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Biking and belonging: understanding the role of socio-cultural influences on cycling in Auckland

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ABSTRACT

This research investigates the influence of socio-cultural factors and sociodemographic characteristics on bicycle use in Auckland, a multi-cultural city in New Zealand. To identify the strength of socio-cultural factors compared to other various social psychological determinants, a conceptual model is proposed encompassing Socio-cultural influences, Price Value, Perceived Safety and Security, Perceived accessibility, Information and Engagement, and Bicycle use. Using Structural Equation Modelling (SEM), the effects of these determinants on bicycle use were assessed. The moderating effects of sociodemographic factors including age, gender, ethnicity, and income level on the influence of these determinants on bicycle usage were also examined. Results suggest that socio-cultural influences have the strongest impact on bicycle use in Auckland, showing that those who ride a bicycle more than others are influenced more by family, friends, community, and culture to use a bicycle. Additionally, sociodemographic characteristics only moderate the influence of socio-cultural factors on bicycle usage indicating that socio-cultural factors influence bicycle use differently across various population groups. The strong influence of socio-cultural factors and the moderating role of sociodemographic characteristics on bicycle use in Auckland suggest that social and cultural dynamics are critical in shaping individual decisions to cycle, even more than practical considerations such as price, infrastructure, engagement, or safety. Therefore, transport strategies targeting specific population groups and relevant socio-cultural barriers can enhance bicycle use and promote equity in cycling. Suggested transport strategies include integrating socio-cultural initiatives with local government's transport policies such as education, community engagement, and awareness campaigns, implementing effective monitoring and evaluation initiatives followed by longitudinal investigations, and incorporating cultural representation in cycling initiatives. These short-term, mid-term, and long-term strategies can guide the development of more inclusive and effective transport strategies to enhance cycling participation across diverse demographic groups and achieve broader societal benefits.

1. Introduction and background

Active and sustainable mobility modes, such as cycling and walking, are being promoted in many countries worldwide to help

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achieve societal, environmental, and health related goals through a reduction in reliance on private motorized vehicles. In Auckland, New Zealand, the 2023 Household Travel Survey indicates that private vehicles dominate transportation, accounting for 86 % of trips, either as a driver or passenger. Public transport makes up only 6 % of trips, while walking and cycling each contribute just 1 % of trips (Ministry of Transport, 2025). Aucklanders' attitudes toward alternative transportation modes reflect this dependence, as a recent study found that 81 % of participants considered public transport much less convenient than driving, and 88 % felt that cycling was less convenient than driving (Ovenden and Allpress, 2024). In the New Zealand context, studies have shown lower bicycle use amongst minorities, women, the elderly, low-income population groups, and Māori (the indigenous population) (Ministry of Health, 2022; Jones et al., 2020; Russell et al., 2021; Shaw and Russell, 2017; Shaw et al., 2020; Thorne et al., 2020; Jahanshahi et al., 2022). A recent study investigating the health benefits of active transport in New Zealand suggested that such benefits are not evenly distributed across the population. Specifically, while Māori receive significantly fewer health benefits from cycling generally (Bassett et al., 2020), the relative benefits are higher when they partake (Jones et al., 2020). Amongst the various ethnic groups, European New Zealanders (and males) are the most likely to use a bicycle in New Zealand, while Pacific peoples are the least likely (Shaw and Russell, 2017). Given the existing inequalities in bicycle use and the disparate levels of general health among various population groups, it is beneficial to investigate cycling equity in New Zealand. To achieve this, it is essential to examine how equity in cycling has been discussed previously and to identify which aspects of cycling equity have not received sufficient attention. The evidence presented below indicates that while bicycle infrastructure has been the primary focus in equity analyses and policy-making, the role of socio-cultural factors, including the influence people receive from their family, friends, community, and culture, has not been adequately considered.

Equity in transport systems is essential as it addresses the needs of vulnerable and marginalized populations, fosters social inclusion, and provides better access to social and economic opportunities (Litman, 2005; Lucas, 2012). Equity in transportation refers to the fair distribution of both benefits and costs among all members of society (Di Cioimmo and Shiftan, 2017). Equity means that the benefits of investment in transport are distributed such that all people can participate in society. It ensures that all demographic groups, irrespective of age, gender, ethnicity, or socioeconomic status, have access to transportation infrastructure and services (Litman, 2024). A recent thorough definition of equity in cycling is "a situation where cycling is a safe, secure mode of travel that improves mobility and accessibility fairly, enabling all people to participate in socio-economic life" (Doran et al., 2021, p. 4). Achieving this situation requires the implementation of policies and practices that ensures equitable access to cycling provisions and consider different communities. As argued by Jahanshahi et al. (2021), equity in cycling can be examined from multiple viewpoints, including equitable access to bicycle infrastructure (Houde et al., 2018; Fuller and Winters, 2017; Pistoll and Goodman, 2014; Mooney et al., 2019), equitable access to destinations by bicycle (Kent and Karner, 2019; Pritchard et al., 2019; Qian and Niemeier, 2019), and equity issues in cycling policies (Bernatchez et al., 2015; Howland et al., 2017; Lam, 2018; Piatkowski et al., 2017; Rebentisch et al., 2019).

The majority of studies investigating cycling equity have focused on access to bicycle infrastructure or access to destinations by bicycle (Chen et al., 2019; Hosford and Winters, 2018; Tucker and Manaugh, 2018; Winters et al., 2018). The existing literature on assessing equity in cycling has largely emphasized the role of better distribution of cycling infrastructure while neglecting to consider the role of socio-cultural factors on cycling equity policies (Jahanshahi et al., 2021). Although many studies worldwide have explored the socio-cultural aspects of cycling (Caulfield et al., 2017; Fishman et al., 2014; Jahanshahi et al., 2020; Nikitas, 2018; Shaheen et al., 2011), applying an equity lens to evaluate the influence of socio-cultural factors on cycling and cycling equity policies has yet to be undertaken. This is an important omission given that the influence of socio-cultural factors on cycling can be expected to vary amongst groups within the population, a consideration significantly aligned with the concept of equity. For example, young people tend to be more cost-dependent, parents influence their children, women are generally less likely to cycle than men, primarily due to safety concerns and societal norms, and cycling perception could vary among people with different cultural backgrounds (Banister and Bowling, 2004; Ogilvie and Goodman, 2012; Pucher and Buehler, 2009; Mackett and Thoreau, 2015; Frater and Kingham, 2020). Thus, an approach where cycling provisions are considered without socio-cultural factors cannot be expected to result in equity in cycling, and including both infrastructure and socio-cultural interventions provides a wiser and more comprehensive approach to cycling equity (Jahanshahi et al., 2023). Consequently, the level of influence of socio-cultural factors compared to other social psychological factors should be considered.

Additionally, various contextual factors can moderate the influence of socio-cultural factors on cycling choice. Auckland is a multicultural city in New Zealand consisting of a high proportion of Māori (indigenous people) and more than 220 ethnic groups with significant ethnic diversity, suggesting a variety of socio-cultural contexts in Auckland. Developing cycling equity policies in a multicultural context requires considering the intersectionality of various sociodemographic factors. The intersectionality approach takes into account the fact that the influence of sociodemographic characteristics is not shaped by a single axis of social division but by their "intersection" (a combination of multiple sociodemographic variables) that creates differences among different population groups. Thus, researchers should not characterize the behavior of a group by considering only one aspect of their identity (Hill and Bilge, 2016). For example, it is not possible to describe "men's cycling behavior" and "women's cycling behavior" without also taking into account other sociodemographic characteristics. Therefore, examining how these intersecting identities moderate the influence of socio-cultural factors on cycling is crucial for developing equitable cycling policies.

This study attempts to address some of the aforementioned gaps by understanding the influence of socio-cultural factors on bicycle use in Auckland, among other influential factors, and investigating the differences among population groups considering socio-demographic characteristics. This research aims to answer the following questions:

1. How do socio-cultural factors influence bicycle use in Auckland?
2. How do socio-cultural factors influence bicycle use compared to other factors?

3. How do sociodemographic characteristics, including age, gender, ethnicity, and income level influence socio-cultural factors and bicycle use in Auckland?
4. What transport strategies would be effective in promoting cycling equity considering socio-cultural influences on cycling?

The results of this research will assist decision-makers better understand the influence of socio-cultural factors and sociodemographic characteristics on Aucklanders' cycling behavior. With this understanding, they will be more prepared to create policies to enhance equity in cycling considering various population groups considering the influence of their social and cultural environment. The practical contribution of this study lies in its potential to inform transport strategies that promote cycling equity in Auckland, and elsewhere, by identifying the strength of socio-cultural factors to influence bicycle use compared to other factors and understanding how this influence varies among different demographic groups. The study can potentially highlight the importance of sociodemographic characteristics in cycling equity policies and help develop targeted and community-based interventions that address the specific needs and barriers faced by different population groups.

The remainder of this paper is organized as follows. The Methodology section outlines the research design, including details on participants and data collection, the development of the questionnaire and conceptual model, as well as the data analysis strategy employed in the study. The Results section presents the findings, beginning with a descriptive analysis of questionnaire items, followed by the structural equation modeling (SEM) outcomes that examine the relationships between various factors and bicycle use. This section also explores the impact of sociodemographic characteristics on bicycle use and extends the analysis with an intersectionality approach. The Discussion and Conclusion sections interpret the findings in the context of the existing literature, emphasizing the implications of socio-cultural influences on cycling in a multicultural urban setting. Finally, the Implications for Policy and Practice section provides actionable recommendations, offering short-term, mid-term, and long-term strategies for promoting cycling equity by integrating socio-cultural considerations into transport policy.

2. Methodology

2.1. Participants and data collection

Participants were recruited from across the Auckland Region using an online panel provided by a university-affiliated survey company. While the company facilitated participant recruitment, we were directly involved in designing the questionnaire and

Table 1

Sociodemographic characteristics including age, gender, ethnicity, highest completed degree, personal annual income, employment situation, and access to car in the household.

