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The effect of ease of travel on travel behaviour and perceived accessibility: A focus on travel to university campus

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ABSTRACT

Ease of Travel (EoT), referring to people's travel skills and motivations, and available travel options and quality can influence how people travel and how easily they can reach out-of-home activities. In this study, we explore the new concept of EoT and analyse its underlying structures using a sample of 2,593 students and staff members of University College London (UK). Subsequently, the determinants of EoT elements are examined, while we also analyse how EoT affects travel to campus and the perceived accessibility of the campus. Results suggest that EoT is effectively composed of the four elements motivation, skills, options and quality. These EoT elements are mainly affected by the residential location, travel disabilities, and the proximity of public transport and shared (e-)bikes. Finally, we found that EoT significantly impacts travel mode choice, travel distance and duration when travelling to campus, while positively affecting the perceived accessibility of the campus. Improving EoT levels, and making it easier for people to travel around, can result in shorter and more active trips and can also increase accessibility to out-of-home activities (improving people's well-being). This could be realised by creating more compact, mixed-use neighbourhoods with easy access to public transport and shared (e-)bikes.

1. Introduction

Motorised transport significantly contributes to air pollution and climate change, due to its greenhouse gas emissions. Additionally, it can result in stress, time loss, and increased chances of getting cardiovascular and respiratory diseases, as it produces noise pollution, congestion, and sedentary lifestyles (e.g., De Vos, 2024a; Gössling et al., 2018). Proposed solutions, such as electric vehicles may therefore only improve environmental sustainability, but not people's health and well-being levels (as part of social sustainability). Hence, it remains important to create a modal shift away from car use towards PT and especially active travel. Over the past decades, studies have indicated that travel mode choice is strongly influenced by the built environment (mainly by characteristics such as density and diversity), and people's travel attitudes and preferences (see, e.g., Cao et al., 2009). However, certain personal elements

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(such as necessary travel skills), and access and quality of the available transport options (such as frequent PT services) are often not included as determinants of travel behaviour. New insights into determinants of travel behaviour can help in creating more sustainable and healthy travel patterns.

Travel is generally a derived demand as people mostly travel to get access to out-of-home activities. People perform these activities to satisfy certain needs and/or actualise their potentials and achieve personal growth and progress to their goals (e.g., Abou-Zeid & Ben-Akiva, 2012; Spinney et al., 2009). However, certain transport disadvantages (e.g., not owning a car, no easy access to PT) or low levels of perceived accessibility can reduce activity participation, leading to social exclusion and low quality of life. Some studies have indicated that poor health and low income can increase transport disadvantage and social exclusion (Currie and Delbosc, 2010; Lucas, 2012), and that poor land use and transport knowledge, and poor quality of transport services, can reduce perceived accessibility levels (Friman et al., 2020; Pot et al., 2021). However, a comprehensive study of elements affecting activity participation and perceived accessibility is still lacking. In order to improve access to activities and people's well-being, it is important to analyse the determinants of perceived accessibility. Both travel behaviour and activity participation – having important impacts on environmental sustainability and people's quality of life – can be affected by how easily people can travel. This ease of travel (EoT), conceptualised by De Vos (2024b), indicates that travel motivation, travel skills, travel options, and travel quality influence travel behaviour and activity participation. Although concepts such as accessibility and perceived accessibility – analysing the ease of reaching destinations – can explain travel behaviour and activity participation to a certain extent, EoT may give additional insights due to its focus on travel itself (instead of destinations) and the incorporation of perceived travel abilities (instead of focusing on objectively-measured built environment characteristics). Additionally, EoT may be regarded as a predictor of (perceived) accessibility; the easier it is to travel, the easier it will be to reach destinations. In this study we will empirically explore the reliability of the EoT concept, analyse its determinants, and examine the effects on travel behaviour and activity participation. The four elements of EoT and how they can impact travel behaviour and activity participation are described in Section 1.1, while the potential impacts of EoT on travel behaviour and activity participation are described in Section 1.2.

1.1. Ease of travel

Ease of Travel (EoT) indicates how easily people can travel (in general or in relation to a specific travel mode) and consists of four elements: travel motivation, travel skills, travel options and travel quality. It differs from the commonly used (perceived) accessibility concept, which mainly focuses on activity destinations and (perceptions towards) built environment characteristics. EoT, on the other hand, focuses on travel and highlights personal abilities to travel (De Vos, 2024b). *Travel motivation* refers to people's needs and desires to travel. People can have different motivations to travel. For example, when traveling to work or to the supermarket, people are most likely travelling to satisfy certain needs (i.e., to earn an income or have access to food). In this case, the motivation to travel is externally regulated; people are travelling for a specific reward at the destination. Travel motivation can also be internally regulated, as people may value or even enjoy certain elements of travel, such as the physical activity provided by walking or cycling, or free time/time to relax when using public transport (PT) (e.g., Jain & Lyons, 2008; Mokhtarian et al., 2015). In certain cases, when travel motivation is truly intrinsic, people may even take detours or travel for the sake of it (when there is no destination or the destination is incidental to the trip) (Hook et al., 2022; Mokhtarian & Salomon, 2001). According to the self-determination theory (Ryan & Deci, 2000, 2020), people will more easily perform and keep performing a certain behaviour when they have an internal and therefore autonomously-driven motivation to behave in that way. Hence, an internal motivation to travel can make it easier for people to travel. Internal travel motivation is closely linked to attitudes towards travel. A person who perceives travel time as a waste of time will not be (autonomously) motivated to travel and may only do so when necessary (i.e., external motivation) (Ory & Mokhtarian, 2005). Some people who like a particular mode of transport but dislike other modes are probably only motivated to travel by that particular mode (Beirão & Cabral, 2007).

