp. Res. Rec. 2673 (7), 12–24.
Flecha, A.C., 2015. Well-being of senior residents in nursing homes. Pedagog. Soc. Rev. Interuniv. 25, 319–341.
Foster, L., Walker, A., 2015. Active and successful aging: a European policy perspective. Gerontologist 55 (1), 83–90.
Friman, M., Gärling, T., Ettema, D., Olsson, L.E., 2017. How does travel affect emotional well-being and life satisfaction? Transp. Res. A Policy Pract. 106, 170–180.
Gao, Y., Rasouli, S., Timmermans, H., Wang, Y., 2018. Trip stage satisfaction of public transport users: A reference-based model incorporating trip attributes, perceived service quality, psychological disposition and difference tolerance. Transp. Res. A Policy Pract. 118, 759–775.
Gawlak, A., Matuszewska, M., Ptak, A., 2021. Inclusiveness of urban space and tools for the assessment of the quality of urban life—A critical approach. Int. J. Environ. Res. Public Health 18 (9), 4519.
Gayman, M.D., Turner, R.J., Cui, M., 2008. Physical limitations and depressive symptoms: Exploring the nature of the association. J. Gerontol. B 63 (4), S219–S228.
Guo, X., Zhao, H., Zhang, W., 2020. The behavioral intention of resident interest expression in urban fringe communities: Based on the theory of perceived value. Public Adm. Policy Rev. 20 (2), 18–32 in Chinese.
Haque, M., Soonthorndhada, K., Hunchangsith, P., Kanchanachitra, M., 2016. Active aging level in Thailand: A comparison between female and male elderly. Health Res. 30 (2), 99–107.
He, S.Y., Cheung, Y.H.Y., Tao, S., 2018. Travel mobility and social participation among older people in a transit metropolis: A socio-spatial-temporal perspective. Transp. Res. A Policy Pract. 118, 608–626.
He, Z., Ma, S., Tang, X., 2009. Empirical study on the influence of learning ability to individual travel behavior. J. Transp. Syst. Eng. Inf. Technol. 9 (2), 75–80.
He, S.Y., Thøgersen, J., Cheung, Y.H.Y., Yu, A.H.Y., 2020. Ageing in a transit-oriented city: satisfaction with transport, social inclusion and wellbeing. Transp. Policy 97, 85–94.
He, J., Zhou, D., Liu, T., Liu, L., Dai, J., 2022. Research on environmental quality evaluation method of urban public service facilities of Xi'an in the aging society. Architectural J. S2, 23–30 in Chinese.
Heaven, B.E.N., Brown, L.J.E., White, M., Errington, L., Mathers, J.C., Moffatt, S., 2013. Supporting well-being in retirement through meaningful social roles: Systematic review of intervention studies. Milbank q. 91 (2), 222–287.
Hemingway, A., Jack, E., 2013. Reducing social isolation and promoting well-being in older people. Qual. Ageing Older Adults 14 (1), 25–35.
Hsu, H.C., Liang, J., Luh, D.L., Chen, C.F., Lin, L.J., 2019. Constructing Taiwan's active aging index and applications for international comparison. Soc. Indic. Res. 146 (3), 727–756.
Ingvardson, J.B., Nielsen, O.A., 2019. The relationship between norms, satisfaction and public transport use: A comparison across six European cities using structural equation modelling. Transp. Res. A Policy Pract. 126, 37–57.
Kim, J., Schmöcker, J.D., Nakamura, T., Uno, N., Iwamoto, T., 2020. Integrated impacts of public transport travel and travel satisfaction on quality of life of older people. Transp. Res. A Policy Pract. 138, 15–27.
Lai, W.T., Chen, C.F., 2011. Behavioral intentions of public transit passengers—the roles of service quality, perceived value, satisfaction and involvement. Transp. Policy 18 (2), 318–325.
Li, J., Xu, L., Yao, D., Mao, Y., 2019. Impacts of symbolic value and passenger satisfaction on bus use. Transp. Res. D Transp. Environ. 72, 98–113.
Li, J., Pei, H., Shi, X., Huang, C., Fang, Y., Zheng, X., Wang, B., Yu, L., 2020a. A comparative study of quantitative measurement tools for active aging. Chin. J. Evid. Based Med. 20 (3), 296–305 in Chinese.
Li, S., Zhang, Y., Ruan, H., Guerra, E., Burnette, D., 2020b. The role of transportation in older adults' use of and satisfaction with primary care in China. J. Transp. Health 18, 100898.
Lierop, van, D., Badami, M.G., El-Geneidy, A.M., 2018. What influences satisfaction and loyalty in public transport? A review of the literature. Transp. Rev. 38 (1), 52–72.
Liu, Q., An, Z., Liu, Y., Ying, W., Zhao, P., 2021a. Smartphone-based services, perceived accessibility, and transport inequity during the COVID-19 pandemic: A cross-lagged panel study. Transp. Res. D Transp. Environ. 97, 102941.