Characteristic	Category	% (Auckland%)
Age (in years)	18–20	7.6 (not reported)
	21–30	19.8 (20.5)
	31–40	20.4 (18.8)
	41–50	20.4 (17)
	51–60	13.5 (15.7)
	>60	18.4 (23)
Gender	Men	44.1 (49)
	Women	54.9 (51)
	Diverse	1 (not reported)
Ethnicity	Māori	7.1 (11.5)
	Pacific peoples	9.4 (15.5)
	Asian	19.1 (28.2)
	MELAA*	1.8 (2.3)
	Indian	10.4 (not reported)
	European/NZ European	50.3 (53.5)
	Other ethnicities	1.8 (1.1)
Highest completed degree	High School or below	31.6
	Undergrad degree	52.4
	Master's degree/Postgraduate	16
Employment situation	Not employed	16
	Part-time employed	14.3
	Full-time employed	52.4
	Homemaker	6.1
Car access in the household	Retired	11.2
	Yes	92.6
Personal annual income (NZD)	No	7.4
	No income	9 (8.7)
	<30 K	23.8 (36.8)
	30 K–70 k	35.7 (34.1)
	70 K–100 K	17.2 (10.3)
	>100 K	14.3 (9.5)

* MELAA: Middle Eastern/Latin American/African.

overseeing the data collection process to ensure alignment with the ethical requirements of this research. The survey company's privacy policy was fully compliant with the ethical standards approved by the University of Auckland. The research study was approved by the University of Auckland Human Participants Ethics Committee (No. UAHPEC3237). Proportional quota sampling was used in this study in an attempt to reproduce the characteristics of Auckland's population in the sample. Specifically, quotas were set for selected subgroups of interest in the study, including age, gender, ethnicity, and income, based on their proportions in the overall population, thereby retaining the population's group proportions.

Based on the research objectives of this study, data also needed to be collected from areas with different levels of cycling infrastructure. Therefore, after consulting these criteria with the survey distribution company and considering their available database, 27 postcodes were chosen for this purpose which included a variety of levels of accessibility to cycling infrastructure in Auckland. The distribution of the questionnaire was random since there are no inclusion or exclusion criteria except for age (over 18 years old).

The questionnaire was conducted from May to July 2021, resulting in 697 approaches (invitations) and 683 responses. After removing incomplete, invalid, and duplicated questionnaires, 491 responses were included in the data analysis, showing a response rate of 70 % (491 out of 697). The response rates in cycling-related studies achieved in previous studies ranged from about 20 % to 80 % depending on the nature of the data collection and case studies (Høye et al., 2020; Schepers et al., 2020; Howland et al., 2017; McTigue et al., 2018; Dill and McNeil, 2013; Lee and Huang, 2014; Zhao and Zhang, 2019). Therefore, the response rate in this study can be considered to be at the high end of that found in the literature.

Table 1 provides an overview of the demographic characteristics of the participants. Referring to Table 1, the distribution of subgroups in gender, age, income levels, and ethnicity closely resemble the overall percentages in Auckland (<https://www.stats.govt.nz>, 2022), shown in parenthesis.

2.2. Questionnaire and the conceptual model

2.2.1. Socio-cultural factors

To evaluate the influence of socio-cultural factors on bicycle use and to compare it to other factors effectively, it is essential to

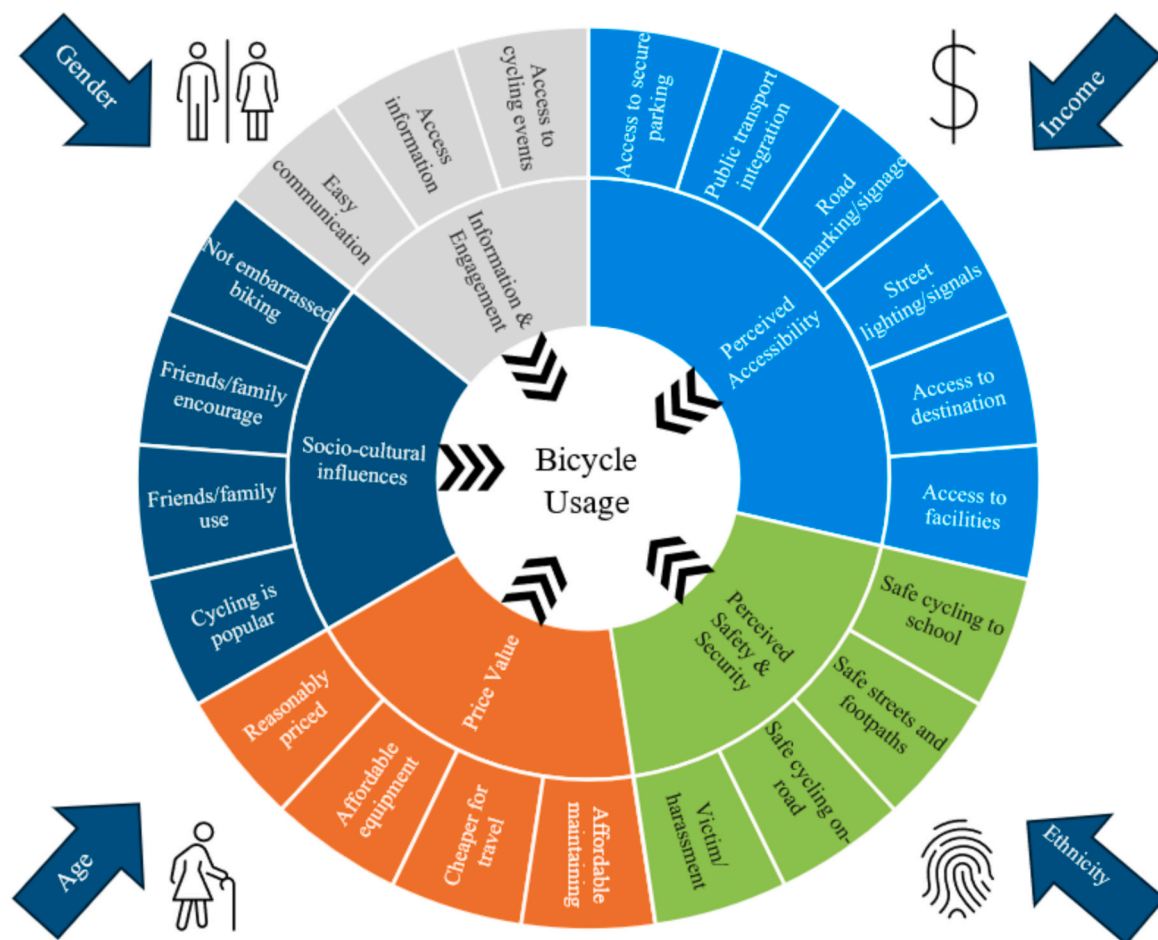


Fig. 1. Conceptual model of study.

consider multiple factors simultaneously. This approach provides a more comprehensive and significant evaluation of how different factors interact and influence bicycle use. Previous behavioral studies and theories such as the Theory of Planned Behavior (TPB) have demonstrated that considering various factors in a unified model can better elucidate the individual influence of each factor on behavior and allow for comparisons (Ajzen, 1991). Therefore, a model encompassing five themes: Socio-cultural influences, Price Value, Perceived Accessibility, Perceived Safety and Security, and Information and Engagement was developed (Fig. 1). While the primary focus of this paper is on socio-cultural factors, integrating these themes into a single model allows us to analyze the specific impact of socio-cultural factors within a broader context. This comprehensive approach ensures that the influence of socio-cultural factors is assessed accurately, robustly, and statistically. In addition, this method helps to better compare the strength of the influence of socio-cultural factors on bicycle use with other factors.

The survey questionnaire was developed to elicit cycling perceptions of various factors amongst Aucklanders (21 items). Referring to Table 2, the questionnaire includes five themes: Socio-Cultural Influences, Price Value, Perceived Accessibility, Perceived Safety and Security, and Information and Engagement. The questions and categories were generated based on the available cycling literature which discussed the factors that influence bicycle use and/or cycling perceptions (Aldred et al., 2016; Chataway et al., 2014; Dill and McNeil, 2013; Fuller and Winters, 2017; Goodman and Aldred, 2018; Hezaveh et al., 2018; Jahanshahi et al., 2019; Jahanshahi et al., 2020; Tompkins, 2017; Jahanshahi and Costello, 2022; Oosterhuis, 2016).

More specifically, socio-cultural factors were designed by considering four questions to cover feelings of embarrassment while cycling, the influence of friends and family cycling, the social image of cycling within the city, and encouragement from friends and family. Schwartz (1992) proposed that values represent ten types of motivational goals: achievement, benevolence, conformity, hedonism, power, security, self-direction, stimulation, tradition, and universalism (Arroyo et al., 2020). The following four questionnaire items in this study are aligned with these values and focused on the socio-cultural values influencing bicycle use. By linking socio-cultural influences with Schwartz's values, this study provides a nuanced understanding of how socio-cultural influences might impact bicycle use considering people's values. The connection of these specific values to the questionnaire items underscores the role of values and attitudes in shaping transport choices.

2.2.2. SC1: I am not embarrassed to be seen riding a bicycle

Feelings of embarrassment while cycling relate to security and power in Schwartz values. Security involves safety, harmony, and stability of society, of relationships, and of self. Some security values serve primarily individual interests (Schwartz, 2012), explaining how fear of social judgment and lack of acceptance can create barriers to cycling. Power, which involves social status and prestige, connects to how individuals might avoid cycling to maintain a certain image or status, reflecting the influence of perceived social hierarchies on transport choices (Jahanshahi et al., 2020; Schwartz, 2012; Gatersleben and Haddad, 2010).

2.2.3. SC2: My friends and family encourage me to ride a bicycle

The encouragement from friends and family connects to stimulation and, to some extent, self-direction. As shown by Arroyo et al. (2020), the more someone values stimulation in life, the more positive they feel towards cycling. Stimulation, which involves the search for excitement, novelty and challenge, may drive individuals to adopt cycling as a mode of transport if it is promoted by friends and family as an exciting and adventurous activity. Self-direction involves independent thought and action, and individuals who value self-direction may be more inclined to cycle if they receive encouragement from friends and family who also support and engage in cycling. While self-direction typically emphasizes independence, encouragement from friends and family can support this value when

Table 2
Questionnaire items for the conceptual model.