Travel skills can refer to physical skills, such as the skills needed to walk, ride a bicycle or drive a car (e.g., accelerating, braking, steering), but also mental skills to recognise obstacles and anticipate the movements of other road users. Travel also requires organisational skills, such as the ability to navigate to a destination, follow traffic rules, read and interpret traffic signs, understand PT timetables and network maps, and know how to buy PT tickets (e.g., Hamidi and Zhao, 2020; Kaufmann et al., 2004). People with mobility or visual impairments, limited navigation skills or limited knowledge of the road and/or PT network may therefore find it difficult to travel (e.g., Low et al., 2020; Park et al., 2023). Travel skills are strongly influenced by previous experiences since people acquire certain skills by repeatedly performing a certain behaviour (Flamm & Kaufmann, 2006). Someone who frequently uses PT in a particular city is likely to get to their destination more smoothly than a tourist who is unfamiliar with the city and its PT network, while an experienced car driver will probably navigate through traffic better than a learner driver. Besides (physical and mental) skills required to travel, people's perceptions of their skills play a role. An able-bodied, intelligent person who does not think that s/he can easily drive or cycle, for instance, will not be inclined to do so.

Travel options refer to the ability to use certain forms of transport. This may refer to private ownership of a particular mode of transport, such as a car, motorcycle or bicycle. The use of PT may only be a viable option if there are PT stops near the residential location. Walking and cycling, on the other hand, is only possible if destinations are accessible on foot or by bike and no barriers prevent active transport (e.g., destinations only accessible via heavy-traffic roads). People's residential location can play an important role in their travel options. In general, people living in compact, mixed-use areas have better access to PT (due to high frequency and good spatial coverage), more opportunities to walk or bike (due to shorter average distances), and better access to car/bike sharing and ride-hailing services compared to people living in suburban areas (e.g., Ewing & Cervero, 2010; Guo and He, 2020; Malik et al., 2021; Næss, 2012). On the other hand, the use of private cars may be constrained in urban neighbourhoods due to congestion, car-restricted

areas, and limited parking spaces. High-income households may have more travel options than low-income households because they can more easily afford a car and can live in (expensive) neighbourhoods with good PT services (Lucas, 2012). Additionally, it is also important how people act upon their available options, as a person with many travel options available may not perceive this as such and therefore may not travel frequently, while a person with only one mode available may still easily travel with that mode.

While travel options indicate whether it is possible to travel in a particular way, *travel quality* is more fine-grained and indicates the extent to which a particular way of travel is likely. In the case of car travel, travel quality refers primarily to fast flowing and unimpeded traffic, including elements such as low congestion and freeways/arterials that bypass residential areas (e.g., Ettema et al., 2013). The (perceived) quality of PT services is influenced by punctuality and frequency, the number of destinations that can be reached without transferring or destinations that can be reached within a certain period of time, but also by service factors such as cleanliness, comfort, waiting conditions and ease of transfers (de Oña et al., 2013; dell'Olio et al., 2011). The quality of walking and cycling can be influenced by the presence and quality of infrastructure, such as wide and well-lit sidewalks, protected bicycle lanes and safe crossings for active travellers (Handy et al., 2014; Winters et al., 2017). Short distances resulting from high density, diversity, and street connectivity can also improve journey quality, as long distances travelled on foot or by bicycle can be exhausting. The quality of travel can differ between urban and suburban areas. In suburban areas, the car may be more convenient due to less congestion, while the quality of PT use and active transport can be higher in urban areas due to better PT services, active travel infrastructure, and shorter distances. For more information on the EoT concept, see De Vos (2024b). Although certain elements of travel quality can easily be measured (e.g., PT frequency), other aspects are more subjective (e.g., cleanliness and comfort of PT vehicles). Hence, the perceived travel quality can also impact EoT.