Liu, Q., Liu, Y., Zhang, C., An, Z., Zhao, P., 2021b. Elderly mobility during the COVID-19 pandemic: A qualitative exploration in Kunming. China. J. Transp. Geogr. 96, 103176.
Liu, J., Rozelle, S., Xu, Q., Yu, N., Zhou, T., 2019. Social engagement and elderly health in China: Evidence from the China Health and Retirement Longitudinal Survey (CHARLS). Int. J. Environ. Res. Public Health 16 (2), 278.
Lucas, K., 2012. Transport and social exclusion: Where are we now? Transp. Policy 20, 105–113.
Lucas, K., 2019. A new evolution for transport-related social exclusion research? J. Transp. Geogr. 81, 102529.
Ma, L., Kent, J.L., Mulley, C., 2016. Transport disadvantage, social exclusion, and subjective well-being: The role of the neighborhood environment—evidence from Sydney. Australia. J. Transp. Land Use 11 (1), 31–47.
Marsh, H.W., Hocevar, D., 1985. Application of confirmatory factor analysis to the study of self-concept: First- and higher order factor models and their invariance across groups. Psychol. Bull. 97 (3), 562–582.
Martens, K., 2018. Ageing, impairments and travel: Priority setting for an inclusive transport system. Transp. Policy 63, 122–130.
McDonagh, J., 2006. Transport policy instruments and transport-related social exclusion in rural Republic of Ireland. J. Transp. Geogr. 14 (5), 355–366.
Mifsud, D., Attard, M., Ison, S., 2019. An exploratory study of the psychological determinants of mobility of older people in Malta. Res. Transp. Bus. Manag. 30, 100373.
Mollenkopf, H., Hieber, A., Wahl, H.W., 2011. Continuity and change in older adults' perceptions of out-of-home mobility over ten years: a qualitative–quantitative approach. Ageing Soc. 31 (5), 782–802.
Ni, A., Zhang, C., Hu, Y., Lu, W., Li, H., 2020. Influence mechanism of the corporate image on passenger satisfaction with public transport in China. Transp. Policy 94, 54–65.
Olsson, L.E., Friman, M., Lättman, K., Fujii, S., 2020. Travel and life satisfaction - from Gen Z to the silent generation. J. Transp. Health 18, 100894.
Papadimitriou, D., Apostolopoulou, A., Kaplanidou, K., 2013. Destination personality, affective image, and behavioral intentions in domestic urban tourism. J. Travel Res. 54 (3), 302–315.
Parasuraman, A., Zeithaml, V.A., Berry, L.L., 1985. A conceptual model of service quality and its implications for future research. J. Mark. 49 (4), 41–50.

Pérez-Cuevas, R., Doubova, S.V., Bazaldúa-Merino, L.A., Reyes-Morales, H., Martínez, D., Karam, R., Gamez, C., Muñoz-Hernández, O., 2015. A social health services model to promote active ageing in Mexico: Design and evaluation of a pilot programme. Ageing Soc. 35 (7), 1457–1480.
Petrick, J.F., Morais, D.D., Norman, W.C., 2001. An examination of the determinants of entertainment vacationers' intentions to revisit. J. Travel Res. 40 (1), 41–48.
Pfaller, L., Schweda, M., 2019. Excluded from the good life? An ethical approach to conceptions of active ageing. Soc. Incl. 7 (3), 44–53.
Plyushteva, A., Boussauw, K., 2020. Does night-time public transport contribute to inclusive night mobility? Exploring Sofia's night bus network from a gender perspective. Transp. Policy 87, 41–50.
Rantanen, T., Portegijs, E., Kokko, K., Rantakokko, M., Törmäkangas, T., Saajanaho, M., 2018. Developing an assessment method of active aging: University of jyvaskyla active aging scale. J. Aging Health 31 (6), 1002–1024.
Reinhard, E., Carrino, L., Courtin, E., Van Lenthe, F.J., Avendano, M., 2019. Public transportation use and cognitive function in older age: A quasiexperimental evaluation of the free bus pass policy in the United Kingdom. Am. J. Epidemiol. 188 (10), 1774–1783.
Russell, D.C., 2013. Virtue ethics, happiness, and the good life. In: Russell, D.C. (Ed.), The Cambridge Companion to Virtue Ethics. Cambridge University Press, New York, NY, pp. 7–28.
Ryan, J., Wretstrand, A., Schmidt, S.M., 2015. Exploring public transport as an element of older persons' mobility: A capability approach perspective. J. Transp. Geogr. 48, 105–114.
Ryan, J., Wretstrand, A., Schmidt, S.M., 2019. Disparities in mobility among older people: Findings from a capability-based travel survey. Transp. Policy 79, 177–192.
Saz-Gil, I., Gil-Lacruz, A., Gil-Lacruz, M., 2019. Active aging and happiness: European senior citizen volunteers. Sociológia. 51 (3), 290–312.