Categories	Items
Socio-Cultural Influences	SC1: I am not embarrassed to be seen riding a bicycle SC2: My friends and family encourage me to ride a bicycle SC3: People who I know (friends and family) cycle often SC4: Cycling is becoming more popular as a transport mode in Auckland
Price Value	PV1: I find the cost of purchasing a bicycle reasonable PV2: I find the cost of purchasing bicycle equipment reasonable PV3: I find the overall cost of commuting with a bicycle cheaper than other transport modes PV4: I find the cost of maintaining a bicycle affordable
Perceived Accessibility	AC1: There are sufficient cycling facilities such as bicycle lanes and/or dedicated cycleways in my residential neighbourhood AC2: There are sufficient cycling facilities to my common destination(s) AC3: There are sufficient street lighting and traffic signals in intersections in my journeys AC4: There are appropriate road marking and bicycle signage in bicycle lanes AC5: It is easy for me to carry my bicycle inside public transport vehicles
Perceived Safety and Security	AC6: I can securely park my bicycle at the station PS1: I am not concerned about becoming a victim of crime or harassment while riding a bicycle PS2: I feel safe cycling on-road PS3: Streets in my neighbourhood feel safe to ride on PS4: I feel that children in my neighbourhood can safely cycle to school
Information and Engagement	IE1: I can easily find cycling promotional events and attend them IE2: I can easily access information about traffic regulations for cyclists IE3: I can easily report issues to the council about cycling facilities and enforcement

it is perceived as affirming the individual's autonomous choices.

2.2.4. SC3: People who I know (friends and family) cycle often

The influence of friends and family cycling can be connected to benevolence and conformity in Schwartz values. Benevolence and conformity values both promote cooperative and supportive social relations (Schwartz, 2012). Benevolence, which focuses on the preservation and enhancement of the welfare of those in frequent personal contact, aligns with the positive impact of social influences from friends and family on using bicycles. Conformity, which involves the restraint of actions that might upset or harm others and adhering to subjective norms, reflects how individuals may choose to cycle to align with the expectations and behaviors of their social circle, including their family and other primary groups (Nordlund and Garvill, 2003; Schwartz, 2012).

2.2.5. SC4: Cycling is becoming more popular as a transport mode in Auckland

The social image of cycling within the city can be linked to universalism, tradition, and achievement. Universalism encompasses understanding, appreciation, tolerance, and protection for the welfare of all people and nature, which aligns with the positive environmental and social perceptions of cycling (Steg and Vlek, 2009). Tradition involves respect and acceptance of cultural values. This reflects how the cultural acceptance and historical context of cycling in a city can influence individual attitudes and behaviors toward cycling (Aldred, 2013). In many cases, traditions can influence bicycle use by providing a more positive social image for private car ownership than active modes (Arroyo et al., 2020). Achievement values emphasize demonstrating competence in terms of prevailing cultural standards, thereby obtaining social approval (Schwartz, 2012). This connects to how individuals may perceive cycling as a way to demonstrate their adherence to social and environmental norms. Therefore, the social image of cycling in society can influence their values towards cycling.

Fig. 1 shows the conceptual model proposed in the study. The model structure was inspired by models such as the Theory of Planned Behavior (TPB) (Ajzen, 1991) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003; Venkatesh et al., 2008), similar to that used by Frater and Kingham (2020) which analyzed cycling perceptions of adolescents for biking to school, and Jahanshahi et al. (2019), which analyzed the intention to use, and use of, bicycles. Socio-Cultural Factors, Perceived Safety and Security, and Price Value were then added to the model, based on the literature. Also, a theme which focuses on perceived accessibility to cycling provisions (Vallejo-Borda et al., 2020; Ng et al., 2017) was added, along with a new cycling perception theme titled "Information and Engagement". This theme focusses on the extent to which having access to information, awareness about cycling events, and the ease with which cycling issues can be reported to council, influence bicycle use. The answer format to questions were designed based on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'.

2.2.6. Bicycle use

Table 3 outlines the cycling characteristics of the participants, detailing factors such as home bicycle accessibility, frequency of bicycle use, participants' bicycle user classifications, and their cycling purposes if they ride a bicycle. The data collection encompassed both individuals who cycle and those who do not. Among those identified as cyclists, the classification followed a division into 'regular cyclists' and 'potential cyclists', as per the suggested categorization by Félix et al. (2017).

Regular Cyclists are those who indicated having cycled in the past month for any purpose; Potential Cyclists are those who had cycled at least once in the past 12 months and Non-Cyclists are those who had not cycled in the past 12 months. The bicycle use classification method in this study was based on the method proposed by Félix et al. (2017) and, subsequently, adopted in other studies (Wang and Akar, 2018; Félix et al., 2019). There is also a four-way classification of bicycle user type that could have been used, introduced by Dill and McNeil (2013). However, a reason to avoid using the four-way classification was the fact that this classification is made upon the individuals' preferences only and is determined by a person's comfort riding a bicycle on different types of bikeways. Therefore, the actual frequency of bicycle use is not the focus in this classification method. For example, Dill and McNeil (2013) find that 34 % of the "strong and fearless" type of cyclists in their classification actually do not use bicycles. The frequency of bicycle use is a crucial factor for categorizing cyclists (Damant-Sirois et al., 2014), and it is required due to the nature of research questions in this study. Therefore, considering the aforementioned two available classification methods, the simplicity of the chosen method was

Table 3
Cycling characteristics of the respondents.

Categories	Percentages	Categories	Percentages
Access to a bicycle at home	%	Cycling purposes	%
Yes	46.7	Commuting	9.5
No	53.3	Short trips	25.5
Average bicycle use (per week)*	%	Recreation/exercise	65
0 times	32.9	Average daily bicycle use (time)	%
1–3 times	60.8	<15 mins	31.7
3–5 times	4.1	15–30 mins	47.2
>5 times	2.3	30–60 mins	18.3
Bicycle use	%	>60 mins	2.8
Non-cyclists	51.2	Cycling injuries experiences	%
Regular cyclists	25.5	Yes	30
Potential cyclists	23.3	No	70

* These percentages are for those who ride a bicycle.

attractive given the length of the questionnaire for this study, as well as considering bicycle use frequency.

2.3. Data analysis strategy

To analyze the data, a descriptive analysis of the questionnaire items was initially conducted presenting the mean, Standard Deviation (SD), and percentage of responses to each question. This provides a general overview of responses to the survey questionnaire.

Next, the conceptual model was analyzed and the prediction of bicycle use by model themes was assessed using Structural Equation Modelling (SEM) using Smart PLS software. The significance and the direction of the effects between the themes were then analyzed. This section answers the first and second research questions by examining the influence of themes on bicycle use and comparing the influence of socio-cultural factors with other themes.

Subsequently, in order to answer the third research question of this study, the effects of the moderators on the relationships between bicycle use and the themes were analyzed using two methods:

- The moderators' effects were analyzed separately. These include age, gender, income level, and ethnicity.
- Following the intersectionality approach, groups were created based on ethnicities (Māori and Pacific peoples, and All Other Ethnicities), income levels (lower, average, and higher), and gender (male and female). In the groups, age was not considered because the amount of data in each group was insufficient for reliable analyses. The literature (Ministry of Health, 2021; Bassett et al., 2020; Shaw and Russell, 2017) emphasized that Māori and Pacific people's bicycle use and perceptions differ from those of other groups. Therefore, respondents were sorted by ethnicity into two broad groups (Māori and Pacific peoples, and All Other Ethnicities).

2.3.1. Reliability of the conceptual model

Conducting a reliability test is crucial for studies with behavioral models (Jahanshahi et al., 2020). Table 4 shows the reliability criteria used in this study, including loading factors and the Variance Inflation Factor (VIF) for each item used in the questionnaire, and Cronbach's alpha coefficients, the computed composite reliability (CR), and the Average Variance Extracted AVEs for each theme, and 'goodness-of-fit' statistical parameters.

- The convergent and discriminant validity of the questionnaire items should be confirmed, using a Confirmatory Factor Analysis (CFA) (Churchill, 1979; Byrne, 2012). This method confirms the relationships between a set of observed variables and a set of common items (Muthen and Muthen, 2010). It is recommended that items with loading factors of less than 0.5 be excluded (Hair et al., 2010). The table shows that all of the items had loading factors greater than 0.5, which is considered acceptable.
- Cronbach's alpha coefficients of themes were found to be between 0.6 and 0.765, within the ranges of acceptable to very good reliability and illustrate acceptable internal consistency for each theme (Hair et al., 2010).
- The computed composite reliability (CR) assesses whether the model fitting is acceptable for the themes and indicates its acceptance in fitting the model. CR values were greater than 0.6 for each theme, indicating its acceptance for fitting the model (Fornell and Larcker, 1981; Hair et al., 2010).
- The Average Variance Extracted (AVE) computes the discriminant validity and appraises the amount of variance produced by each theme according to its components (Bagozzi et al., 1991; Chen, 2016). AVE is acceptable if values are greater than 0.5 (Fornell and

Table 4
Reliability tests for the model.

Categories	Items	Loading Factor	VIF	AVE	Cronbach's alpha	CR
Socio-Cultural Influences	SC1	0.483	1.09	0.55	0.59	0.78
	SC2	0.885	1.42			
	SC3	0.807	1.36			
Price Value	PV1	0.775	2.32	0.50	0.75	0.83
	PV2	0.776	2.26			
	PV3	0.633	1.44			
	PV4	0.704	1.62			
Perceived Accessibility	AC1	0.685	1.72	0.50	0.76	0.83
	AC2	0.763	1.77			
	AC4	0.633	1.37			
	AC5	0.734	1.34			
	AC6	0.739	1.38			
Perceived Safety and Security	PS1	0.624	1.31	0.58	0.76	0.85
	PS2	0.840	1.69			
	PS3	0.834	1.80			
	PS4	0.752	1.57			
Information and Engagement	IE1	0.855	1.43	0.65	0.74	0.85
	IE2	0.828	1.64			
	IE3	0.745	1.46			
GOF = 0.367 R ² = 34.1 % O ² = 0.324						

Larcker, 1981; Hair et al., 2010). All AVEs were considered acceptable with values of greater than 0.5, except for the Socio-Cultural Influences and Perceived Accessibility themes, returning AVEs of 0.461 and 0.475, respectively. Consequently, we removed SP4 and AC3 from their respective themes as they returned the lowest loading factors of 0.471 and 0.58, respectively. That produced a valid AVE for the Socio-Cultural Influences and Perceived Accessibility themes, returning values of 0.508 and 0.556, respectively. Based on the AVE test, 19 items within five themes were retained for analysis in the conceptual model.