1.2. The effect of ease of travel on travel behaviour and activity participation

The extent to which a person believes they can easily perform a behaviour (perceived behavioural control) stimulates that behaviour (Ajzen, 1991). Therefore, EoT can influence travel behaviour. EoT can potentially influence the frequency, distance and duration of trips. Those who are able to travel easily because they are motivated, have the necessary options and skills, and have high-quality transport available may travel more frequently than those facing difficulties travelling. Furthermore, a person who finds it easy to travel by a particular mode of transport is likely to do so. For example, a person who has a driver's license and owns a car, enjoys driving, and lives in a congestion-free area with no significant car restrictions is likely to make most of their trips by car (e.g., Buehler, 2011). Beyond the obvious effects of travel options on travel behaviour (e.g., the need to obtain a driving license in order to drive a car), existing studies on travel behaviour have focused particularly on the effects of travel motivations and attitudes on travel behaviour. Studies have found that travel liking has a positive effect on travel frequency, while many studies have indicated positive impacts of mode-specific attitudes on the likelihood of choosing that mode of travel (Bagley & Mokhtarian, 2002; Kitamura et al., 1997; Ory and Mokhtarian, 2009). Some studies have found that people's travel behaviour often coincides with the desired trip duration, the desired travel amount and the desired use of a particular mode of transport (e.g. De Vos et al., 2020; Ory & Mokhtarian, 2009; Ye et al., 2020). In addition, many studies found strong effects of the built environment – strongly influencing travel options and travel quality – on travel behaviour. They show that people living in low-density, single-use neighbourhoods travel more frequently and longer distances compared to people living in compact, mixed-use neighbourhoods (e.g., Ewing & Cervero, 2010). Conversely, travel behaviour can also influence EoT. Travelling in a certain way can improve travel skills, as it can take a while for a person to master the sometimes complex skills required to travel. For example, safely driving a car through traffic requires repeated training to become proficient at steering, braking, accelerating, but also anticipating the movements of other cars, and following traffic rules. In addition, frequent use of a particular mode of transport can improve attitudes towards this mode (e.g., Kroesen et al., 2017).

EoT can also influence access to out-of-home activities. People who are motivated to travel (by a particular mode of transport), have the skills and knowledge required to travel, have easy access to different types of transport, and have high-quality transport networks/services available may find it easy to access activities. Therefore, EoT could influence perceived accessibility levels. Previous studies

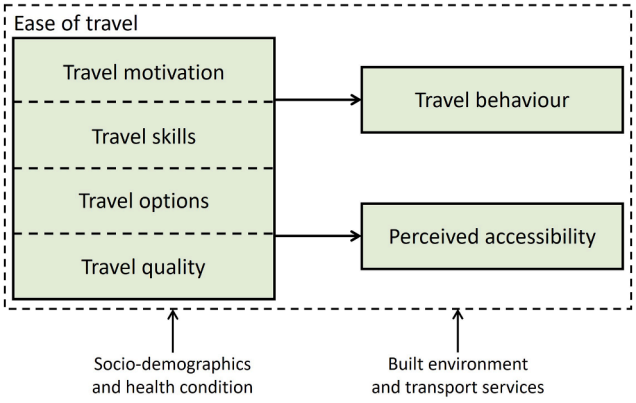

Fig. 1. Suggested framework of the determinants and outcomes of ease of travel.

have found that limited travel skills and abilities, physical impairments and limited access to transport (e.g., no car or poor PT) can negatively impact participation in activities and lead to social exclusion and reduced levels of well-being (Currie and Delbosc, 2010; Lucas, 2012). The quality of transport can affect the types of activities that are accessible within a given time. For example, a person who has access to a low-frequency PT stop with limited destinations may not be able to reach his/her desired activity and may have to settle for a second-choice option. In summary, a low level of EoT – and the resulting restrictions on travel behaviour – can negatively impact the number of desired activities that are accessible. On the other hand, the desire to participate in activities outside the home can also influence EoT. A person may learn to drive or buy a car in order to have access to destinations that are only accessible by car; or a person may move to an urban neighbourhood to have a wide range of activities nearby. The motivation to travel can also stem from the activity at the destination. A person may have an intrinsic motivation to travel because they like the activity at the destination, even though they have a neutral to negative attitude towards travelling. Participation in an activity also affects travel behaviour, as people need to travel to reach these activities, and the location of activities (e.g., distance from home) influences travel distance, duration, and mode choice.

Based on the above discussion, it is likely that EoT influences travel behaviour and perceived accessibility. However, how EoT, or aspects of it, impact both elements is largely unknown. This is the first study to analyse the EoT concept as introduced by De Vos (2024b), by using a large sample of University College London (UCL) students and staff. In this paper, we will explore the four elements of EoT, analyse their determinants, and examine the impacts on travel behaviour and perceived accessibility, as presented in Fig. 1. Possible feedback effects of travel behaviour and perceived accessibility on EoT as described above will not be analysed in this study. First, we will analyse whether EoT is actually built up by the four suggested elements by using an exploratory factor analysis. Second, we will analyse the determinants of the EoT elements, by exploring the effects of socio-demographic characteristics (including the presence of mobility impairments) and the residential location and its available transport services on EoT elements. Finally, we will examine how EoT affects travel mode choice, travel duration, and travel distance, but also how it influences perceived accessibility. The remainder of this paper is organised as follows. In Section 2, the used data and methods are described, while the results are shown in Section 3. In section 4 we provide a discussion and conclusion.

2. Data and methods

2.1. Data collection

This study uses data from the 2023 University College London (UCL) travel survey (De Vos, 2023). This survey collected information from UCL students and staff, in order to create insights into how UCL students and staff travel and how they experience it, with the main objective of making travel generated by UCL more sustainable and convenient. This study uses data from the first part of the survey, focusing on how respondents travel to campus, and how this travel is perceived.[1] Data was collected during the last four weeks of term 2, i.e., from February 27 until March 27, 2023. The survey was distributed via various UCL newsletters for staff and students, and UCL social media pages (Instagram, Facebook, and Twitter). As an incentive to complete the survey, respondents were told they would be entered into a drawing to receive one of eight £50 multi-store gift vouchers; the eight winners were selected in April. In the end, 2,912 UCL staff members and students completed the survey, of which 2,593 participants were retained after removing responses with too much missing data.

