Boat commuting, travel satisfaction and well-being: Empirical evidence from Greater London

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Abstract

Promoting well-being and contentment among daily commuters is pivotal for sustainable and thriving societies. This study investigates the reciprocal link between commuting satisfaction, overall life contentment, and personality traits, focusing on the unique and eco-friendly mode of boat commuting in particular. Using a combination of subjective survey data and objective physiological measures (resting heart rate (RHR) and facial emotions), this empirical study uncovers heightened commuting satisfaction among boat commuters compared to non-boat users. Employing analytical tools such as exploratory factor analysis (EFA), independent t-tests and ordinal logistic regression (OLR), the study elucidates the positive influence of boat commuting on life contentment and personality traits. While Spearman correlation tests did not establish significant links between low RHR, cheerful facial emotions, and commute satisfaction, the findings illuminate intricate connections between commuting mode and well-being. These insights hold relevance for shaping sustainable commuting strategies and policies, thus contributing to enhanced urban well-being and ecologically conscious transportation practices.

Keywords

Commuting by boat; travel mode choice; mental health; well-being; Greater London

1. Introduction

1.1 Research background

Citizens' well-being can be seen as one of the primary objectives of public policies (Bache and Reardon, 2016). Well-being, measured across various domains, often involves exploring individuals' mental states, and is commonly characterised as happiness research. In recent times, a growing number of researchers have investigated individuals' levels of satisfaction regarding various transport modes and uses. Conceptually, transportation can be perceived as a "social framework," encompassing regulations, physical facilities, and conduct (Reardon and Abdallah, 2013, p.637). For instance, within the realm of travel behaviour research, scholars have explored topics such as urban transport and social disparities (Cao and Hickman, 2019), well-being and mode switching (Abou-Zeid et al., 2012), residential relocation (De Vos et al., 2018), well-being among specific groups, such as older adults (Nordbakke and Schwanen, 2014), and even the associations between well-being and leisure trips (Friman et al., 2017a).

Daily travel enhances well-being and life satisfaction (Dinner et al., 1999; Ettema et al., 2010; Friman et al., 2017a; Sirgy et al., 2011). Recent empirical research (De Vos et al., 2019; Friman et al., 2017a; Olsson et al., 2020) highlights the importance of studying the relationship between travel satisfaction and life satisfaction in order to gain insights into factors influencing well-being. This has implications for urban planning and policymaking, including identifying happiness-inducing travel modes, understanding the trade-offs and synergies between travel and other life domains, and proposing interventions to enhance travel and life satisfaction. Moreover, even when using the same travel mode, individuals may differ in terms of how the positive and negative effects of specific travel experiences influence travel satisfaction, overall well-being and life satisfaction (Sirgy et al., 2011). That is to say, well-being outcomes also vary based on personality traits, which encompass creative thinking, productivity, interpersonal relationships, and resilience, among others (Gao et al., 2017). Personality traits such as optimism and self-esteem serve as crucial factors in measuring

well-being outcomes (e.g., see Danner et al., 2001).

Although the relationship between travel and well-being has been acknowledged in scholarly works by introducing mediating factors such as life satisfaction (e.g., Friman et al., 2017a; Li et al., 2022) and personality traits (e.g., Gao et al., 2017; Singleton, 2019), there is a scarcity of research specifically exploring commuting journeys (Chatterjee et al., 2019; Clark, 2020; Liu et al., 2022; Tao et al., 2023). Commuting, as an integral facet of daily life, significantly influences individual experiences, emotions and overall well-being (Clark et al., 2020). Commuters encounter both positive and negative situations during their journeys, which consciously or unconsciously affect the "external conditions" of quality of life, including job satisfaction, personal happiness, social interactions, and physical well-being. Understanding more about how different travel modes affect commuters' well-being is also crucial for urban planning and policymaking. One such mode is commuting by boat, involving the use of boats or ferries for transportation along waterways such as rivers or canals.

1.2 The status of boat commuting and motivation for the research

Commuting by boat, an environmentally friendly and unique mode of travel, offers specific well-being benefits. In recent times, there has been a growing interest in exploring alternative and sustainable travel modes to address challenges such as urban gridlock, environmental contamination, greenhouse gas emissions, and resource utilisation in city environments (Jain et al., 2020; Zavareh et al., 2020). Commuting by boat offers certain advantages over other travel modes, delivering a serene, socially engaging, and physically active experience that may mitigate mental health issues associated with longer commutes (Sandberg et al., 2023). It caters to a variety of individual preferences, providing flexibility and satisfaction in terms of travel time, reliability, and personal control, as well as enhancing job satisfaction, social life, and overall well-being by fostering positive experiences and emotions (Chatterjee et al., 2019). Hence, it is worth conducting an empirical investigation of boat commuting to offer comprehensive insights into the connection between this

transportation mode and well-being. While previous studies have examined the relationships between commuting and well-being, some research gaps remain.

Firstly, there is a scarcity of studies focusing on inland waterways transportation (IWT) as a catalyst for public transport (PT) usage. Despite recent investigations into passengers' attitudes towards water transit planning (Tanko et al., 2019) and water tourism as a leisure space (Kaaristo and Rhoden, 2017), minimal attention has been given to how boat commuting influences commuters' well-being. Boat commuting, as a form of IWT, represents an alternative or complementary PT mode, contributing to sustainable and eco-friendly travel. Despite research endeavours exploring connections between sustainable commuting modes and well-being, boat commuting has been given limited consideration, especially in cities such as London (the UK), Stockholm (Sweden), and Bangkok (Thailand) (Tanko et al., 2017).

Secondly, when exploring the ways in which well-being influences travel behaviour, previous studies have considered different variables, such as the connectivity of the public transport infrastructure and other modal characteristics relating to trip satisfaction (Chng et al., 2016). However, other relevant variables that also influence well-being, such as personality traits, life satisfaction and physiological characteristics (the degree to which individuals experience positive emotions and feelings of contentment, such as resting heart rates (RHR) and facial expressions), have not yet been explored jointly. For example, although Diener and Suh (1997) have produced evidence to suggest that personality traits could affect the level of contentment experienced during a journey, few scholars have included this variable when conducting travel behaviour research (Gao et al., 2017).

Thirdly, the appraisal of people's well-being is often referred to as 'a wicked problem' (Bache and Scott, 2017), because it involves several different measurements that are not easy to quantify. Although fields such as economic psychology (Kahneman and Deaton, 2010.) and social psychology (Diener et al., 2020) encompass dimensions such as the objective, subjective, hedonic, and eudaimonic aspects of well-being, in transport-

domain research, researchers tend to focus only on one or two aspects of well-being, and mainly rely on survey data: for example, Clark et al. (2020) investigated subjective well-being, while Liu et al. (2020) explored hedonic and eudaimonic well-being. In order to achieve a more rounded assessment of well-being, incorporating contrasting definitions of well-being into a survey and using physiological techniques (e.g., using Fitbit devices to measure RHR or cameras to capture facial emotions) (Dons et al., 2015; Minocha et al., 2018) could be beneficial.