- The Variance Inflation Factor (VIF) is used to investigate multi-collinearity. The values of VIF being less than 4 for all of the items showed that each item is a good choice for its theme, indicating that the themes are designed appropriately for that item (Hair et al., 2021).
- The Kolmogorov-Smirnov and Shapiro-Wilk tests showed the normality of the distribution of the data, a necessary criterion for many statistical tests and analyses of power and reliability.
- In addition to the comprehensive reliability and validity checks described above, the hypothesized structural model was evaluated by adopting a predictive modeling approach that aligns well with the objectives and nature of this research. Accordingly, rather than relying on traditional covariance-based fit indices such as RMSEA, CFI, or TLI, which are more suitable for theory-confirmatory models, prediction-oriented metrics were conducted to assess the model's quality using a range of performance criteria recommended in the literature (Tenenhaus et al., 2005; Wetzels et al., 2009; Hair et al., 2011; Hair et al., 2022). These included the Goodness-of-Fit (GOF), R^2 values, and Q^2 values.

The Goodness-of-Fit (GOF), introduced by Tenenhaus et al. (2005) and further benchmarked by Wetzels et al. (2009), was used to assess the overall predictive performance of the model, with values of 0.1, 0.25, and 0.36 representing small, medium, and large extents of predictive power, respectively. In this study, the GOF value was 0.367, indicating a large extent of overall model fit and predictive relevance.

The Q^2 value, which reflects the model's out-of-sample predictive accuracy, was interpreted using guidelines from Hair et al. (2022), where 0.02, 0.15, and 0.35 indicate small, medium, and large extents of predictive relevance. The Q^2 value of 0.324 in this study suggests the model has a large extent of predictive relevance.

For the R^2 value, which assesses the amount of variance explained in the dependent variable, values of 0.25, 0.50, and 0.75 are typically considered weak, moderate, and substantial, respectively (Hair et al., 2022). The study model produced an R^2 of 0.341, indicating a weak to moderate explanatory power.

3. Results

3.1. Descriptive analysis of questionnaire items

A descriptive analysis of the questionnaire indicates that the majority of respondents agreed or strongly agreed that they are not embarrassed to be seen riding a bicycle, suggesting that cycling is considered to be culturally acceptable in Auckland. Most respondents

Table 5
Descriptive statistics for indicators and categories (overall).

Categories/Questions	Mean	SD	1 (Strongly disagree%)	2	3	4	5 (Strongly agree%)
Socio-Cultural Influences	3.12	0.742					
SC1: Not embarrassed biking	3.59	1.143	4.9	14	22.1	34.6	24.3
SC2: Friends and family	2.63	1.104	18.6	26.5	32.2	18.8	4.0
SC3: People who I know	2.88	1.163	13.1	28.1	23.6	28.3	6.9
SC4: Cycling is becoming popular	2.87	1.158	13.4	27.9	23.6	28.7	6.3
Price Value	3.34	0.678					
PV1: Reasonably priced	3.09	0.975	6.3	20.6	35.2	34.0	4.0
PV2: Cost of equipment	3.06	0.962	6.1	21.3	37.0	31.8	3.8
PV3: Cheaper form of travel	3.54	0.962	4.2	8.1	30.8	43.7	13.2
PV4: Affordable maintaining	3.45	0.844	1.8	10.1	37.0	43.4	7.7
Perceived Accessibility	3.07	0.691					
AC1: Cycling facilities	3.10	1.080	6.9	24.1	30.0	30.0	8.9
AC2: Cycling to destination(s)	3.03	1.044	8.7	21.3	34.4	29.8	5.7
AC3: Street lighting/signals	3.32	0.984	5.1	14.2	31.4	41.5	7.7
AC4: Road marking/signage	3.37	0.918	2.6	15.0	33.2	41.5	7.7
AC5: Public transport integration	2.72	1.001	11.9	28.9	37.9	18.0	3.4
AC6: Secure parking	2.86	0.895	6.5	25.5	47.0	17.8	3.2
Perceived Safety and Security	2.77	0.832					
PS1: Victim/harassment	2.75	1.096	14.8	26.3	32.2	22.1	4.5
PS2: Safe cycling on-road	2.42	1.079	22.7	32.2	28.3	13.6	3.2
PS3: Safe streets in neighborhood	2.97	1.113	11.5	21.9	32.0	27.5	7.1
PS4: Safe cycling to school	2.93	1.076	10.3	25.1	31.4	27.7	5.5
Information and Engagement	2.99	0.758					
IE1: Access cycling events	2.83	0.963	9.9	22.7	45.1	18.8	3.6
IE2: Access information	3.09	0.916	4.9	18.6	42.7	29.6	4.2
IE3: Easy communication	3.05	0.913	5.5	17.8	47.4	24.5	4.7

agree or strongly agree that cycling is an affordable mode of travel with affordable maintenance costs. However, there is a higher level of disagreement regarding the reasonable pricing of bicycles and their equipment. Most respondents agree or strongly agree that they have sufficient street lighting, road marking, and signage in their cycling journeys (Table 5).

3.2. Structural equation modeling

The structural model consists of five themes, including Socio-Cultural Influences, Price Value, Perceived Accessibility, Perceived Safety and Security, and Information and Engagement. In Fig. 2, the themes (latent variables) are presented as circles, items (observed indicators) are presented as rectangles, and loading factors between the themes and items are represented by the coefficients on the paths.

Analysis of the conceptual model, using SEM, shows that the five themes have direct paths to Bicycle Use. Table 6 reveals data about the significance and direction of the effects between each theme and the Bicycle Use. As shown in Fig. 2 and Table 6, all of the coefficients linking the themes and Bicycle Use are positive. The results show that, after examination of the model, three paths are supported. Socio-cultural influences have a positive strong direct effect on Bicycle use, while Perceived Safety and Security, and Information and Engagement have a weak positive direct effect on Bicycle use. These findings not only confirm the hypothesized importance of socio-cultural influences in bicycle use but also show that socio-cultural influences play the most important role in influencing people's bicycle use.

3.3. Impact of sociodemographic characteristics on bicycle use

Sociodemographic characteristics including age, gender, ethnicity, and income level are included in the model as moderators. In this section, the effects of sociodemographic characteristics on the relationship between Socio-Cultural Influences, Price Value, Perceived Accessibility, Perceived Safety and Security, Information and Engagement, and Bicycle Usage are examined. Overall, the

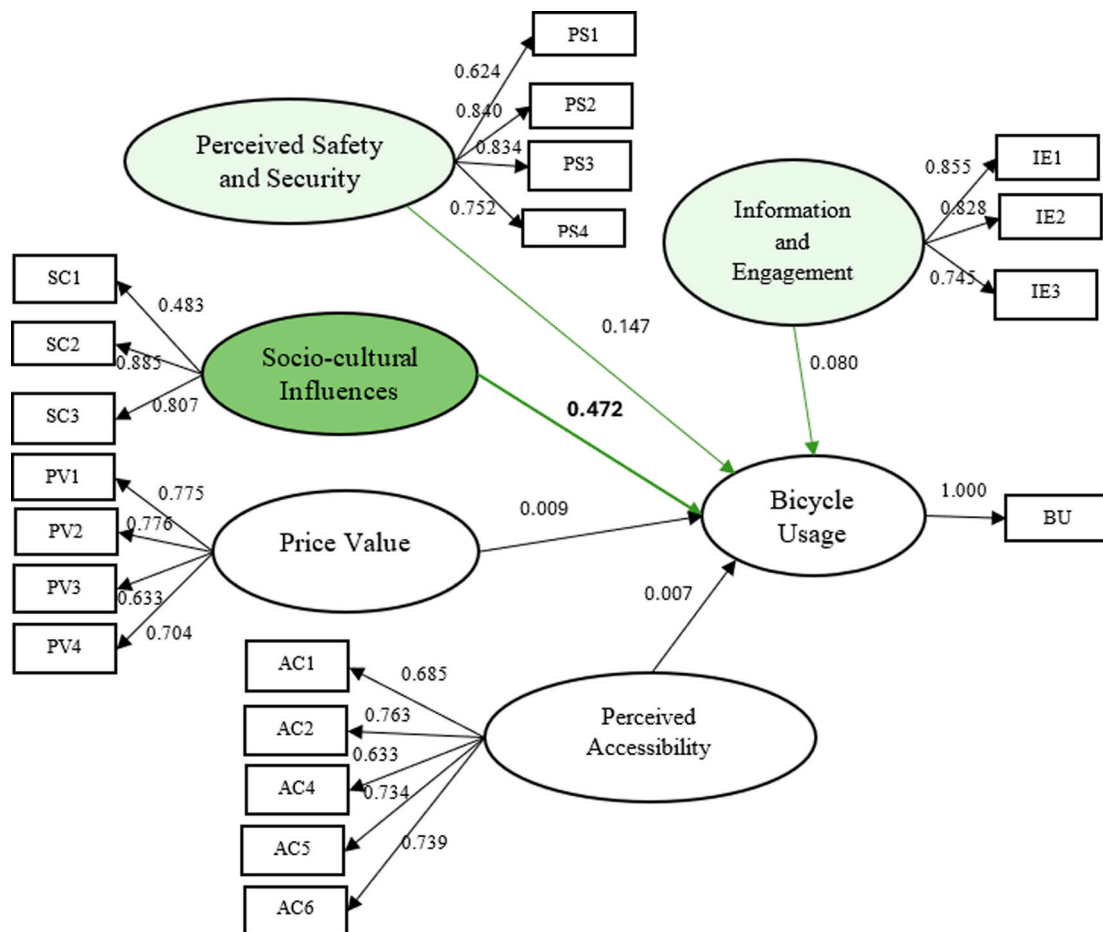


Fig. 2. Results of the SEM for the conceptual model. Green colors show significant themes and relationships. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 6
Results of the structural model.

Category	Effect Direction	Coefficient	p-value	Result
Socio-Cultural Influences to BU	+	0.472**	0.000	Supported
Price Value to BU	+	0.009	0.802	Not Supported
Perceived Accessibility to BU	+	0.007	0.863	Not Supported
Perceived Safety/Security to BU	+	0.147**	0.001	Supported
Information and Engagement to BU	+	0.080*	0.046	Supported

+: a positive effect, -: a negative effect; BU: Bicycle use; * shows significant influence.

* $P < 0.05$, ** $P < 0.01$.

only identified significant moderating impacts indicate that socio-cultural factors influence bicycle use differently across various age and ethnic groups.

3.3.1. Ethnicity

Ethnicities in this study included Māori and Pacific peoples, NZ European, Indian, Asian, and European. For MELAA and Other Ethnicities, the sample numbers were insufficient for a reliable analysis, therefore these two groups were excluded from the analyses. Results show that none of the ethnicities had any moderating effect on the relationship between Perceived Accessibility, Price Values, Information and Engagement, and Perceived Safety and Security, and Bicycle Use. This means that their relationship is not influenced by ethnicity. Interestingly, all ethnic groups moderate the relationship between Socio-Cultural Influences and Bicycle Use (Table 7). This indicates that socio-cultural factors influence bicycle use differently across various ethnic groups.