The biggest group of respondents are administrative staff members (21.6 %), followed by research staff (19.7 %), undergraduate students (16.0 %), professors (13.9 %), postgraduate students (11.6 %), PhD students (9.8 %), and teaching staff (4.3 %), while 3.0 % indicated another status. Respondents from Medical Sciences (13.4 %), Engineering Sciences (11.9 %), and Population Health Sciences (11.5 %) were best represented in the sample. Due to the presence of students, almost half of the respondents (45.5 %) are 30 years old or younger; 32.4 % is between 31 and 45 years old, while 22.1 % is older than 45. Women are overrepresented in the sample (66.2 % women versus 33.8 % men), while the majority of respondents (63.6 %) live in Greater London. A small group of respondents (4.4 %) indicates to have a disability that limits their ability to travel.

2.2. Methods

In order to 1) explore the reliability of the four EoT elements, 2) analyse their determinants, and 3) examine the effects of EoT on travel behaviour and perceived accessibility, we first performed a factor analysis to identify latent variables underlying statements regarding EoT. In a second step, we performed linear regressions with the factor scores as dependent variables to explore the effects of determinants (i.e., socio-demographics and travel mode availability) on the EoT elements. Third, we analysed how mode use, travel duration, travel distance, and perceived accessibility differs according to various levels of EoT elements. Finally, multiple regressions were performed, analysing the effects of EoT elements on travel behaviour and perceived accessibility, while accounting for socio-demographics and travel mode availability. We acknowledge that a structural equation modelling approach could have done these steps simultaneously. However, we are not exploring indirect effects (e.g., of EoT determinants on travel behaviour), while the multi-staged approach ensures clarity and robustness at each step of analysis. Additionally, running a structural equation model did not result in a good model fit, most likely because of the high number of dependent variables (i.e., nine variables representing travel

[1] The second part of the survey (for most UCL staff and PhD students) – which was not used for this study – focuses on (attitudes towards) academic travel.

behaviour and perceived accessibility with different functional forms).

2.3. Key variables

2.3.1. Ease of travel

Based on De Vos (2024b), respondents were asked to indicate to what extent they agree on twelve statements (on a scale from 1 (totally disagree) to 5 (fully agree)), three statements referring to travel motivation, travel skills, travel options, and travel quality each. It should be noted that the statements refer to how people perceive their ability to travel, and do not incorporate measurable elements of travel (such as car ownership and available PT services). In order to create a limited number of factors representing different aspects of EoT, a factor analysis was performed, resulting in four factors, and explaining 72.7 % of the total variance (Table 1). In order to identify latent variables underlying a set of variables, principal axis factoring (with promax rotation) was chosen (instead of other methods such as principal component analysis). Two variables were removed as they did not have a high loading (i.e., above 0.4) on any of the factors (i.e., *I like to travel; Overall, I can travel in a desired way* (avg. scores: 3.15 and 3.64, respectively)). The first factor refers to the presence of travel options, while the second factor refers to the possession of travel skills. The third and fourth factor refer to travel motivation and travel quality, respectively.[23] Hence, the created factors are in line with the suggested elements by De Vos (2024b). On the other hand, we do acknowledge that the internal consistency (inter-item correlation, measured by Cronbach's alpha) is not great for the factors travel skills and travel quality, and that only two statements per factor (for travel motivation and travel quality) is not ideal. The average scores on the travel options and skills statements (at least for the positively phrased ones) are relatively high (> 3.4), suggesting that respondents generally have substantial options and skills to travel. The average scores on the travel motivation statements are rather neutral, while the travel quality statements indicate that respondents' travel is not always as desired.

2.3.2. Travel to campus

Respondents were asked information regarding their most recent, usual trip to the UCL campus they most frequently travel to. Most respondents (81.3 %) generally travel to the Bloomsbury campus, located in London's city centre (within the inner ring road) and well connected by PT (with multiple train, underground/overground, and bus stops nearby). The remaining respondents either travel to other UCL buildings located in the centre of London (17.3 %), or to the new UCL East campus (around 10 km east of Bloomsbury, but still well connected by PT; 1.4 %). Most respondents travelled by underground/overground (London's metro/light rail system; 39.3 %), followed by train (29.1 %), walking (11.7 %), cycling (private (e-)bicycle; 9.7 %), and bus/tram (6.8 %). Only 1.9 % of the respondents travelled by car, while 1.6 % travelled by other modes (e.g., e-scooter, rental (e-)bicycle, motorcycle).[4] The low car use can be explained by high levels of congestion around campus and limited parking availability. Travel durations and distances are relatively long, since most UCL staff and students do not live in the city centre. Only 25.6 % of the respondents has a commute of 30 min or less, while 31.5 % travel more than 60 min to campus. These long commute durations to London are not unusual as almost four in ten people working in Central London (39.3 %) have a commute of at least 60 min (Department for Transport, 2022). Around four in ten respondents lives within ten kilometres from their main campus, while almost one in three lives more than 25 km away (Table 2).[5]

2.3.3. Perceived accessibility

The survey also collected information regarding the perceived accessibility of the campus which respondents most frequently travel to (Fig. 2). Respondents were asked to indicate to what extent they agree on the following statement "Overall, the campus is easily accessible" on a scale from 1 (totally disagree) to 5 (fully agree). The majority of respondents agrees with this statement, while only 5 % (strongly) disagrees. We also asked information regarding mode-specific perceived accessibility. Since the majority of respondents (75.2 %) normally uses PT to reach the campus, we also examine perceived accessibility by PT. PT users ($n = 1{,}837$) generally agree on the statement "The campus can easily be reached by public transport". Less than 2 % (strongly) disagrees while more than 90 % (fully) agrees. In sum, the campus most frequently visited by UCL students/staff is regarded as easily accessible.