Taking London as an example, this study thoroughly investigates the association between using boats for commuting and the well-being of individuals within the framework of London PT. More specifically, the study aims to investigate how commuting satisfaction, both by boat and other PT modes, is influenced by life satisfaction, mental and emotional states, personality traits, and physiological characteristics, by considering boat commuting as a unique and environmentally friendly mode of travel. This study makes three main contributions to the existing literature. Firstly, it focuses on commuting in London, highlighting boat commuting in particular, a topic that has previously received limited attention. By investigating this specific transportation mode, the study offers valuable insights that can be used to promote PT, and IWT especially, as sustainable alternatives for healthier and greener travel behaviour. Secondly, the research unravels the interplay between life satisfaction, personality traits, physiological characteristics, and well-being in the context of travel behaviour. It strives to bridge this gap by emphasising how life satisfaction and personality traits are interconnected, thereby enriching our understanding of the multifaceted factors influencing well-being within the realm of travel behaviour. Thirdly, the study encompasses a comprehensive range of definitions and domains pertaining to well-being, departing from the typical adoption of a *hedonic*, *eudaimonic*, or *subjective* well-being perspective. Beyond the traditional and *subjective* survey method, an innovative data collection approach, namely an *objective* physiological approach, is implemented to procure physiological data, thus enhancing the precision of the well-being outcome measurements.

The paper is organised as follows. It commences with a comprehensive review of the current research literature, highlighting the relationships between well-being and commuting journeys in Section 2. Section 3 illustrates the conceptual framework, while Section 4 outlines the data collection and research methods. Subsequently, Section 5 presents the outcomes derived from the principal analysis of the dataset, detailing the procedural stages, including exploratory factor analysis, independent t-tests, ordinal logistic regression, and Spearman tests employed in the analysis. Finally, Section 6 provides a summary of the main findings and a conclusion.

2. Literature review

2.1 Linking contrasting well-being definitions to commuting journeys

Well-being refers to people's feelings and functioning on an overall level, which includes satisfaction with their lives (APPG on well-being Economics, 2014). Appraising well-being in relation to public policy is not an easy task (Sandow et al., 2014), due to the fact that it is a growing area of research and a fluid notion that can be interpreted and defined in different ways (Schwanen and Ziegler, 2011; Dodge et al., 2012; Gärling et al., 2002). To exemplify, *objective* well-being (OWB) is intrinsically linked to fundamental human requisites, including aspects such as income, health, education, the calibre of the social and environmental milieu, safety and security, as well as the capacity to actualise social and civil entitlements (Reardon and Abdallah, 2013), including that of moving around freely. *Subjective* well-being (SWB) encompasses satisfaction with the overall life experience, spanning domains such as familial relationships, professional engagement, and leisure pursuits (Bergstad et al., 2011). Furthermore, well-being within the context of transportation can also manifest as the " fulfilment of human potential," as per the eudaimonic interpretation of the concept. This interpretation can be apprehended as an entirely internal subjective encounter for each

individual (Alatartseva and Barysheva, 2015).

Due to its multi-dimensionality, proposing a singular definition of well-being poses a significant challenge. Consequently, based on the various domains and definitions of well-being, researchers have attempted to use different approaches to define and appraise well-being: for instance, the Swedish Core Affect Scale (SCAS) is used to capture people's feelings in daily life in order to measure emotional or short-term well-being (Västfjäll et al., 2002). Concurrently, the utilisation of the Satisfaction with Life Scale (SWLS) (Pavot and Diener, 1993) and the Personal Well-Being Index (PWI) (Cummins et al., 2003) has been widespread for the quantification of contentment with life or enduring well-being. These measurements assess individuals' contentment across a range of factors, encompassing their living conditions, physical well-being, accomplishments, social ties, safety, community involvement, outlook on the future, overall life satisfaction, and personal happiness (Friman et al., 2017a). Table 1 illustrates the various measures employed in different fields to study well-being. For example, in the field of psychology, researchers have combined aspects of well-being in various theories and models. Diener et al. (2010) used both material prosperity (OWB) and psychosocial prosperity (SWB) to predict life satisfaction and positive feelings, and found that material prosperity was more strongly associated with life evaluation, while psychosocial prosperity was more strongly associated with positive feelings. Cummins (2000) proposed an interactive model comprising OWB and SWB, and argued that subjective quality of life is homeostatically maintained within a narrow range, and objective quality of life influences subjective quality of life through a feedback loop. Diener (2010) reviewed literature on subjective and objective well-being, and concluded that both dimensions are essential to achieve a complete understanding of human happiness.

Table 1. Measures of well-being used in different policy fields/domains.

Field/domain	Aim of well-being measurements	Findings according to measures of well-being	Study

Psychology	To identify the correlates of self-reported happiness	Happiness can be used as a measure of the overall evaluation of an individual's life	Wilson, 1967
	To delineate the comprehensive constructs that mirror an individual's subjective assessment of overall existence	SWB should concentrate on a holistic evaluation of all facets of an individual's life.	Diener, 1984
Public Health	To examine the links connecting physical and mental well-being	Mindfulness was demonstrated to enhance both physical well-being and psychological health.	Halliwell, 2009
Economics	To understand more about more about the correlated properties of well-being	Elevated levels of well-being exhibit an association with improved health status, enhanced occupational productivity, and enhanced performance within the market	Graham et al., 2004
	To understand more about the associations between well-being and job security	Job security is one of the most important job-related determinants of well-being, far exceeding the impact of salary.	European Social Survey, 2013
Community/ Place	To assess the strengths of and challenges faced by the local community	Measurement of well-being can be used to promote equality and sustainability'	Thriving places, 2020
Education	To learn more about children's health at school by looking at their emotional well-being	Nurturing children's emotional well-being must be a higher priority in education	Inchley et al., 2020

In contrast, research within the transport domain predominantly focuses on a specific aspect of well-being (e.g., SWB) as the primary outcome, employing self-report measures such as satisfaction, happiness, or affect, with which to assess it (Liu et al., 2020). While these methods have certain advantages, they also possess shortcomings, because they may not capture the full complexity and diversity of well-being, potentially influenced by biases and errors (MacLeod, 2015). Therefore, the challenge of measuring

commuters' well-being, and are levels necessitates careful consideration to ensure accurate results. Despite numerous efforts in recent years to determine the optimal approaches for analysing the correlation between travel and individual well-being (De Vos, 2018), no consensus has been reached on defining and measuring well-being accurately in order to promote initiatives for a healthier society. This requires the inclusion of more dimensions of well-being, such as its objective, subjective, hedonic, and eudaimonic aspects. Scrutiny should be on the various ways in which well-being intersects with the transportation domain (Nordbakke and Schwanen, 2014). To attain a holistic view, contrasting definitions and domains of well-being are considered, guided by the work of Brown et al. (2017) and Nordbakke and Schwanen (2015).