To compare the ethnic groups in terms of the relationship between Socio-Cultural Influences and Bicycle Use, one-by-one comparisons were made (Table 8). There are only two significant differences found between ethnicities, namely Māori and Pacific people show significantly less sensitivity to Socio-Cultural Influences compared with NZ Europeans (p -value = 0.03). Also, Asian people show significantly less sensitivity to Socio-Cultural Influences compared with NZ Europeans, with a p -value of 0.004.

3.3.2. Age

Results indicate that in a similar way to ethnicity, all of the age groups were found to be only sensitive to the relationship between Socio-Cultural Influences and Bicycle Use. Table 9 shows the moderating effect for each age group, for each path in the model. This indicates that socio-cultural factors influence bicycle use differently across various age groups.

To compare the effect of age groups on the relationship between Socio-Cultural Influences and Bicycle Use, one-by-one comparisons were made (Table 10). Significant differences are found for only three age groups, with 21–30 year olds showing significantly higher sensitivity to Socio-Cultural Influences compared with 31–40 year olds and 41–50 year olds, with p -values of 0.001 and 0.035, respectively. Also, 31–40 year olds show significantly less sensitivity to socio-cultural influences compared with > 60 year olds, with a p -value of 0.029.

3.3.3. Gender and income level

Results show that the comparison between gender groups and income levels in terms of the relationship between themes and bicycle use does not show any significant difference.

3.4. Impact of sociodemographic characteristics on bicycle use; an intersectionality approach

As mentioned previously, the moderating effect of the combined sociodemographic groups was also assessed to investigate intersectionality, as well as to identify any differences between these groups and single sociodemographic characteristics. The number of participants was such that gender, income level, and ethnicity were all able to be considered for most combinations. Specifically, ethnicities were split into two main groups (Māori and Pacific peoples, and All Other Ethnicities), income levels were split into three main groups (lower: no income and income < 30 k, average: income between 30 k and 100 k, and higher: income > 100 k), and gender was split into two groups (male and female), resulting in 12 group combinations. Two of the groups were eliminated because of low numbers (higher income Māori and Pacific males and higher income Māori and Pacific females). The remaining groups are shown in Fig. 3.

Table 7
The moderating effect of each ethnic group for each path in the model.

Group	path	Coefficient	StandardDeviation	T Statistics	p-Values
Māori & Pacific peoples	SC → BU	0.335	0.090	3.710	0.000
NZ European	SC → BU	0.558	0.049	11.377	0.000
Indian	SC → BU	0.502	0.118	4.259	0.000
Asian	SC → BU	0.266	0.086	3.081	0.002
European	SC → BU	0.482	0.124	3.896	0.000

Note: p -values (<0.05) indicate significant moderating relationships.

Table 8
Significant differences in one-by-one comparisons of ethnic groups.

SC → BU	Path Coefficients difference	p-Value
Māori and Pacific people vs NZ European	−0.224	0.030
NZ European vs Asian	0.292	0.004

Table 9
The moderating effect of each age group for each path in the model.

Age group	Path	Coefficient	StandardDeviation	T Statistic	p-Values
18–20	SC → BU	0.493	0.168	2.940	0.003
21–30	SC → BU	0.623	0.084	7.417	0.000
31–40	SC → BU	0.225	0.089	2.529	0.012
41–50	SC → BU	0.373	0.087	4.266	0.000
51–60	SC → BU	0.468	0.099	4.707	0.000
>60	SC → BU	0.507	0.095	5.362	0.000

Note: p-values (<0.05) indicate significant moderating relationships.

Table 10
Significant differences in one-by-one comparisons of age groups.

SC → BU	Path Coefficients difference	p-Value
21–30 vs 31–40	0.398	0.001
21–30 vs 41–50	0.250	0.035
31–40 vs >60	−0.282	0.029

The results of comparisons between the groups only show two significant findings:

- Among women from all other ethnicities, those with higher income levels are less sensitive to the influence of socio-cultural influences on bicycle use.
- Among women from all other ethnicities, those with higher income levels are more sensitive to the influence of Price Value on bicycle use.
- There are no significant differences among other combined groups.

4. Discussions

This research aimed to understand the impact of socio-cultural influences on bicycle use in Auckland, identify the strength of socio-cultural influences compared to other factors, and evaluate the influence of various sociodemographic characteristics including age, gender, ethnicity, and income level on socio-cultural influences and cycling in Auckland. This section discusses the results, addressing the three research questions outlined in the introduction.

Based on the structural equation modeling, this research revealed that socio-cultural influences showed the strongest relationship with bicycle use. This relates to the impact of participants' friends and family on their bicycle use as well as the image of bicycles in

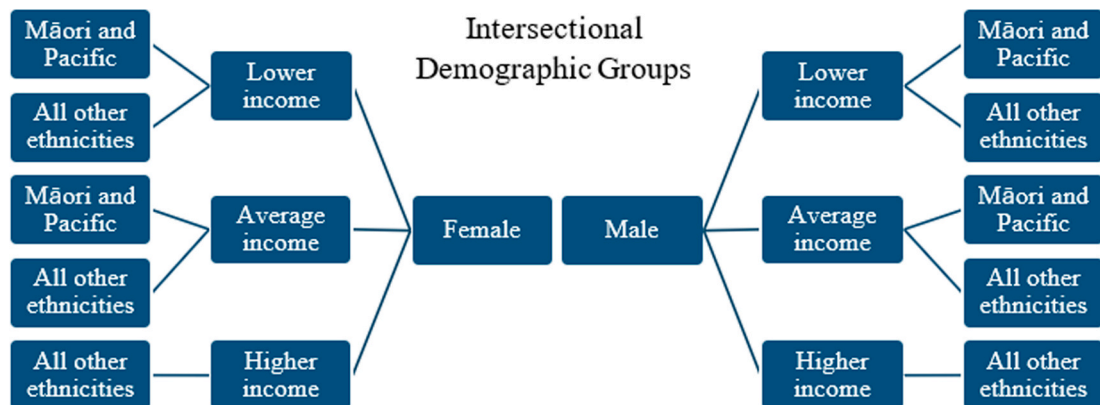


Fig. 3. Intersectional demographic groups based on ethnicity, income level, and gender.

society. People who perceived that others (for example, their friends and family) believed that they should use a bicycle showed a relatively higher bicycle use rate. Also, people who were not embarrassed to be seen riding a bicycle showed a higher bicycle use rate. These findings not only confirm the hypothesized importance of socio-cultural influences within the broader social psychological framework but also reveal that these factors play a pivotal role in influencing bicycle usage in Auckland. This result may be attributed to the strong role of subjective norms, peer behavior, and cultural perceptions in shaping transport choices, particularly in a multi-cultural city like Auckland, where diverse communities, including Māori and Pacific peoples, often place significant value on family and community ties. In such contexts, social encouragement and cultural acceptance can be powerful motivators, sometimes outweighing practical considerations like cost or infrastructure availability. While counterintuitive compared to traditional transport approaches emphasizing infrastructure, safety, cost and/or demographics our findings align with emerging research highlighting the growing importance of socio-cultural influence in transport behaviors, as discussed below.

The findings above are consistent with the notion that in travel behavior, social influence impacts people's opinions on an individual's acceptance or rejection of a behavior (Venkatesh et al., 2003; Yuan et al., 2005; Axhausen, 2008; Carrasco and Miller, 2009; Goetzke and Rave, 2010; Sherwin et al., 2014). As Sherwin et al. (2014) found, social influence plays a significant role in the decision to start cycling regularly. This influence can be direct, such as encouragement from friends and family, or indirect, from broader social and cultural contexts. A study on Latino-immigrant neighborhoods in the USA found that Social norms and the influence of friends and family are crucial in shaping cycling behavior among Latino communities (Barajas, 2019). A report from New Zealand Transport Agency also showed that social influences help normalize cycling in New Zealand, so that those cycling more frequently are more likely to have friends, family, or colleagues who also cycle (NZ Transport Agency, 2021).

The findings of this study are also align with previous research that indicated that the image of the bicycle in society influences cycling. Exploring the relationship between cycling, modernity, and national culture, Oosterhuis (2016) highlighted how social class and modern values have shaped cycling trends across different countries. Oosterhuis emphasizes that the adoption and cultural significance of cycling are closely tied to broader societal transformations and national identities. For instance, in the late 19th century, cycling was associated with technological progress and individual liberation, predominantly embraced by the liberal urban upper and middle classes. In countries such as The Netherlands and Denmark, where egalitarian values and a consensus-driven political culture prevailed, cycling maintained its popularity and high use levels. In contrast, in countries with more pronounced class distinctions, such as Germany and Britain, cycling became associated with the lower classes and declined in status as the elite adopted cars (Oosterhuis, 2016).

Although factors such as perceived accessibility did not significantly influence bicycle use in our case study, this finding aligns with a growing body of research suggesting that psychological variables may not always function as key drivers of travel behavior in a unidirectional way (from these variables to behavior). For example, Mehdizadeh and Kroesen (2025) found that, contrary to traditional assumptions, travel mode use has a stronger effect on perceived accessibility than the reverse. This suggests that interventions aimed solely at improving perceptions of accessibility may be insufficient to drive behavioral change. Similarly, Kroesen et al. (2017), in a longitudinal study, demonstrated that travel behavior and attitudes are mutually influential over time, and, importantly, that the impact of behavior on attitudes was notably stronger than the reverse, challenging the conventional assumption that changing attitudes is a prerequisite for changing behavior. This research investigated the moderating effect of sociodemographic characteristics on the relationships between socio-cultural influences and bicycle use. Findings indicated that socio-cultural influences influence bicycle use differently across various age and ethnic groups. As reported in the results section, Māori, and Pacific peoples are significantly less sensitive to socio-cultural influences, compared with NZ Europeans. The influence of ethnicity on cycling perceptions in the New Zealand context was discussed by Jahanshahi et al. (2022) and confirmed that various ethnic groups with different cultural backgrounds could have different perceptions about cycling. Importantly, racial and ethnic identities do not explicitly motivate or discourage cycling on their own (Barajas, 2019) and it could be related to cultural differences, social norms, and travel habits of different ethnic groups (Tahir, 2023). Socio-cultural influences were also more effective for encouraging younger people to use a bicycle. A study in a Swiss city showed that one of the main determinants explaining cycling practices among young people was social influences (Schmassmann et al., 2023).