Skarin, F., Olsson, L.E., Roos, I., Friman, M., 2017. The household as an instrumental and affective trigger in intervention programs for travel behavior change. Travel Behav. Soc. 6, 83–89.
Stanley, J.K., Hensher, D.A., Stanley, J.R., Vella-Brodrick, D., 2011. Mobility, social exclusion and well-being: exploring the links. Transp. Res. A Policy Pract. 45 (8), 789–801.
Sweeney, J.C., Soutar, G.N., 2001. Consumer perceived value: The development of a multiple item scale. J. Retail 77 (2), 203–220.
Swift, A., Cheng, L., Loo, B.P.Y., Cao, M., Witlox, F., 2021. Step-free railway station access in the UK: The value of inclusive design. Eur. Transp. Res. Rev. 13 (1), 45.
Thanakwang, K., Isaramalai, S., Hatthakit, U., 2014. Development and psychometric testing of the active aging scale for Thai adults. Clinical Interventions in Aging. 2014, 1211–1221.
Thanakwang, K., Soonthorndhada, K., 2007. Attributes of active ageing among older persons in Thailand: Evidence from the 2002 survey. Asia-Pacific Population J. 21 (3), 113–135.
Ulaga, W., Chacour, S., 2001. Measuring customer-perceived value in business markets: A prerequisite for marketing strategy development and implementation. Ind. Mark. Manag. 30 (6), 525–540.
Vecchio, G., Martens, K., 2021. Accessibility and the capabilities approach: A review of the literature and proposal for conceptual advancements. Transp. Rev. 41 (6), 833–854.
Vella-Brodrick, D.A., Stanley, J., 2013. The significance of transport mobility in predicting well-being. Transp. Policy 29, 236–242.
Voss, C., Sims-Gould, J., Ashe, M.C., McKay, H.A., Pugh, C., Winters, M., 2016. Public transit use and physical activity in community-dwelling older adults: Combining GPS and accelerometry to assess transportation-related physical activity. J. Transp. Health 3 (2), 191–199.
Walker, A., 2016. Population ageing from a global and theoretical perspective: European lessons on active ageing. In: Moulaert, T., Garon, S. (Eds.), Age-Friendly Cities and Communities in International Comparison: Political Lessons, Scientific Avenues, and Democratic Issues, Springer, Cham, Switzerland, pp. 47–64.
Wang, C.H., 2009. Dialectics in multitude an exploration into/beyond Henri Lefebvre's conceptual triad of production of space. J. Geogr. Sci. 55, 1–24 in Chinese.
Wang, X., Wang, X., Ma, H., 1999. Rating scales for mental health. Chin. Ment. Health J. 282 in Chinese.
Wang, Y., Wong, Y.D., Goh, K., 2021. Perceived importance of inclusive street dimensions: A public questionnaire survey from a vision(ing) perspective. Transportation 48 (2), 699–721.
World Health Organization, 2011. International Classification of Functioning, Disability and Health (ICF)[online]. World Health Organization. [Viewed 1 January 2011]. Available from:URL https://www.who.int/standards/classifications/international-classification-of-functioning-disability-and-health.
World Health Organization, 2022. Ageing and health[online]. World Health Organization. [Viewed 1 October 2022]. Available from:URL https://www.who.int/news-room/fact-sheets/detail/ageing-and-health.
Xiao, H., Li, S., 2017. Effect of corporate social responsibility and customer attribution on post-recovery satisfaction: Based on the mediating role of customer identification. Nankai Bus. Rev. 03, 124–134 in Chinese.
Ye, C., Chai, Y.e., Zhang, X., 2011. Review on studies on production of urban space. Econ. Geogr. 31 (3), 409–413 in Chinese.
Yi, L., 2020. The impacts of social cohesion on floating population's life satisfaction: Evidence from CSS dataset. Zhejiang Soc. Sci. 6, 73–78 in Chinese.
Yigitcanlar, T., Mohamed, A., Kamruzzaman, M., Piracha, A., 2019. Understanding transport-related social exclusion: A multidimensional approach. Urban Policy Res. 37 (1), 97–110.
Yuan, Y., Yang, M., Wu, J., Rasouli, S., Lei, D., 2019. Assessing bus transit service from the perspective of elderly passengers in Harbin. China. Int. J. Sustain. Transp. 13 (10), 761–776.
Zeithaml, V.A., 1988. Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. J. Mark. 52 (3), 2–22.
Zhang, C., Juan, Z., Luo, Q., Xiao, G., 2016. Performance evaluation of public transit systems using a combined evaluation method. Transp. Policy 45, 156–167.
Zhang, C., Liu, Y., Lu, W., Xiao, G., 2019. Evaluating passenger satisfaction index based on PLS-SEM model: Evidence from Chinese public transport service. Transp. Res. A Policy Pract. 120, 149–164.
Ziegler, F., Schwanen, T.I.M., 2011. I like to go out to be energised by different people: An exploratory analysis of mobility and wellbeing in later life. Ageing Soc. 31 (5), 758–781.