Initially, preceding investigations pertaining to comprehending the interrelations between daily travel conduct (e.g. commuting) and emotional well-being have primarily concentrated on restricted facets of travel behaviour, notably emphasising travel modes (Zhu and Fan, 2018), and even then, they have only evaluated some of the differences between commuters' experiences (Chng et al., 2016). The mode of travel used for daily commuting has the potential to significantly affect individuals' emotions, stress levels, and satisfaction, which in turn can affect their overall well-being (Lorenz, 2018). Even in studies that consider multiple interpretations of well-being in a transport context , commuting trips have only been partially explored (Chatterjee *et al*., 2019). Additionally, the advantages associated with active modes of transportation, like walking and cycling, in relation to the positive impacts they have on physical and mental well-being health., have been firmly established, and there is growing evidence demonstrating the detrimental impacts of non-active modes of commuting on health and well-being. However, the specific effects of public transport have not been widely explored (e.g. Ettema et al., 2015). In addition, promoting the usage of public transport may also benefit commuters' physical and mental health. Currently, London is facing an inactivity crisis (White, 2015) with over 40% of Londoners not achieving the recommended weekly 150 minutes of activity due to a widespread reliance on cars and technology in general (Transport for London, 2023). As of March 2016, the count of registered vehicles in London had reached 3.3 million (Rivas et al., 2017). Mitigating private car use

and bolstering the adoption of public transportation, through the enhancement of commuters' well-being throughout their work-related journeys, has the potential to profoundly metamorphose the city of London. This could lead to an improvement in the well-being of the urban area's inhabitants, workforce, and visitors alike. Lastly, although it has become more widely used in recent years, commuting by boat is still not officially regarded as a viable commuting option by most people, other than those living near to the piers.

2.2 Understanding the effect of well-being factors on commuting journeys

Travel satisfaction emerges as a pivotal component within the nexus of transportation and well-being. The existing literature elucidates the bifurcation of travel satisfaction into two distinct dimensions: the affective facet, encapsulating the emotional experiences during a journey; and the cognitive facet, encompassing the actual appraisal of the trip's merits (Ettema et al., 2011). Additionally, certain trip attributes exert influence upon travel satisfaction. For instance, lengthier travel distances tend to evoke adverse emotional responses among travellers, contributing to the propensity to evaluate trip quality and efficiency in unfavourable terms (Morris and Zhou, 2018). Moreover, travel satisfaction is amenable to the sway of travel-related attitudes. For instance, research indicates that harbouring positive attitudes towards a specific mode of travel can engender a favourable impact on travel satisfaction when the same mode is used (Ye and Titheridge, 2017). Hence, it is crucial to consider commuting satisfaction not just as an outcome of commuting attributes, inclinations, and choices, but rather as fundamental components in comprehending overall well-being and contentment linked to commuting experiences (De Vos et al., 2019).

The ensuing section offers a more intricate discourse on the broader construct of overall well-being and the factors entwined with travel satisfaction. Commuting exemplifies a kind of journey with distinct attributes, such as accessibility, booking procedures, cost, and travel duration, which enable engagement in activities to varying extents. These travel-related elements are generally addressed in studies that have used surveys or interviews to find out about participants’ perceptions of them. In the realm of travel satisfaction, a growing

inclination toward exploring the interrelation between travel and well-being has led to preceding investigations scrutinising individuals' contentment levels with distinct categories of journeys as well as overall travel experiences (e.g., Ettema et al., 2011). For instance, increasing travel distances and poor quality of travel experienced via different types of public transport modes have been shown to negatively influence commuters' happiness (Mahoney, 2015).

As previously indicated, travel satisfaction has the potential to contribute to an individual's well-being (Friman et al., 2017b). However, some investigations have approached the subject from a converse standpoint, delving into how well-being can influence individuals' travel experiences, as evidenced by studies such as that by Gao et al. (2017). It is posited that the capability to engage in travel facilitates individuals' participation in activities that play an instrumental role in attaining significant life goals, thereby enhancing their overall life satisfaction (Ettema et al., 2010). Life satisfaction, defined as a cognitive judgement and general evaluation of an individual's life, can be both impacted by specific living conditions (e.g., employment and health) (Helliwell, 2006) and daily activities (De Vos, 2019), and in turn, certain aspects of life satisfaction can also affect levels of travel satisfaction (Headey et al., 1991). In this case, life satisfaction can be used as measure of well-being (Friman et al., 2017), thus precipitating a shift in focus from exploring how travel satisfaction is influenced by well-being, to examining how travel satisfaction can affect life satisfaction. Given that life satisfaction functions like a metric of well-being (Friman et al., 2017b), an exploration of the way in which well-being influences travel experiences, inevitably prompts an inquiry into the reciprocal influence of life satisfaction on overall well-being. However, although understanding of how life satisfaction influences domain satisfaction has been a pertinent topic for several decades, knowledge about the relationship between well-being and travel satisfaction has only recently accrued, as the study of travel satisfaction has appeared on the agenda of travel behaviour researchers (Gao et al., 2017). Currently, there is a gap in terms of research that simultaneously assesses the reciprocal effects of life satisfaction on travel satisfaction, particularly within the realm of transportation (Ettema and Schekkerman, 2016). Therefore, the current study investigates the

connection between commuting contentment and overall life satisfaction in the daily journeys of individuals.

In addition, personality traits may also influence the degree of travel satisfaction and life satisfaction experienced, but have been largely ignored in studies of travel satisfaction (Gao et al., 2017). Personality traits refer to the reliability and validity of determining how optimistic/pessimistic an individual could be. The substantial impact of personality stands as one of the most consistent and remarkable revelations in the realm of subjective well-being exploration (Sandvik et al., 1993). Nevertheless, studies concerning travel satisfaction have predominantly sidestepped the role of personality traits. To gain deeper insights into passengers' personality traits, the Revised Life Orientation Test (LOT-R) can be employed. The notion of life orientation, introduced by Scheier and Carver (1985), represents a conventional psychological instrument employed to gauge an individual's inherent levels of optimism. In either case, well-being is evaluated through the assessment of a person's life contentment (referred to as 'life satisfaction') and their emotional well-being (referred to as 'travel satisfaction'). It emphasises that the latter aspect, both directly and indirectly, exerts an impact on the former (Friman et al., 2017a). Therefore, when investigating the links between commuting and well-being, it becomes essential to consider how overall life satisfaction and personality traits influence commuting satisfaction.

Beyond life satisfaction and personality traits, physiological data can also provide insights into the degree to which individuals experience positive emotions and feelings of contentment (Diener, 1984), and can be assessed by an individual’s physiological characteristics, such as resting heart rate (RHR) and facial emotions. RHR is the number of times a person’s heart beats or squeezes in the absence of exertion (Dons et al., 2015). In adults, a typical heart rate at rest usually falls between 60 and 100 beats per minute. Generally, a lower heart rate at rest signifies improved heart efficiency and enhanced cardiovascular fitness. Affective traits are enduring aspects of personality that indicate how individuals typically experience and convey emotions. By contrast, affective states are temporary shifts in mood or emotion that arise from significant circumstances. Facial emotions represent outward displays of emotions, which can be influenced by both affective traits and

affective states. In well-being studies, physiological data, such as facial emotions analysis, has been utilised in leisure contexts (González-Rodríguez et al., 2020) and other fields, but its application in the transport sector has not been widespread.