[2] The four factors are, because of the use of the oblique promax rotation, correlated with each other. The lowest correlation is between travel options and travel motivation (0.21), while the highest correlation is between travel options and travel skills (0.68).

[3] It should be noted that the travel motivation factor mainly refers to internally regulated motivation, whereby people are motivated because they value or like certain elements of the behaviour (see Section 1.1, first paragraph).

[4] This mode share considerably differs from the overall mode share of Greater London, i.e., 36% car trips, 35% PT trips, and 29% trips by active modes (Transport for London, 2023). However, this data includes trips for other purposes (e.g., leisure, shopping) and trips outside Central London. Commuters travelling to the City of London (a London borough in Central London), for instance, mostly travel by PT (84% of trips), followed by active travel (9%), while fewer than 5% drive to work (City of London, 2019). This mode share is more closely aligned with the mode share of our respondents. Unfortunately, there is no data available on the mode share of commuters to the borough of Camden, the location of Bloomsbury campus.

[5] Since travel distance is often hard to estimate, respondents could indicate: *I cannot estimate the distance of this trip*, or skip the question. As a result, only 1,443 respondents reported their estimated travel distance.

Table 1
Ease of travel factors (factor loadings below 0.4 are not shown to improve readability)[1].

Factor	Statement (and average score)	Loading
Travel options	My travel options are available to me whenever I want (avg.: 3.41)	0.84
(Cronbach's α: 0.80)	I have a lot of travel options available (avg.: 3.47)	0.75
	The travel options I have available enable me to reach my desired out-of-home activities (avg.: 3.88)	0.52
Travel skills (Cronbach's α: 0.66)	I easily find my way to out-of-home activities (avg.: 3.80)	0.71
	I feel confident while travelling (avg.: 3.97)	0.69
	My travel is physically challenging for me (avg.: 2.16)	−0.48
Travel motivation (Cronbach's α: 0.82)	The only good thing about travelling is reaching the destination (avg.: 2.83)	−0.84
	Travel time is wasted time (avg.: 3.07)	−0.81
Travel quality (Cronbach's α: 0.68)	I have longer travel durations than desired (avg.: 3.45)	−0.88
	I spend more money on travel than desired (avg.: 4.01)	−0.52

[1] Factor loadings represent the degree of association between the statement and the factor.

Table 2
Most recent, usual travel to UCL campus.

		%
Travel mode	Bus/tram	6.8
	Underground/overground	39.3
	Train	29.1
	Car	1.9
	Walking	11.7
	Cycling	9.7
	Others	1.6
Travel duration	Short (≤ 30 min.)	25.6
	Medium (30—60 min.)	42.9
	Long (> 60 min.)	31.5
Travel distance	Short (≤ 10 km)	39.7
	Medium (10—25 km)	28.9
	Long (> 25 km)	31.4

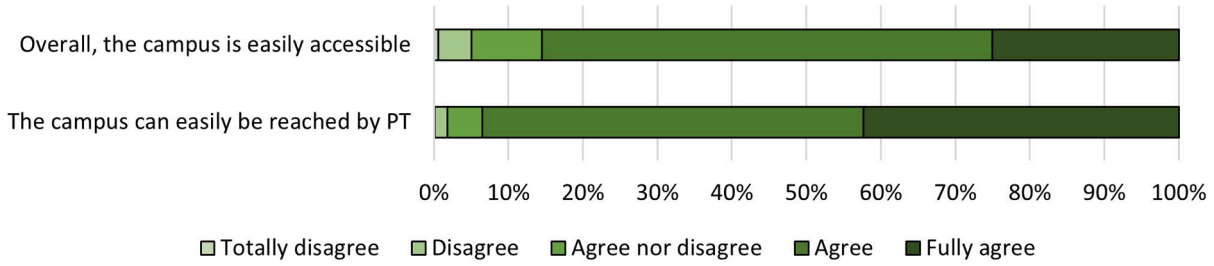

Fig. 2. Overall perceived accessibility (n = 2,544) and perceived accessibility by PT (n = 1,837).