When the intersectional groups were assessed, only the income level of women (excluding Māori and Pacific women) influenced their sensitivity to the impact of socio-cultural influences on using a bicycle. The different sensitivity to socio-cultural influences by people with different income levels could be related to the impact of social classes on cycling perceptions. Previous studies also reported that social class can influence cycling perceptions (Jahanshahi et al., 2020; Nawaz and Ali, 2020). Also, studies showed that being in different social classes (which is influenced by income level) influences the level of sensitivity to socio-cultural influences (Steinbach et al., 2011).

The findings from this research offer valuable insights that can be applied to other urban areas with similar sociodemographic characteristics. Understanding the role of socio-cultural influences on bicycle use and the importance of considering them in cycling equity policies are broadly applicable to any urban context. Additionally, the policy implications derived from this research are transferable to other cities aiming to improve transportation equity. Urban areas experiencing similar challenges related to the lack of a comprehensive transportation equity policy can leverage these findings to design more inclusive and effective cycling strategies that cater to diverse populations.

One potential limitation of this study might be a selection effect due to the language barrier, given that the questionnaire was only provided in English. In addition, the reliance on self-reported data via an online survey may have introduced response biases, such as social desirability or recall bias. Finally, while the intersectional analysis highlighted income and gender, other factors such as disability status or community characteristics were not explored, which could offer a more nuanced understanding. Future research could address these limitations by incorporating qualitative methods and targeted groups. Furthermore, the cross-sectional nature of

this study imposes limitations on causal inference. While we identified significant associations between social influences and bicycle use, these relationships are inherently complex and could potentially be bidirectional. As such, our findings should be interpreted with caution regarding causality given its unidirectional nature.

4.1. Implications for policy and practice

This research has highlighted the importance of socio-cultural influences in bicycle use in Auckland. By focusing on subjective norms, community dynamics, and cultural influences, this study provides insights for cycling policymakers and decision-makers. The goal is to foster cycling equity policies that go beyond traditional infrastructure investments to address the social dynamics that influence cycling behavior, ensuring more equitable and inclusive cycling strategies.

The key contribution of this research lies in demonstrating that socio-cultural influences, particularly those related to family, friends, community, and subjective norms, play a dominant role in influencing bicycle use in Auckland compared to other factors such as infrastructure, safety, cost, and/or demographics. These findings are especially significant in Auckland, a multicultural city where cultural identity, family ties, and community connections profoundly shape daily behaviors, including transport choices. This was highlighted by examining and comparing the influence of various factors on bicycle use and in-depth analysis of differences among population groups based on sociodemographic characteristics including age, gender, ethnicity, and income. Findings encourage cycling policy and decision-makers to consider the power of socio-cultural influences on bicycle use. This can open new avenues for promoting cycling equity initiatives and implementing fair transport strategies that are community-focused and target particular barriers of population groups. The policy implications derived from this research can guide the development of more equitable and effective transport strategies to enhance cycling participation across diverse demographic groups and achieve broader societal benefits. The policy implications drawn from this study are designed to leverage these socio-cultural insights and promote cycling equity through short-term, mid-term, and long-term strategies.

4.1.1. Short-term strategy

In terms of short-term strategy, integrating socio-cultural initiatives with local government's transport strategies, such as community engagement, education, and awareness campaigns, could effectively consider the influence of socio-cultural factors on cycling. Policymakers could prioritize engaging with communities to understand and address specific cultural and social norms that influence cycling behavior. Effective community engagement is essential for promoting cycling equity. Transport planners and local governments can conduct interviews and surveys to understand the unique perceptions and social influences in different communities. Involving stakeholders, such as community leaders and local organizations, in the planning process can provide valuable insights and build trust. This can help normalize cycling within different communities by leveraging local champions and community leaders to promote positive cycling perceptions. In addition, implementing education and awareness campaigns that highlight the health, environmental, and social benefits of cycling can shift and balance the overall societal attitudes and increase acceptance of cycling as a sustainable mode of transport. Establishing mechanisms for ongoing feedback and being responsive to community needs will also ensure that transport strategies remain relevant and in line with cycling equity policies.

This short-term strategy focuses on immediate actions that can be implemented quickly to create awareness and empower communities. Community engagement and education campaigns can be initiated relatively quickly and can start showing results within a short period.

4.1.2. Mid-term strategy

In terms of mid-term strategy, implementing effective monitoring and evaluation initiatives is crucial for advancing cycling equity, particularly given the significant role of socio-cultural influences and differences among population groups' sensitivities. Employing data-driven methods to address the specific barriers faced by different demographic groups is essential. This process includes gathering and analyzing data on cycling perceptions and social norms about cycling, with a focus on the impact of socio-cultural influences. Establishing a multifaceted monitoring and evaluation mechanism for cycling policies considering factors beyond cycling infrastructure ensures that local transport strategies meet equity goals and address the unique needs of diverse communities. Regularly collecting public opinions from various demographic groups and modifying transport strategies by considering their experiences and socio-cultural contexts is critical. Additionally, longitudinal investigations that examine the long-term effects of transport strategies on different population groups could offer valuable insights into the success of implemented interventions. This strategy ensures that policymakers or local transport advisors are guided by a comprehensive understanding of how socio-cultural influences shape cycling behavior, leading to more focused, effective, and fair cycling policies for all communities.

This mid-term strategy involves establishing systems and processes that require some time to develop and implement. Monitoring and evaluation initiatives necessitate the collection and analysis of data over a period, typically a few years, to assess the effectiveness of policies and interventions. These initiatives are crucial for making data-driven adjustments and improvements to cycling policies based on observed trends and feedback.

4.1.3. Long-term strategy

In terms of large-term strategy, incorporating cultural representation in cycling initiatives could help engage socio-cultural influences of communities. A suggested intervention is to create cycling promotional campaigns that reflect the cultural diversity of the community. This involves using images, languages, and narratives that resonate with different cultural groups to make cycling more appealing. For instance, campaigns could feature stories and testimonials from Māori or Pacific people, showcasing cycling as a

valuable and inclusive mode of transport. Additionally, organizing cycling events and festivals that celebrate cultural diversity can further enhance engagement. These events could include cultural performances, traditional foods, and other activities that attract a wide range of participants, highlighting the inclusivity and communal benefits of cycling. Such culturally relevant campaigns and inclusive events not only can promote cycling but also foster a sense of community and belonging, encouraging more people from diverse backgrounds to participate in and embrace cycling, powered by social influences. However, this cultural engagement must be conducted with careful consideration of all cultural protocols. For instance, for Māori communities, respecting and incorporating Māori cultural values and practices in all stages of planning and implementation is required to ensure that the initiatives are not only inclusive but also respectful. Engaging with community leaders and representatives throughout the process can help ensure that the initiatives align with cultural expectations and are well-received by the community.

This long-term strategy is focused on sustainable and systemic changes that evolve over an extended period. Incorporating cultural representation and organizing inclusive events require ongoing efforts to build relationships, trust, and engagement within diverse communities. These initiatives aim to create lasting cultural shifts and deeper societal integration of cycling, which takes more time to achieve and sustain.

The above policy implications, including short-term, mid-term, and long-term strategies could enhance transport strategy and promote cycling equity by emphasizing the impact of socio-cultural influences and the unique needs of diverse communities. However, it is important to acknowledge that prioritizing such investments within existing financial constraints remains a significant challenge. For similar transport strategies, the investments and distribution of resources largely depend on government priorities, budget constraints, and the demands from various other sectors. In such a trade-off situation, policymakers and transport strategists typically encounter complexities in which political will, public support, and the broader economic context could play a crucial role in determining the feasibility and implementation of these initiatives.

5. Conclusions

This research provides new insights into the role of socio-cultural influences on bicycle use in Auckland, a multicultural urban context. Our findings demonstrate that socio-cultural influences from family, friends, community, and culture are the most significant predictors of bicycle use in Auckland. These results highlight the powerful impact of social norms and cultural perceptions on transport choices, especially in diverse communities like Auckland. Importantly, the study reveals that the influence of these socio-cultural factors varies across demographic groups, reinforcing the idea that cycling behavior is shaped not only by individual preferences and infrastructure availability but also by broader social and cultural dynamics. Intersectional analysis further suggests that income levels, particularly among women, moderate the relationship between socio-cultural influences and bicycle use, indicating the nuanced interplay between class, gender, and socio-cultural factors in shaping cycling behavior. This finding underscores the importance of addressing inequalities that may prevent certain groups from benefiting from cycling initiatives. Additionally, differences in socio-cultural influences across ethnic groups point to the need for tailored approaches to bicycle promotion, acknowledging that a one-size-fits-all strategy may not effectively address the barriers and motivations specific to different communities.

The findings highlight the need for transport strategies that move beyond infrastructure to address socio-cultural dynamics in promoting cycling equity. While improving cycling infrastructure remains essential, complementary efforts such as community-led cycling initiatives, culturally relevant cycling campaigns, and policies that integrate social networks into active transport promotion can help shift perceptions and encourage broader adoption of cycling.

Crucially, if bicycle use itself helps shape social norms and perceptions, as emerging research suggests, then even small increases in ridership could generate positive feedback loops. Seeing more people cycle, especially among friends, family, and within the community, may gradually normalize cycling, reduce social stigma, and shift cultural narratives about who cycling is for. This highlights the transformative potential of behavior-led change: while it is important to understand how social influences affect cycling, it is equally vital to recognize that increasing bicycle use may actively reshape those very influences.

Future research could explore qualitative methods to deepen the understanding of cultural and community-specific barriers to cycling and investigate how targeted interventions can be designed to leverage socio-cultural influences across diverse urban populations. Moreover, longitudinal studies could track how shifts in social norms over time affect cycling behavior, providing valuable insights for long-term policy development. Ultimately, a holistic approach that integrates infrastructure, policy, and social interventions is crucial for fostering a more inclusive and sustainable cycling environment in cities such as Auckland.

Author Contribution

The authors confirm their contribution to the paper as follows: study conception and design: D. Jahanshahi, S. B. Costello; data collection: D. Jahanshahi; analysis and interpretation of results: D. Jahanshahi, S. B. Costello, Kim Natasha Dirks, B. van Wee; draft manuscript preparation: D. Jahanshahi, S. B. Costello, Kim Natasha Dirks, B. van Wee. All authors reviewed the results and approved the final version of the manuscript.