2.3 Exploring well-being outcomes through subjective and objective measurements

Traditional methods of measuring well-being outcomes include self-report surveys (Liu et al., 2021), polls and interviews (Mokhtarian, 2019). These methods based on individuals' opinions, have been favoured because contemporary views of well-being are often subjective (Dodge et al., 2012). During the process of data collection, conventional studies have employed subjective measurements to gain insight into the interactions between transportation and individual well-being. For instance, Abreu et al. (2018) employed a stated preference survey to examine how transport demand influenced commuting mode selection within Lisbon. Their findings revealed that enhancing public transport services constitute the most efficacious approach for fostering their adoption. Although stated preference surveys are widely used to capture individuals' levels of well-being and satisfaction, similarly to other approaches used in isolation, self-report methods have numerous constraints in terms of their effectiveness (Shephard, 2003).

Hence, advocating for the utilisation of *objective* travel behaviour data has been a common recommendation to enhance the precision and accuracy of outcomes. More recently, physiological techniques, such as the use of Fitbit devices to measure RHR or cameras to capture facial emotions (Dons et al., 2015; Minocha et al., 2018), have begun to be used as well, to compensate for the bias associated with self-report measures. Although these have not been frequently used for well-being assessment, recent advances in physiological measurement technologies have meant that they now have potential as alternative means of assessing emotions. As an example, the Physical Activity through Sustainable Transport Approaches (PASTA) project, utilising global physical activity questionnaires, assessed public transport users' biological responses

(including pulse rate and breathing) to shed light on the biological reactions associated with the travel experience (Dons et al., 2015).

RHR is the count of a person's heartbeats or contractions without physical activity (Dons et al., 2015). It serves as an indicator of moderate- to severe-intensity activity and can reflect individuals' emotions, such as fear, during travel (Farrington, 2007). Facial expressions are among the emotional characteristics, representing enduring aspects of personality and emotion. These features encompass acute, intense, and typically short-term psychophysiological changes triggered by meaningful conditions in the human environment, such as reactions during commuting to and from work. The inclusion of facial expressions, linked to specific emotions, constitutes a pivotal aspect in the examination of human mood in the context of transport (Ekman and Friesen, 1971). In fact, travellers' moods can also be assessed through 'selfies', thus providing additional insights into commuters' stress levels. According to Ko (2018), visual expressions serve as a crucial data channel in interpersonal communications, suggesting that these images can be employed for facial emotion recognition (FER). Despite this potential, there is a notable scarcity of observational studies investigating the differences in physiological characteristics and commuting satisfaction among passengers using various daily transportation modes (Javadian, 2014).

RHR data can be obtained from Fitbit, and facial images can be captured using mobile phone 'selfies'. Regarding facial images, facial expressions are not universally consistent due to cultural and ethnic differences. Therefore, research involving training data for facial emotion recognition (FER) appears to be more compelling. This process involves machine learning and the analysis of extensive datasets using neural network-based models, such as deep convolutional networks. Notable achievements in this field include the CIFAR-10 dataset (collection of 60,000 colour images, often used for facial emotion recognition), the ImageNet LSVRC-2010 contest (containing 1,000 categories of detected objects, such as facial images), and a neural network with the ability to recognise race, age, and gender (Ko, 2018). As this study revolves around the classification of emotions, the aforementioned deep architectures are applied. Utilising the OpenCV face

recognition program (Correa et al., 2022), the collected data can be trained for the neural network, and therefore, for FER.

3. Conceptual framework

This research strives to bridge the research gap by emphasising how life satisfaction and personality traits are interconnected, thereby enriching our understanding of the multifaceted factors influencing well-being within the realm of travel behaviour. Beginning with a comparison of boat and non-boat commuters, the research investigates commuting satisfaction levels, specifically in relation to the unique and environmentally friendly mode of boat commuting. The study employs a dual approach, combining *subjective* survey measurements with *objective* physiological assessments, namely, resting heart rate (RHR) and facial emotion recognition (FER). By triangulating findings from these diverse sources, the research seeks to provide comprehensive insights into the impact of life satisfaction, personality traits and physiological data (e.g., RHR and FER) on commuting satisfaction. This innovative approach positions the study at the forefront of unravelling the intricate dynamics of commuter well-being and travel behaviour, contributing significantly to the fields of transportation, psychology, and urban sustainability research.

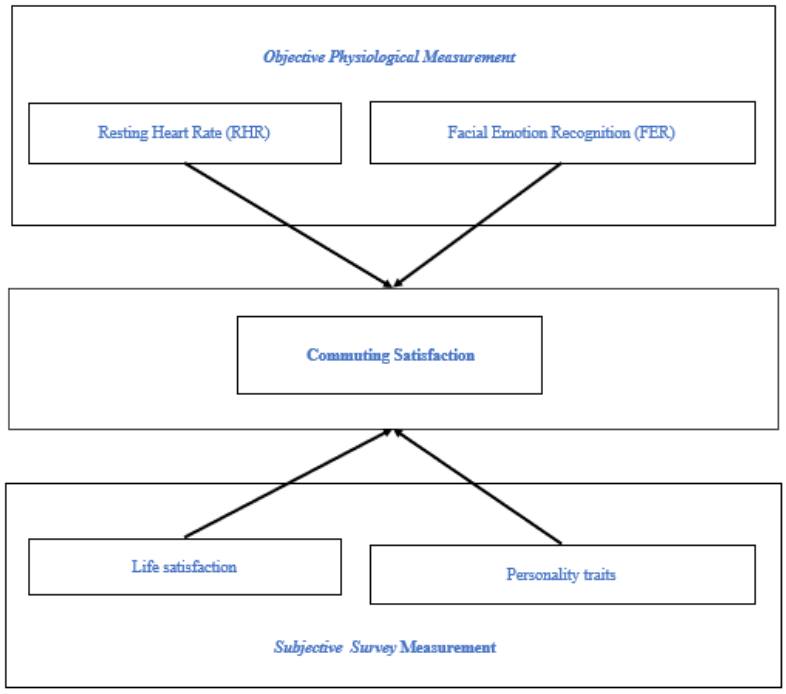

Fig 1. Conceptual Framework

4. Case study and methods

4.1 Case study context

The study takes London as an example. Covering an area of 1,572 square kilometres, London has over 8 million residents. As reported by Transport for London (TfL) in 2017, though London's transport system is recognised for its complexity and overall development, commuters encounter persistent challenges and dissatisfaction with their travel experiences. This is attributed to issues such as congestion, safety concerns, and pollution, highlighting areas that require attention in order to enhance efficiency and overall satisfaction. Statistics from TfL in 2017 revealed that approximately 20% of trips are made for commuting purposes, 10% of trips are for education, and 8% of journeys are due to personal business. Additionally, people working in London have the longest average commuting time from home to work (i.e., commuting one-way without any

detours) in the UK, of approximately 40 minutes each way, almost twice the worldwide average of 20 minutes, and longer than many major cities in Europe, such as Berlin (30 minutes), Paris (34 minutes), and Madrid (35 minutes).