3. Results

3.1. Determinants of ease of travel elements

In order to know which variables influence EoT, four linear regressions are performed, one for each factor resulting from the factor analysis (Table 3). The factor scores, i.e., values for each respondent on the underlying factors, are thereby used as dependent variables. The following independent variables were included: personal characteristics (age (years), gender (0: man; 1: woman), residential location (0: outside Greater London; 1: within Greater London), travel disability (disability limiting the ability to travel), and UCL status), and travel mode availability (driving license, car ownership, bicycle ownership, PT discount card, bus/tram stop within 10 min waking, underground/overground stop within 10 min walking, train station within 10 min walking, rental (e-)bikes available in neighbourhood, rental e-scooters available in neighbourhood). The models indicate that living outside of London and having a disability hampering travel have a negative impact on EoT, while age seems to have a positive effect. Owning a bicycle, but especially having PT stops within walking distance and having rental (e-)bikes available in the neighbourhood positively influence EoT. Having a driving license and owning a car do not influence EoT elements. The (adjusted) R^2s indicate that the independent variables explain a significant share of the variance in travel options, travel skills and travel quality, but not so much of the variance in travel motivation.

Table 3
Linear regression models for EoT components (Coef. = Coefficient; S.C. = standardised coefficient; underlined: sig. at $p < 0.05$; bold: sig. at $p < 0.01$).

	Travel options		Travel skills		Travel motivation		Travel quality	
	Coef.	S.C.	Coef.	S.C.	Coef.	S.C.	Coef.	S.C.
Personal characteristics								
Age	0.00	0.05	**0.01**	**0.09**	**0.02**	**0.22**	**0.01**	**0.21**
Gender (woman)	−0.05	−0.03	−0.06	−0.03	0.01	0.01	−0.03	−0.01
Residential location (London)	**0.62**	**0.33**	**0.30**	**0.16**	0.07	0.04	**0.47**	**0.25**
Travel disability	**−0.40**	**−0.09**	**−0.79**	**−0.18**	**−0.33**	**−0.07**	**−0.29**	**−0.06**
UCL status (ref: student)								
Administration	0.02	0.01	0.03	0.01	−0.02	−0.01	0.08	0.04
Teaching/research staff	−0.01	−0.01	0.00	0.00	−0.09	−0.04	−0.04	−0.02
Professorial staff	−0.01	−0.01	0.03	0.01	0.13	0.05	−0.03	−0.01
Travel mode availability								
Driving license	0.03	0.02	0.03	0.02	−0.03	−0.02	0.01	0.01
Car ownership	0.05	0.03	0.04	0.02	−0.05	−0.03	−0.02	−0.01
Bicycle ownership	0.08	0.04	**0.11**	**0.06**	**0.17**	**0.09**	−0.02	−0.01
PT discount card	0.04	0.02	0.06	0.03	0.07	0.04	0.05	0.03
Bus/tram stop in 10 min.	**0.25**	**0.12**	**0.22**	**0.12**	**0.16**	**0.08**	**0.11**	**0.05**
Under/overground stop in 10 min.	**0.25**	**0.14**	**0.21**	**0.12**	−0.02	−0.01	**0.31**	**0.17**
Train station in 10 min.	**0.14**	**0.07**	**0.11**	**0.06**	**0.14**	**0.08**	**0.12**	**0.07**
Rental (e-)bikes available in neighb.	**0.33**	**0.17**	**0.28**	**0.15**	**0.18**	**0.10**	**0.24**	**0.13**
Rental (e-)scooters available in neighb.	0.05	0.02	0.06	0.03	−0.00	−0.00	0.08	0.04
R^2	0.36		0.23		0.10		0.26	
Adjusted R^2	0.36		0.22		0.10		0.25	

3.2. Ease of travel, travel behaviour, and perceived accessibility

In order to examine potential effects of EoT on travel behaviour and perceived accessibility, respondents' levels of EoT elements were categorised as low (factor scores < -0.5), neutral (factor scores between −0.5 and 0.5) and high (factor scores > 0.5). By doing so, we can explore how respondents' behaviour varies according to different levels of EoT. Fig. 3 shows that respondents with various levels of EoT often use different travel modes.[6] The following significant effects (based on one-way ANOVAs with LSD post-hoc tests) were most apparent. Those with low levels of travel options travel more by train compared to those with high levels of travel options, while opposite differences were found for walking and cycling. The same effects – albeit less strong – can be found for travel skills. The effect of travel motivation on mode choice is less clear. We only found that those with high motivation levels cycle more and use underground/overground less often compared to those with low motivation levels. Finally, those with low travel quality mostly travel more by train than those with high travel quality levels, while for walking and cycling the opposite has been found.

Table 4 shows how travel to campus and the perceived accessibility of this campus is influenced by EoT elements. The trip duration to campus is clearly higher for those with low levels of travel options, travel skills, and travel quality, compared to those with high levels on these elements. The same effect is found for travel motivation, albeit is less strong. Similar effects were found in regards to trip distance. Those with lower levels of travel options, travel skills, and travel quality travel longer distances to campus compared to those with high levels. The effect of motivation is weaker and less clear. Perceived accessibility seems strongly influenced by EoT. Those with high levels of travel options, skills, motivation and quality, perceive the campus to be significantly more accessible compared to those with low EoT levels. For PT users, we found similar effects. Those with high levels of EoT indicate that the campus is easier to access by PT compared to those with low EoT levels.