CRedit authorship contribution statement

Danial Jahanshahi: Writing – review & editing, Investigation, Project administration, Conceptualization, Software, Data curation, Methodology, Writing – original draft, Formal analysis. **Seósamh B. Costello:** Writing – review & editing, Methodology, Supervision, Conceptualization. **Kim Natasha Dirks:** Supervision, Writing – review & editing. **Bert van Wee:** Supervision, Writing – review &

editing.

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.

References

- Ajzen, I., 1991. The theory of planned behavior. *OrganBehav. Hum. Decis. Process.* 50 (2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T).
- Aldred, R., Woodcock, J., Goodman, A., 2016. Does more cycling mean more diversity in cycling? *Transp. Rev.* 36 (1), 28–44. <https://doi.org/10.1080/01441647.2015.1014451>.
- Arroyo, R., Ruiz, T., Mars, L., Rasouli, S., Timmermans, H., 2020. Influence of values, attitudes towards transport modes and companions on travel behavior. *Transport. Res. F: Traffic Psychol. Behav.* 71, 8–22. <https://doi.org/10.1016/j.trf.2020.04.002>.
- Banister, D., Bowling, A., 2004. Quality of life for the elderly: the transport dimension. *Transp. Policy* 11 (2), 105–115. [https://doi.org/10.1016/S0967-070X\(03\)00052-0](https://doi.org/10.1016/S0967-070X(03)00052-0).
- Barajas, J.M., 2019. Perceptions, people, and places: influences on cycling for latino immigrants and implications for equity. *J. Planning Educat. Res.* <https://doi.org/10.1177/0739456X19864714>.
- Bassett, D., Hosking, J., Ameratunga, S., Woodward, A., 2020. Variations in the health benefit valuations of active transport modes by age and ethnicity: a case study from New Zealand. *J. Transp. Health* 19 (October), 100953. <https://doi.org/10.1016/j.jth.2020.100953>.
- Bernatchez, A.C., Gauvin, L., Fuller, D., Dubé, A.S., Drouin, L., 2015. Knowing about a public bicycle share program in Montreal, Canada: are diffusion of innovation and proximity enough for equitable awareness? *J. Transp. Health* 2 (3), 360–368. <https://doi.org/10.1016/j.jth.2015.04.005>.
- Caulfield, B., O'Mahony, M., Brazil, W., Weldon, P., 2017. Examining usage patterns of a bike-sharing scheme in a medium sized city. *Transp. Res. A Policy Pract.* 100, 152–161. <https://doi.org/10.1016/j.tra.2017.04.023>.
- Chataway, E.S., Kaplan, S., Nielsen, T.A.S., Prato, C.G., 2014. Safety perceptions and reported behavior related to cycling in mixed traffic: a comparison between Brisbane and Copenhagen. *Transport. Res. F: Traffic Psychol. Behav.* 23, 32–43. <https://doi.org/10.1016/j.trf.2013.12.021>.
- Chen, S., 2016. Using the sustainable modified TAM and TPB to analyze the effects of perceived green value on loyalty to a public bike system. *Transp. Res. A* 88, 58–72. <https://doi.org/10.1016/j.tra.2016.03.008>.
- Chen, Z., Guo, Y., Stuart, A.L., Zhang, Y., Li, X., 2019. Exploring the equity performance of bike-sharing systems with disaggregated data: a story of southern Tampa. *Transp. Res. A Policy Pract.* 130 (March), 529–545. <https://doi.org/10.1016/j.tra.2019.09.048>.
- Damant-Sirois, G., Grimsrud, M., El-Geneidy, A.M., 2014. What's your type: a multidimensional cyclist typology. *Transportation* 41 (6), 1153–1169. <https://doi.org/10.1007/s11116-014-9523-8>.
- Di Ciommo, F., Shifan, Y., 2017. Transport equity analysis. *Transp. Rev.* 37 (2), 139–151. <https://doi.org/10.1080/01441647.2017.1278647>.
- Dill, J., McNeil, N., 2013. Four types of cyclists? *Transp. Res. Rec.* 2387, 129–138. <https://doi.org/10.3141/2387-15>.
- Doran, A., El-Geneidy, A., Manaugh, K., 2021. The pursuit of cycling equity: a review of Canadian transport plans. *J. Transport Geogr.* 90 (February 2020). <https://doi.org/10.1016/j.jtrangeo.2020.102927>.
- Félix, R., Moura, F., Clifton, K.J., 2017. Typologies of urban cyclists: review of market segmentation methods for planning practice. *Transp. Res. Rec.* 2662 (1), 125–133. <https://doi.org/10.3141/2662-14>.
- Félix, R., Moura, F., Clifton, K.J., 2019. Maturing urban cycling: comparing barriers and motivators to bicycle of cyclists and non-cyclists in Lisbon, Portugal. *J. Transport Health* 15 (January), 100628. <https://doi.org/10.1016/j.jth.2019.100628>.
- Fishman, E., Washington, S., Haworth, N., Mazzei, A., 2014. Barriers to bikesharing: an analysis from Melbourne and Brisbane. *J. Transp. Geogr.* 41, 325–337. <https://doi.org/10.1016/J.JTRANGEO.2014.08.005>.
- Frater, J., Kingham, S., 2020. Adolescents and bicycling to school: Does behaviour setting/place make a difference? *J. Transport Geogr.* 85 (August 2019). <https://doi.org/10.1016/j.jtrangeo.2020.102724>.
- Fuller, D., Winters, M., 2017. Income inequalities in Bike score and bicycling to work in Canada. *J. Transp. Health* 7 (September), 264–268. <https://doi.org/10.1016/j.jth.2017.09.005>.
- Gatersleben, B., Haddad, H., 2010. Who is the typical bicyclist? *Transport. Res. F: Traffic Psychol. Behav.* 13 (1), 41–48. <https://doi.org/10.1016/j.trf.2009.10.003>.
- Goodman, A., Aldred, R., 2018. Inequalities in utility and leisure cycling in England, and variation by local cycling prevalence. *Transport. Res. F: Traffic Psychol. Behav.* 56, 381–391. <https://doi.org/10.1016/j.trf.2018.05.001>.
- Hezaveh, A.M., Zavareh, M.F., Cherry, C.R., Nordfjærn, T., 2018. Errors and violations in relation to bicyclists' crash risks: Development of the Bicycle Rider Behavior Questionnaire (BRBQ). *J. Transport Health* 8 (September 2017), 289–298. <https://doi.org/10.1016/j.jth.2017.11.003>.
- Hosford, K., Winters, M., 2018. Who are Public bicycle share programs serving? an evaluation of the equity of spatial access to bicycle share service areas in Canadian cities. *Transp. Res. Rec.* <https://doi.org/10.1177/0361198118783107>.
- Houde, M., Apparicio, P., Séguin, A.M., 2018. A ride for whom: Has cycling network expansion reduced inequities in accessibility in Montreal, Canada? *J. Transport Geogr.* 68 (November 2017), 9–21. <https://doi.org/10.1016/j.jtrangeo.2018.02.005>.
- Howland, S., McNeil, N., Broach, J., Rankins, K., MacArthur, J., Dill, J., 2017. Current efforts to make Bikeshare more equitable: survey of system owners and operators. *Transport. Res. Record: J. Transport. Res. Board* 2662 (1), 160–167. <https://doi.org/10.3141/2662-18>.
- Høy, A.K., Johansson, O., Hesjevoll, I.S., 2020. Safety equipment use and crash involvement among cyclists – Behavioral adaptation, precaution or learning? *Transport. Res. F: Traffic Psychol. Behav.* 72, 117–132. <https://doi.org/10.1016/j.trf.2020.05.002>.
- Jahanshahi, D., van Wee, B., Kharazmi, O.A., 2019. Investigating factors affecting bicycle sharing system acceptability in a developing country: the case of Mashhad, Iran. *Case Stud. Transport Policy*. <https://doi.org/10.1016/j.cstp.2019.03.002>.
- Jahanshahi, D., Danial, B., Costello, S., Natasha Dirks, K., Chowdhury, S., & Van Wee, B. (2022). Understanding Perceptions of Cycling Infrastructure Provision and its Role in Cycling Equity. <https://doi.org/10.1177/03611981221117821>.
- Jahanshahi, D., Chowdhury, S., Costello, S.B., van Wee, B., 2021. Review of key findings and future directions for assessing equitable cycling usage. *Transport. Res. Record: J. Transport. Res. Board*. <https://doi.org/10.1177/0361198121995193>.
- Jahanshahi, D., Costello, S.B., Dirks, K.N., van Wee, B., 2023. Who benefits from cycling initiatives? An evaluation of perceived effectiveness and differences among population groups. *Case Stud. Transport. Policy* 13 (May). <https://doi.org/10.1016/j.cstp.2023.101049>.
- Jahanshahi, D., Tabibi, Z., van Wee, B., 2020. Factors influencing the acceptance and use of a bicycle sharing system: applying an extended Unified Theory of Acceptance and use of Technology (UTAUT). *Case Stud. Transport Policy* 8 (4), 1212–1223. <https://doi.org/10.1016/j.cstp.2020.08.002>.
- Jones, R., Kidd, B., Wild, K., Woodward, A., 2020. Cycling amongst Māori: patterns, influences and opportunities. *N. Z. Geogr.* 76 (3), 182–193. <https://doi.org/10.1111/nzg.12280>.
- Kent, M., Karner, A., 2019. Prioritizing low-stress and equitable bicycle networks using neighborhood-based accessibility measures. *Int. J. Sustain. Transp.* 13 (2), 100–110. <https://doi.org/10.1080/15568318.2018.1443177>.
- Kroesen, M., Handy, S., Chorus, C., 2017. Do attitudes cause behavior or vice versa? an alternative conceptualization of the attitude-behavior relationship in travel behavior modeling. *Transp. Res. A Policy Pract.* 101, 190–202.
- Lam, T.F., 2018. Hackney: a cycling borough for whom? *Applied Mobilities* 3 (2), 115–132. <https://doi.org/10.1080/23800127.2017.1305151>.