In 2017, trips undertaken by public transport (PT) constituted 45% of the total journeys made in London, while journeys made by private means accounted for 32%. It is therefore essential to enhance PT use by improving PT experiences to achieve a greener and healthier city (London Transport Strategy, 2022). To this end, TfL serves as the governing entity overseeing the transportation network in the broader expanse of London, exercising authority over the London Underground and bus services, as well as the Docklands Light Railway (DLR) - a technologically advanced urban transit system. In addition, Southern Railway, a British train operating company, primarily operates trains, while Thames Clippers manages boats, providing commuters with diverse transit options. London's extensive network of rivers, canals, and other bodies of water provides an environment conducive to the development of boat commuting routes. Commuters in London now have the option to utilise boats or ferries to travel to their place of work, effectively bypassing traffic congestion and other problems associated with PT. This mode of commuting not only offers a practical solution to the problem of traffic congestion, but also provides a more serene and pleasant travel experience than other methods of transport.

The river Thames flows through London, and Uber Boat, in collaboration with Thames Clippers, is the primary operator of boat commuting services in the city. As illustrated in Figure 2, the route begins at Bankside Riverside Pier and concludes at Putney, employing high-speed catamarans that serve 24 piers across the city, with departures occurring every 10-20 minutes during peak times. This area possesses a comprehensive and well-established transportation network, encompassing both private and public services. Boat commuting provides a comfortable and flexible means of traversing London, offering a serene, socially engaging, and physically active experience. Furthermore, it promotes environmental sustainability by reducing

carbon emissions and noise pollution.

Subjective data were gathered from a random sample of London commuters, with a primary focus on individuals utilising the five modes of public transport: boat, DLR, train, bus, and Tube. Additionally, three private modes of transport were also considered, namely, car (driver or passenger), walking, and cycling. *Objective* data, comprising RHR monitored through Fitbit, and facial expressions captured via mobile phone cameras in the form of 'selfies,' were collected specifically in relation to PT modes.

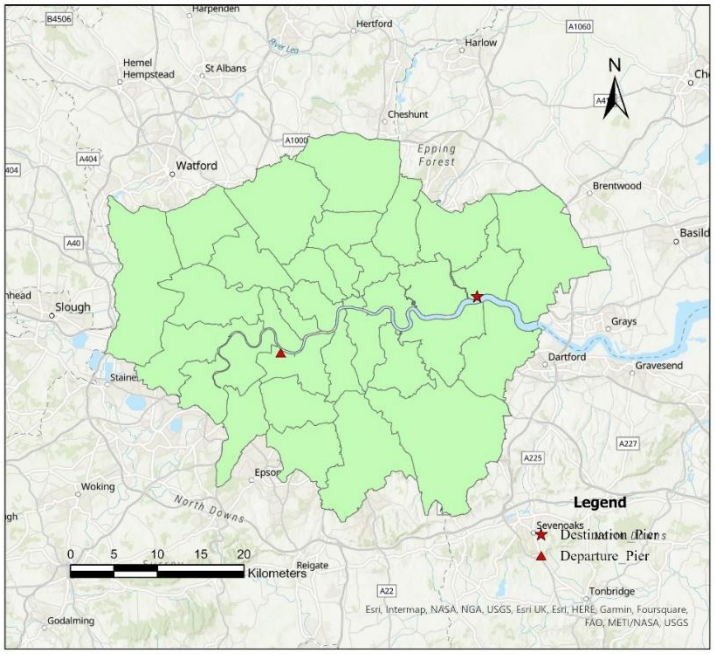

Fig 2. Case study map

4.2 Subjective survey and objective physiological data

A survey constituted the *subjective* measurement tool in this study. It contained questions on socio-demographics, commuting satisfaction and habits, personality traits and life satisfaction, and was administered

in person, in June 2019, among London commuters who use the 8 commuting modes. The selection of respondents was conducted using a straightforward random sampling method (Saunders and Lewis, 2017). Table 2 presents a statistical overview of the dataset. After data cleaning, a total of 1,027 valid survey data were obtained. Since the study specifically compares boat and non-boat commuters' experiences of public transport, the survey data excluded individuals commuting by bicycle (n=39), walking (n=113), and car (n=92). Therefore, the final dataset comprised 784 observations. The main reason for including as many transport modes as possible is to make the collected data comparable to real-world situations. For instance, according to the Department for Transport (2022), the proportion of people commuting on foot in London was 11%, while those commuting by bus accounted for 6% of the total, and the proportion of commuters who cycled to work was 4%, which is similar to the percentages for the collected data (11%, 14.1% and 3.8%, respectively). This proves that the collected data is representative of the population as a whole.

Table 2. Statistical Overview of the Dataset (n=1,027).

Individual characteristics		Observations	Percentage
Gender	Male	456	44.4%
	Female	571	55.6%
Age	18-24	377	36.7%
	25-34	380	37.0%
	35-54	211	20.5%
	55-64	41	4.0%
	Over 65	18	1.8%
Educational level	College or lower	239	23.3%
	Undergraduate level	371	36.1%

	Postgraduate level	350	34.1%
	PhD level	67	6.5%
Employment status	Full-time employment	522	50.8%
	Part-time employment	108	10.5%
	Unemployed	25	2.4%
	Student	262	25.5%
	Retired	31	3.0%
	Self-employed	79	7.7%
Number of children in the family	0	798	77.7%
	1	115	11.2%
	2 or above	114	11.1%
Main commuting modes	Boat	112	10.9%
	DLR	104	10.1%
	Train	176	17.1%
	Tube	246	24.0%
	Bus	145	14.1%
	Bicycle	39	3.8%
	Walking	113	11.0%
	Car	92	9.0%

As detailed in Section 4.1, the *objective* measurements used to collect data on commuting satisfaction were RHR and FER. When completing the face-to-face *subjective* surveys, PT commuter participants were

asked about their willingness to take part in the process of data collection for the objective measurements. After obtaining their consent, a Fitbit was provided to each participant as an incentive. To complete this process, participants were required to maintain a travel diary over three days, documenting their PT commuting experiences to and from work or school. A pre-experiment survey assessed participants' happiness levels before the data collection. Throughout the three days, participants recorded their highest and lowest heart rates during their commutes using the Fitbit. Similarly, participants captured self-images during their commutes over the three-day period. While 21 participants initially agreed to participate, only 15 participants submitted their data. After data cleaning, only 45 RHR data points were obtained, and the facial image data were also reduced to 45 to align with the RHR data.

4.3 Methods

This study promotes the use of PT, focusing specifically on boat commuting, by comparing travel behaviour and well-being levels in relation to different modes of travel, using exploratory factor analysis (EFA) and independent t-tests. The study also explores the mutual connection between commuting contentment and overall well-being, particularly in relation to contentment across diverse life domains (e.g., personality traits and life satisfaction), quantified through an ordinal logistic regression (OLR) analysis. The correlations between well-being and physiological data, i.e., RHR and FER, were also appraised using the Spearman correlation approach.