3.3. The effect of ease of travel on travel behaviour and perceived accessibility

Fig. 3 and Table 4 already give interesting information on the links between EoT, travel behaviour and perceived accessibility. However, in order to know whether EoT influences travel behaviour and perceived accessibility independent from other elements (such as socio-demographics), it is important to control for these elements. Hence, we have performed five binary regressions (for each travel mode), two linear regression for travel duration/distance, and two ordinal regressions for perceived (PT) accessibility. As independent variables, the four EoT factors were included, together with the personal characteristics and travel mode availability variables as shown in Table 3.

Table 5 indicates that, after controlling for personal characteristics and travel mode availability, EoT only has modest effects on the use of bus or tram (hence the relatively low R^2s). Bus/tram use is mainly influenced by whether or not respondents live in Greater London. For the use of underground or overground, travel quality plays an important role. Those with low perceived levels of travel quality will travel more by under/overground compared to those who can travel in a desired way. Those living in Greater London, owning a bicycle, having nearby underground/overground stations, and non-students are also more inclined to use this mode, while nearby train stations have a negative impact. A lack of travel options and the availability of travel skills positively influence train use,

[6] Car use was not included in the analysis due to the low share of car users in the sample.

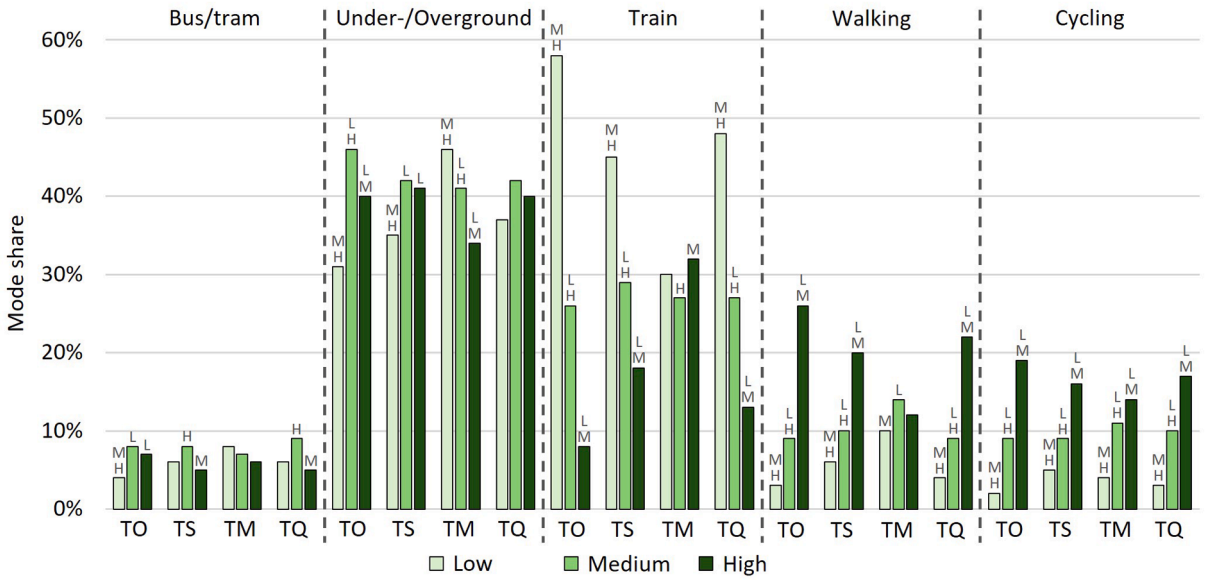

Fig. 3. Mode share according to levels of EoT (TO = Travel options; TS = Travel skills; TM = Travel motivation; TQ = Travel quality; L,M,H = significantly different from groups low, medium, and high, respectively, at $p < 0.05$).

Table 4
Travel behaviour and perceived accessibility according to EoT levels[1].

	Travel duration (min.)	Travel distance (km)	Perceived accessibility Fully agree (%)	Perceived accessibility Agree/fully agree (%)	Perceived PT accessibility Fully agree (%)	Perceived PT accessibility Agree/fully agree (%)
Travel options						
Low	67.5 ^{M,H}	54.0 ^{M,H}	14.1^{H}	72.3 ^{M,H}	29.7 ^{M,H}	87.8 ^{M,H}
Medium	48.8 ^{M,H}	26.1 ^{L,H}	17.7^{H}	86.8 ^{L,H}	38.8 ^{L,H}	95.5 ^{L,H}
High	35.1 ^{L,M}	11.2 ^{L,M}	45.9 ^{L,M}	91.1 ^{L,M}	70.7 ^{L,M}	98.7 ^{L,M}
Travel skills						
Low	60.4 ^{M,H}	45.0 ^{M,H}	12.1 ^{M,H}	70.2 ^{M,H}	23.7 ^{M,H}	85.6 ^{M,H}
Medium	49.1 ^{L,H}	28.7 ^{L,H}	17.2 ^{L,H}	87.0 ^{L,H}	36.7 ^{L,H}	95.5 ^{L,H}
High	40.6 ^{M,H}	20.9 ^{M,H}	49.4 ^{L,M}	91.3 ^{L,M}	76.7 ^{L,M}	98.8 ^{L,M}
Travel motivation						
Low	52.2 ^{M,H}	29.6	18.4 ^{M,H}	80.2 ^{M,H}	34.9^{H}	89.0 ^{M,H}
Medium	47.6 ^{L}	27.6^{H}	23.1 ^{L,H}	84.2 ^{L}	40.3^{H}	95.1 ^{L}
High	48.6 ^{L}	34.3 ^{M}	32.0 ^{L,M}	86.9 ^{L}	52.4 ^{L,M}	96.1 ^{L}
Travel quality						
Low	63.5 ^{M,H}	46.7 ^{M,H}	18.4^{H}	77.0 ^{M,H}	35.1^{H}	89.9 ^{M,H}
Medium	49.9 ^{L,H}	29.0 ^{L,H}	18.6^{H}	84.7 ^{L,H}	39.3^{H}	93.9 ^{L,H}
High	35.7 ^{L,M}	14.3 ^{L,M}	38.4 ^{L,M}	90.0 ^{L,M}	58.7 ^{L,M}	98.6 ^{L,M}