- Lee, C.F., Huang, H.I., 2014. The attractiveness of Taiwan as a bicycle tourism destination: a supply-side approach. *Asia Pacific J. Tourism Res.* 19 (3), 273–299. <https://doi.org/10.1080/10941665.2012.739190>.
- Litman, T., 2005. Evaluating transportation equity: guidance for incorporating distributional impacts in transportation planning. Victoria Transport Policy Institute, Victoria, British Columbia 8 (2), 50–65.
- Litman, T. (2024). Evaluating transportation equity: guidance for incorporating distributional impacts in transport planning. In: Victoria Transport Policy Institute (Vol. 92, Issue 4).
- Lucas, K., 2012. Transport and social exclusion: where are we now? *Transp. Policy* 20, 105–113. <https://doi.org/10.1016/j.tranpol.2012.01.013>.
- McTigue, C., Monios, J., Rye, T., 2018. Identifying barriers to implementation of local transport policy: an analysis of bus policy in Great Britain. *Utilities Policy* 50 (December 2017), 133–143. <https://doi.org/10.1016/j.jup.2017.12.002>.
- Mehdizadeh, M., Kroesen, M., 2025. Does perceived accessibility affect travel behavior or vice versa? Alternative theories testing bidirectional effects and (in) consistency over time. *Transp. Res. A Policy Pract.* 191, 104318.
- Ministry of Transport (2025). <<https://www.transport.govt.nz/statistics-and-insights/household-travel>>.
- Mooney, S.J., Hosford, K., Howe, B., Yan, A., Winters, M., Bassok, A., Hirsch, J.A., 2019. Freedom from the station: Spatial equity in access to dockless bike share. *J. Transport Geogr.* 74 (November 2018), 91–96. <https://doi.org/10.1016/j.jtrangeo.2018.11.009>.
- Nawaz, S., Ali, Y., 2020. Analyzing the influence of social, cultural, behavioral traits on cycling and walking in Pakistan. *Transp. Res. Interdiscip. Perspect.* 7, 100182. <https://doi.org/10.1016/j.trip.2020.100182>.
- Ng, A., Debnath, A.K., Heesch, K.C., 2017. Cyclist safety perceptions of cycling infrastructure at un-signalised intersections: Cross-sectional survey of Queensland cyclists. *J. Transp. Health* 6, 13–22. <https://doi.org/10.1016/j.jth.2017.03.001>.
- Nikitas, A., 2018. Understanding bike-sharing acceptability and expected usage patterns in the context of a small city novel to the concept: a story of ‘Greek Drama’. *Transport. Res. F: Traffic Psychol. Behav.* 56, 306–321. <https://doi.org/10.1016/j.trf.2018.04.022>.
- Nordlund, A.M., Garvill, J., 2003. Effects of values, problem awareness, and personal norm on willingness to reduce personal car use. *J. Environ. Psychol.* 23 (4), 339–347. [https://doi.org/10.1016/S0272-4944\(03\)00037-9](https://doi.org/10.1016/S0272-4944(03)00037-9).
- New Zealand Transport Agency. (2021). Understanding attitudes and perceptions of cycling & walking (Issue February). <https://www.nzta.govt.nz/assets/resources/understanding-attitudes-and-perceptions-of-cycling-and-walking/NZTA-Attitudes-to-cycling-and-walking-final-report-2019.pdf>.
- Ogilvie, F., Goodman, A., 2012. Inequalities in usage of a public bicycle sharing scheme: Socio-demographic predictors of uptake and usage of the London (UK) cycle hire scheme. *Prev. Med.* 55 (1), 40–45. <https://doi.org/10.1016/j.ypmed.2012.05.002>.
- Oosterhuis, H., 2016. Cycling, modernity and national culture. *Soc. Hist.* 41 (3), 233–248. <https://doi.org/10.1080/03071022.2016.1180897>.
- Ovenden, K. and J Allpress (2024). Perceptions of public transport, cycling and walking among Auckland drivers. Auckland Council technical report, TR2024/2.
- Piatkowski, D., Marshall, W., Afzalan, N., 2017. Can web-based community engagement inform equitable planning outcomes? A case study of bikesharing. *J. Urban.* 10 (3), 296–309. <https://doi.org/10.1080/17549175.2016.1254672>.
- Pistoll, C., Goodman, A., 2014. The link between socioeconomic position, access to cycling infrastructure and cycling participation rates: an ecological study in Melbourne, Australia. *J. Transport Health* 1 (4), 251–259. <https://doi.org/10.1016/j.jth.2014.09.011>.
- Pritchard, J.P., Tomasiello, D.B., Giannotti, M., Geurs, K., 2019. Potential impacts of bike-and-ride on job accessibility and spatial equity in São Paulo, Brazil. *Transp. Res. A Policy Pract.* 121 (January), 386–400. <https://doi.org/10.1016/j.tra.2019.01.022>.
- Pucher, J., Buehler, R., 2009. Cycling for a few or for everyone: the importance of social justice in cycling policy. *World Transport Policy Practice* 15 (1), 57–64.
- Qian, X., Niemeier, D., 2019. High impact prioritization of bikeshare program investment to improve disadvantaged communities’ access to jobs and essential services. *J. Transp. Geogr.* 76 (February), 52–70. <https://doi.org/10.1016/j.jtrangeo.2019.02.008>.
- Rebentisch, H., Wasfi, R., Piatkowski, D.P., Manaugh, K., 2019. Safe streets for all? analyzing Infrastructural response to pedestrian and cyclist crashes in New York City, 2009–2018. *Transp. Res. Res.* 2673 (2), 672–685. <https://doi.org/10.1177/0361198118821672>.
- Russell, M., Davies, C., Wild, K., Shaw, C., 2021. Pedalling towards equity: exploring women’s cycling in a New Zealand city. *J. Transport Geogr.* 91 (June 2020). <https://doi.org/10.1016/j.jtrangeo.2021.102987>.
- Schepers, P., de Geus, B., van Cauwenberg, J., Ampe, T., Engbers, C., 2020. The perception of bicycle crashes with and without motor vehicles: which crash types do older and middle-aged cyclists fear most? *Transport. Res. F: Traffic Psychol. Behav.* 71, 157–167. <https://doi.org/10.1016/j.trf.2020.03.021>.
- Schmassmann, A., Baehler, D., Rérat, P., 2023. The contrasted evolution of cycling during youth. Determinants of bicycle ownership and use. *Int. J. Sustain. Transp.* 18 (2), 103–114. <https://doi.org/10.1080/15568318.2023.2223139>.
- Schwartz, S.H., 2012. An overview of the schwartz theory of basic values. *Online Readings Psychol. Culture* 2 (1), 1–20. <https://doi.org/10.9707/2307-0919.1116>.
- Shaheen, S. A., Zhang, H., Martin, E., & Guzman, S. (2011). China’s Hangzhou Public Bicycle Understanding Early Adoption and Behavioral Response to Bikesharing. March 2010, 33–41. <https://doi.org/10.3141/2247-05>.
- Schwartz, S.H., 1992. Universals in the content and structure of values: theoretical advances and empirical tests in 20 countries. *Adv. Exp. Soc. Psychol.* 25, 1–65. [https://doi.org/10.1016/S0065-2601\(08\)60281-6](https://doi.org/10.1016/S0065-2601(08)60281-6).
- Shaw, C., Russell, M., 2017. Benchmarking cycling and walking in six New Zealand cities: pilot study 2015. *J. Transp. Health* 5. <https://doi.org/10.1016/j.jth.2017.05.349>.
- Shaw, C., Russell, M., Keall, M., MacBride-Stewart, S., Wild, K., Reeves, D., Bentley, R., Woodward, A., 2020. Beyond the bicycle: seeing the context of the gender gap in cycling. *J. Transp. Health* 18 (May), 100871. <https://doi.org/10.1016/j.jth.2020.100871>.
- Sherwin, H., Chatterjee, K., Jain, J., 2014. An exploration of the importance of social influence in the decision to start bicycling in England. *Transp. Res. A Policy Pract.* 68, 32–45. <https://doi.org/10.1016/j.tra.2014.05.001>.
- Steg, L., Vlek, C., 2009. Encouraging pro-environmental behaviour: an integrative review and research agenda. *J. Environ. Psychol.* 29 (3), 309–317. <https://doi.org/10.1016/j.jenvp.2008.10.004>.
- Steinbach, R., Green, J., Datta, J., Edwards, P., 2011. Cycling and the city: a case study of how gendered, ethnic and class identities can shape healthy transport choices. *Soc. Sci. Med.* 72 (7), 1123–1130. <https://doi.org/10.1016/j.socscimed.2011.01.033>.
- Tahir, L. (2023). Perceptions and barriers of immigrants towards cycling as a mode of transport in Malmo, Sweden.
- Tenenhaus, M., Vinzi, V.E., Chatelin, Y.-M., Lauro, C., 2005. PLS Path modeling. *Comput. Statistics Data Anal.* 48 (1), 159–205.
- Thorne, R., Wild, K., Woodward, A., Mackie, H., 2020. Cycling projects in low-income communities: Exploring community perceptions of Te Ara Mua – Future Streets. *New Zealand Geographer* 76 (3), 170–181. <https://doi.org/10.1111/nzg.12276>.
- Tompkins, K. J. (2017). “Are We Building Biking Solidarity”: Gendered, Racial, and Spatial Barriers to Bicycling in Portland, Oregon. (Doctoral Dissertation, Portland State University).
- Tucker, B., Manaugh, K., 2018. Bicycle equity in Brazil: Access to safe cycling routes across neighborhoods in Rio de Janeiro and Curitiba. *Int. J. Sustain. Transp.* 12 (1), 29–38. <https://doi.org/10.1080/15568318.2017.1324585>.
- Vallejo-Borda, J.A., Rosas-Satizábal, D., Rodríguez-Valencia, A., 2020. Do attitudes and perceptions help to explain cycling infrastructure quality of service? *Transp. Res. Part D: Transp. Environ.* 87 (September), 102539. <https://doi.org/10.1016/j.trd.2020.102539>.
- Wang, K., Akar, G., 2018. The perceptions of bicycling intersection safety by four types of bicyclists. *Transport. Res. F: Traffic Psychol. Behav.* 59, 67–80. <https://doi.org/10.1016/j.trf.2018.08.014>.
- Wetzels, M., Odekerken-Schröder, G., Van Oppen, C., 2009. Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration. *MIS Q.* 33 (1), 177–195.
- Winters, M., Fischer, J., Nelson, T., Fuller, D., Whitehurst, D.G.T., 2018. Equity in spatial access to bicycling infrastructure in mid-sized canadian cities. *Transp. Res. Res.* 2672 (36), 24–32. <https://doi.org/10.1177/0361198118791630>.
- Zhao, P., Zhang, Y., 2019. The effects of metro fare increase on transport equity: New evidence from Beijing. *Transport Policy* 74 (January 2018), 73–83. <https://doi.org/10.1016/j.tranpol.2018.11.009>.