For the *subjective* survey, a set of items was decided upon to measure commuting satisfaction with different commuting modes, life satisfaction, and personality traits. Participants assessed each item using a 7-level Likert scale, starting at 1 (reflecting minimal happiness/satisfaction) and finishing at 7 (reflecting maximal happiness/satisfaction). Subsequently, EFA was employed to evaluate the reliability and validity of commuting satisfaction levels among public transport users. The EFA method possesses substantial data reduction capabilities and facilitates the creation of composite variables. Therefore, via the EFA, it was

possible to establish the relationships between a large list of indicators of travel satisfaction, rated by commuters who use public transport, and select significant variables from the data. To achieve this, a principal component analysis (PCA) employing Varimax rotation was conducted on the chosen set comprising 12 travel satisfaction variables. To examine the possibility that there is a difference in satisfaction levels between boat users and users of other forms of public transport, travel satisfaction was compared between frequent boat travellers and non-boat users (e.g., DLR, train, bus and Tube). Independent t-tests were conducted to determine the statistical importance of variances between these distinct groups.

To comprehend the relationships between the dependent variable of commuting satisfaction and the independent variables of life satisfaction and personality traits, an OLR analysis was run. This analysis aimed to estimate the influence of each variable's magnitude (Eboli and Mazzulla, 2009). OLR models are used to analyse the impacts of a set of predictors, whether they are represented numerically or categorically, on the logarithm of the odds that the dependent variable assumes lower values rather than higher ones (Cainarca and Sgobbi, 2005). When the dependent variable takes on J distinct values in an ordinal fashion, its relationship with the predictors X_k can be formulated using the following equation:

$$Logit\ P_i = ln\ \left[\frac{p(X)}{1-p(X)}\right] = \alpha_j + \sum_{k=1}^{K} \beta_k X_k = \alpha + X\beta \qquad (1)$$

For values of J varying from 1 to J-1, the parameter α_j corresponds to intercepts. These α_j values indicate the likelihood of the dependent variable Y assuming lower values instead of higher ones when all independent variables are absent. Meanwhile, β_k represents the logarithm of the odds that changes with a one-unit increase in the independent variables X_k. Positive β_k coefficients indicate heightened probabilities of the dependent variable assuming higher values, and conversely, negative coefficients suggest the opposite (Eboli and Mazzulla, 2009a). The Partial Order Model (POM) is optimally suited to handle dependent variables whose ordinal nature can be perceived as rooted in a latent and potentially unobservable continuous dimension

(Eboli and Mazzulla, 2009a). However, for the present study, the preference leaned towards employing an OLR over the POM model.

A Spearman test was undertaken to assess the correlations between commuting satisfaction, RHR and FER. Regarding RHR, mean values were obtained from each participant's highest and lowest heart rate reading. In the case of FER, a convolutional neural network (CNN) was used to classify emotions using 7 dimensions: neutral, happy, surprise, fear, disgust, sad and angry. This is known as a dimensionality reduction technique which makes it to easier to visualise the dataset (Joe and Joe, 2019), to enhance the comprehension of connections between the aforementioned factors (commuting satisfaction, RHR, and the 7 dimensions of FER).

5. Findings and discussion

5.1 Boat users' higher levels of reported happiness

Addressing the first research gap is intended to encourage the use of IWT as a favoured PT mode, and thus, we assumed that boat and non-boat commuters would rate their levels of commuting satisfaction differently. Indexes of commuting satisfaction were clustered. Table 3 shows the resulting three indexes of the EF. Index 1 gives an indication of commuters' basic needs, including their satisfaction with safety, the booking system(s), ease of access to the method of transport and commuting time. Index 2 relates to commuters' general perceptions of their commute, such as their satisfaction with London Transport management, individuals' most recent commuting experiences, and their perspectives on the commuting method's efficacy as a transitional bridge between home and work were assessed. Index 3 relates to the commuting experience, including satisfaction with the user-friendliness of the environment, on-board service, recreational facilities, whether the journey inspired new ideas/insights/solutions and eco-friendly features.

Table 3. Results of the exploratory factor analysis

Index 1: Basic needs	Index 2: General perceptions	Index 3: Commuting experience
• Safety and security • Booking • Access • Commuting time	• London Transport management • Satisfaction with their last commute • Whether the commute facilitates a meaningful shift from one's residence to the workplace	• User-friendly environment • On-board service • Recreational aspects • Whether the journey inspired new ideas/insights/solutions • Eco-friendly features

Drawing from the three commuting satisfaction indices, independent t-tests were conducted to discern variations in perceptions between individuals who commute via boats and those who do not. Promoting the use of PT has become a political priority (Ettema et al., 2010), and, in particular, the development of IWT (Tanko and Burke, 2017). As shown in Table 4, both sets of users show high levels of satisfaction under Index 1 (basic needs). However, individuals who engage in regular boat travel displayed notably elevated levels of satisfaction concerning Index 3 characteristics (potential desires) (M=5.760, SD=0.963) in comparison to those who do not use boats for commuting (M=4.153, SD=1.173). Prior research has examined aspects of commuting by boat, such as its carbon footprint (e.g., Jonkeren et al., 2011), perceived comfort, and well-being (e.g., Márquez et al., 2014). However, the domain of travel satisfaction with regard to boat commuting has not been extensively explored in the literature until now. The findings indicated that commuters who opt for boat travel reported higher satisfaction levels across the dimensions of the three measures of travel satisfaction compared to non-boat users. This difference in the satisfaction ratings could be explained by the fact that travelling by boat is simply more enjoyable. The findings of our study showed that people who commute by boat rated the variables relating to well-being more favourably than non-boat users.

Table 4. Results of independent t-tests

	Boat users		Non-boat users		Mean differences	p
	M	SD	M	SD		
Index 1	6.020	0.785	5.351	0.989	0.669	0.000***
Index 2	5.607	0.952	5.093	1.225	0.514	0.001***
Index 3	5.760	0.963	4.153	1.173	1.607	0.001***

Standard errors in parentheses. *** p<0.01，** p<0.05，* p<0.1

5.2 How satisfaction with commuting changes when mediated by life satisfaction and personality traits

The second research gap aims to investigate how external variables relating to well-being (e.g., life satisfaction and personality traits) affect commuting satisfaction. We conducted an ordinal logistic regression (OLR) analysis to assess this. OLR was chosen due to its capability to model ordinal dependent variables, such as Likert scale variables, by examining the associations between overall satisfaction with commuting and several independent variables, including life satisfaction and personality traits. The OLR model used median values of different commuting satisfaction variables to create the dependent variable - overall commuting satisfaction. There were two levels within this variable: 'satisfied with the commuting journey'; and 'dissatisfied with the commuting journey'. The independent variables comprised life satisfaction and personality traits, as shown in Table 5. As previously mentioned, each of these variables was assessed on an ordinal scale using numerical codes from 1 to 7, where 1 signifies the lowest level of satisfaction/happiness and 7 signifies the highest level of satisfaction/happiness. The five life satisfaction variables were: *In general,*

I feel safe (*Objective* and *short-term* well-being), *I am in good health* (*Objective* well-being), *I lead a purposeful and meaningful life* (*Eudamionic* well-being), *I am satisfied with my current financial situation and living conditions* (*Eudamionic* well-being), *I felt positive and happy during the last two weeks* (*Subjective* and *short-term* well-being) and *I am optimistic about my future* (*Eudamionic* well-being).

Table 5. Independent external well-being variables selected for the OLR model.

Domains	Variables	Wellbeing definitions/ intentions of measurements
Life satisfaction	In general, I feel safe	Objective wellbeing
	I am in good health	Objective wellbeing
	I lead a purposeful and meaningful life	Eudaimonic wellbeing
	My social relationships (family, friends, etc.) are supportive and rewarding	Hedonic wellbeing
	I am satisfied with my current financial situation and living conditions	Hedonic wellbeing
	I felt positive and happy during the last two weeks	Short-term and subjective wellbeing
Personality traits	I am optimistic about my future	Optimism
	I do not get upset and anxious too easily	Optimism
	It is easy for me to relax	Optimism
	It is important for me to keep busy	Daily activity
	It is easy for me to be calm and emotionally stable	Cognitive ability

I expect more good things to happen to me than bad things	Optimism

This section discusses the model fit, indicating its statistical significance with P (Sig.) < 0.001. Goodness-of-fit is assessed using Chi-square and deviance statistics to evaluate disparities between observed and expected values. R_2 values are provided to show the proportion of variability explained by the explanatory variables, but it should be noted that these values are not definitive indicators. The parallel lines test was used to examine the appropriateness of the OLR model. The statistically significant parallelism assumption ($p > 0.05$) resulted in the acceptance of the null hypothesis, suggesting that the dependent variable changes linearly with the predictors, and affirming the idea that commuting satisfaction is influenced by life satisfaction and personality traits.

Table 6 provides information about the model fit, including, Goodness-of-Fit, the Parallel Lines Test, and the Pseudo R-Square values. Firstly, it shows information about the model fit, highlighting that the null hypothesis assumed all the predictor coefficients were zero. However, with P (Sig.) < 0.001, at least one coefficient emerged as statistically significant. Subsequently, the table displays information regarding the goodness-of-fit assessment, which was carried out utilising Pearson's Chi-square and deviance statistics. These metrics facilitate the evaluation of disparities between observed and expected model values, thereby determining the model's conformity to the data. The premise is that if $p > 0.05$, the null hypothesis is supported, suggesting a well-fitting model. The R^2 values are also included, elucidating the proportion of variability in the outcome explained by the explanatory variables. However, it is important to note that these values are not definitive indicators. Furthermore, the table shows details of the parallel lines test, designed to gauge the appropriateness of the OLR model. The null hypothesis posits uniform predictor coefficients across all levels of the dependent variable, when tested using Chi-square analysis. A statistically significant parallelism assumption ($p > 0.05$) results in the null hypothesis being accepted. This signifies a linear

relationship between the dependent variable and the predictors across all categories. Consequently, the null hypothesis that commuting satisfaction is influenced by life satisfaction and personality traits was accepted.

Table 6. Model fit assessment

Model Fit Information					**Goodness-of-Fit**			
Model	-2 Log Likelihood	Chi-Square	df	Sig.		Chi-Square	df	Sig.
Intercept Only	2397.806				Pearson	3498.767	4625	1
Final	2199.636	198.169	7	0	Deviance	2042.988	4625	1
Test of Parallel Lines[a]					**Pseudo R- Square**			
Model	-2 Log Likelihood	Chi-Square	df	Sig.	Cox and Snell	0.175		
Null Hypothesis	2199.636				Nagelkerke	0.188		
General	2133.776[b]	65.860[c]	35	0.001	McFadden	0.071		

The null hypothesis posits that the location parameters (slope coefficients) remain consistent across response categories.

a. Employing the Logit link function.

b. The log-likelihood value attains its highest point, with no further increase achievable even after employing the maximum number of step-halving steps.

c. The Chi-Square statistic was calculated using the log-likelihood value from the final step of the model. However, the reliability of the test remains ambiguous.

The regression results are shown in Table 7. In this model, the overarching variable of interest is overall commuting satisfaction, carefully delineated as the dependent variable. The analytical landscape is broadened by the inclusion of seven independent variables, meticulously curated to encapsulate six facets of the life satisfaction category and an additional facet emanating from personality traits. Scrutinising the interplay between these variables yielded compelling insights, revealing a noteworthy positive nexus between commuting contentment and both life satisfaction and personality traits. In Section 4, equation (1) embodies the essence of our estimations, echoing the logit function's narrative and revealing a significant positive connection between commuting contentment, life satisfaction, and personality traits. Equation (2) is listed below.

$$Logit\ P_i = ln\ \left[\frac{p(X)}{1-p(X)}\right] = \alpha_k + \beta^T X_i,\ k = 1, \dots, K-1 \qquad (2)$$

Where $\alpha_1 = -2.336, \alpha_2 = 0.376, \alpha_3 = 2.447, \alpha_4 = 3.983, \alpha_5 = 6.542,\ \alpha_6 = 8.467$ are the values of the six intercepts α_k, and $\beta = [0.335, 0.092, 0.048, 0.117, 0.080, 0.073, 0.165]^T$ is the vector of coefficients for the predictors.

From the results, it is evident that *objective* well-being, encompassing feelings of safety, good health, and satisfaction with one's financial situation and living conditions, exerts a positive influence on commuting satisfaction. These findings resonate with previous studies such as those conducted by Bergstad et al. (2011) and De Vos (2013). Notably, the feeling of safety emerges as a paramount factor whereas satisfaction with one's financial situation and living conditions are less crucial. The prominence of feeling safe can be attributed to the distinctive nature of transportation as a derived demand, compelling individuals to move between locations (Chen et al., 2015). Consequently, people prioritise their safety when navigating the complexities of the real world.

Eudaimonic well-being, exemplified by leading a purposeful and meaningful life, and *short-term* well-being, indicated by experiencing positive and happy feelings in the last two weeks, also exert a considerable influence on commuting satisfaction. These findings align with studies such as that by Mokhtarian (2019). It is worth bearing in mind that future research avenues could delve more deeply into investigating how eudaimonic components of well-being shape travel satisfaction, a domain that has been explored in fields such as tourism (Al-okaily et al., 2023) but remains relatively under-researched in the transport sector.

Surprisingly, short-term well-being demonstrates a modest impact on commuting satisfaction. This phenomenon can be attributed to commuters perceiving commuting activities as part of their daily routine or work, leading them to adopt a more neutral stance when evaluating their satisfaction levels. By contrast,

optimistic commuters, characterised by optimism about the future and ease of relaxation, tend to exhibit higher levels of commuting satisfaction. This observation resonates with prior studies, such as the one conducted by Gao et al. (2017).

Table 7. Results of ordinal logistic regression

	Estimate	Sig.
[Commuting Satisfaction = 1]	-2.336	0.027
[Commuting Satisfaction = 2]	.376	0.388
[Commuting Satisfaction = 3]	2.447	0.000
[Commuting Satisfaction = 4]	3.983	0.000
[Commuting Satisfaction = 5]	6.542	0.000
[Commuting Satisfaction = 6]	8.467	0.000
In general, I feel safe	0.335	0.000
I am in good health	0.092	0.146
I lead a purposeful and meaningful life	0.048	0.459
I am satisfied with my current financial situation and living conditions	0.117	0.012
I felt positive and happy during the last two weeks	0.080	0.122
I am optimistic about my future	0.073	0.259
It is easy for me to relax	0.165	0.001

Likelihood-ratio= $x^2(7)$: 2199.636, p-value<0.01; R^2 Cox and Snell =0.175; R^2 Nagelkerke= 0.188; R^2 McFadden=0.071; Count R^2=65.860.

5.3 How commuting satisfaction changes when mediated by heart rate and emotions

The third research gap concerns the role played by the physiological data, obtained via an innovative data collection process, in measuring commuting satisfaction. Spearman correlation tests were used to assess the correlations between commuting satisfaction, RHR and FER (Bland & Altman, 2000). Firstly, we used the Spearman correlation to establish whether there was a linear correlation between commuting satisfaction and RHR. Through graphical representation of these variables, we discerned the presence of a non-linear relationship between them. Following this, we tested the positive and negative directions of interaction between the two variables.

In regard to the facial image data, prior to carrying out the Spearman correlation test, it was necessary for one variable to be monotonically correlated with the other. The monotonic correlation was found by testing the relationship between commuting satisfaction and the seven dimensions of facial emotions. Happy, Surprise, Fear, and Sad emerged as categories.

The outcomes of the Spearman correlation analysis are displayed in Table 8. This test was designed for application with recurring measures, and the 95% limits of agreement were adjusted accordingly (Bland & Altman, 2013). In addition, the absolute disparities showed that commuting satisfaction increases when the resting heart rate declines. In brief, in our study, within the range of 68 to 112, RHR has a negative correlation with commuting satisfaction. Accordingly, if the resting heart rate is low, commuters tend to be happier with their commuting experience.

Table 8. Results of the Spearman correlation tests regarding commuting satisfaction and RHR.

		Commuting Satisfaction
Resting Heart Rate	Pearson Correlation	-0.041
	Sig. (2-tailed)	0.8

As mentioned above, four categories of emotions remained. As is evident from Table 9, faces showing 'happiness', 'sadness', and 'fear' have positive interactions with commuting satisfaction, while being surprised has a negative interaction with commuting satisfaction. Counterintuitively, respondents who showed the emotions of sadness and fear still reported high levels of commuting satisfaction. This is likely to be because errors can occur in CNN in terms of differentiating the participants' emotions, partly because the facial emotions database that was used was a global one.

Table 9. Results of the Pearson correlation tests regarding commuting satisfaction and facial emotions.

		Commuting Satisfaction
Happy	Pearson Correlation	.080
	Sig. (2-tailed)	.685
Surprise	Pearson Correlation	-.021
	Sig. (2-tailed)	.916
Fear	Pearson Correlation	.045
	Sig. (2-tailed)	.819
Sad	Pearson Correlation	.028
	Sig. (2-tailed)	.888

6. Conclusions

This study explored how commuting influences well-being, with a focus on commuters who reside in

London, while considering contrasting definitions of well-being. It was found that boat commuters are happier than non-boat users. The analysis showed that there were significant differences in commuting satisfaction, personality traits and life satisfaction between commuters who used different modes of travel. The moderating effects of personality traits and life satisfaction on overall commuting satisfaction were also demonstrated.

This paper accentuates the advantages of public transport usage for both mental and physical well-being, thereby contributing to more sustainable transportation practices by reducing car dependence. This significance is particularly pertinent considering the detrimental environmental consequences linked with car usage. Furthermore, the research enriches the well-being discourse within a transport context by evaluating well-being metrics in relation to travel patterns. While environmental concerns have relevance, they might not be singularly effective in incentivising passengers to switch to public transport; enhancing service quality could potentially yield greater impact. Moreover, the study's novelty lies in its utilisation of physiological data—specifically, resting heart rate (RHR) and facial emotion recognition (FER)—as alternatives to conventional self-report measures of well-being. An additional noteworthy aspect of this research is the incorporation of personality traits, a facet often disregarded in travel behaviour inquiries. Their inclusion offers a more nuanced comprehension of well-being, thereby addressing existing measurement limitations.

This paper adds to the discourse on promoting the adoption of public transport, including innovative modes such as IWT. Urban linear ferry systems are gaining traction as a progressively favoured transportation option in cities worldwide (Tanko and Burke, 2017). In the case of London, which is situated on the river Thames, commuting by boat is gradually gaining in popularity among commuters who live close to the 23 piers across the city, although awareness of it remains much lower than that of road transport alternatives. The examination of boat commuting has predominantly been explored in existing literature with a focus on its environmental impact, notably its carbon footprint (Jonkeren et al., 2011), as well as factors such as comfort and safety (Márquez et al., 2014). Additionally, perceived quality, passenger age demographics, pricing,

accessibility of destinations from nearby ports, connectivity, onboard facilities, and scheduling have all been considered as aspects of relevance. In the aftermath of the 2017 London Bridge attack, there was a 5% surge in PT patronage, as numerous commuters transitioned from road transport to rail and river services. This trend underlines the promising potential of river commuting as a secure, convenient, and eco-friendly transportation alternative for London residents. Consequently, we recommend an augmented allocation of funding for the Thames River Service in the future, with the aim of facilitating network expansion, enhancing facilities, and promoting its advantages on a broader scale.

The study encourages the use of public transport, and IWT. Urban linear ferry systems are experiencing a growing popularity on a global scale. In London, although there is considerably less awareness of the option of commuting by boat along the river Thames than road-based alternatives, it offers a promising alternative. Evaluating commuting by boat in relation to criteria that extend beyond its carbon footprint to factors such as comfort, safety, quality, and connectivity, highlights its potential. Given the rise in public transport usage following significant events, increasing funding for Thames River services should be considered. Furthermore, the integration of physiological data collection methods into the assessment of well-being assessments adds an element of robustness to the research.

To promote the adoption of PT, and IWT in particular, increased investment in Thames River services is recommended. Embracing commuting by boat as a viable option is in keeping with the growing global trend for using urban linear ferry systems. Additionally, given the complexities involved in measuring well-being, the utilisation of physiological data collection methods can enhance the accuracy of the research results. Consequently, this approach offers a more holistic comprehension of commuters' well-being, imparting valuable insights that can inform policymaking and interventions designed to promote sustainable transportation choices.

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