[1] L,M,H = significantly different from groups low, medium, and high, respectively at $p < 0.05$ using one-way ANOVAs with post-hoc multiple comparison analysis using the LSD method.

just as living outside Greater London and having a train station nearby, whereas having an underground/overground station nearby has a negative influence. Having ample travel options and high perceived travel quality positively influences walking, just as living in Greater London, owning a bicycle, and being a UCL student. Travel options positively affects cycling, while travel skills have a negative impact. Additionally, those living in Greater London, men, those not owning a car, but owning a bicycle, and students are more likely to cycle. The effects of travel options on train use and active travel seem in line with existing studies indicating that PT users are often 'captive' travellers, while active travellers are mostly 'choice' users (e.g., Beimborn et al., 2003; Humagain et al., 2021; Jacques et al., 2013). Studies analysing the effects of travel skills and travel quality on mode choice seem absent. Hence, this is the first study doing so. The effects of EoT on train use, walking and cycling seem somewhat less strong than expected based on Fig. 3, which showed rather clear patterns. This could be explained by the fact that the influence of EoT on mode choice is partly explained by variations in travel mode availability and residential location, which are important determinants of EoT (Table 3).

Table 6 indicates that travel options and travel quality have a negative impact on travel duration and distance, while travel

Table 5
Binary logistic regressions for travel mode choice (Coef. = Coefficient; underlined: sig. at $p < 0.05$; bold: sig. at $p < 0.01$).

	Bus/tram		**Under/ overground**		**Train**		**Walking**		**Cycling**	
	Coef.	Wald	Coef.	Wald	Coef.	Wald	Coef.	Wald	Coef.	Wald
Ease of Travel										
Travel options	0.46	4.54	0.03	0.08	**−1.11**	**40.5**	**0.65**	**9.44**	**0.88**	**13.8**
Travel skills	−0.50	6.62	0.17	2.47	**0.66**	**16.2**	−0.34	2.97	**−0.71**	**10.8**
Travel motivation	0.13	1.29	−0.11	2.75	0.07	0.43	−0.06	0.30	0.30	4.86
Travel quality	−0.33	5.80	**−0.32**	**16.3**	−0.13	0.84	**0.50**	**17.0**	0.24	3.05
Personal characteristics										
Age	−0.02	3.22	0.00	0.54	**0.02**	**7.16**	−0.02	4.25	0.02	4.57
Gender (woman)	0.27	1.68	0.27	5.95	−0.23	1.62	0.04	0.05	**−0.66**	**12.1**
Residential location (London)	**2.22**	**35.9**	**0.86**	**35.4**	**−2.75**	**188**	**2.08**	**15.2**	**1.93**	**30.0**
Travel disability	0.58	2.31	−0.27	1.06	−0.37	1.16	−0.28	0.31	0.09	0.03
UCL status (ref: student)										
Administration	0.04	0.02	**0.72**	**18.2**	0.49	3.61	**−1.65**	**23.4**	**−0.88**	**7.06**
Teaching/research staff	−0.13	0.21	0.30	3.87	**0.73**	**8.85**	**−0.91**	**14.2**	−0.47	2.71
Professorial staff	0.48	1.33	0.32	2.16	−0.19	0.34	−0.83	4.00	−0.42	1.28
Travel mode availability										
Driving license	−0.23	1.31	−0.13	1.28	0.46	4.91	−0.14	0.65	0.43	3.48
Car ownership	0.08	0.09	−0.16	1.44	−0.21	1.04	−0.10	0.15	**−0.70**	**9.44**
Bicycle ownership	**−0.60**	**7.69**	**−0.77**	**47.5**	0.17	0.95	**−1.05**	**29.1**	**4.57**	**96.7**
PT discount card	−0.33	2.45	0.13	1.36	0.39	4.79	−0.25	2.12	−0.41	3.53
Bus/tram stop in 10 min.	0.62	6.08	0.03	0.04	0.13	0.56	−0.09	0.15	−0.01	0.00
Under/overgr. Stop in 10 min.	−0.33	2.34	**1.41**	**119**	**−2.78**	**154**	0.41	2.77	−0.12	0.27
Train station in 10 min.	−0.48	5.69	**−0.79**	**52.3**	**2.04**	**102**	**0.49**	**8.55**	−0.02	0.01
Rental (e-)bikes in neighb.	−0.06	0.06	−0.22	2.18	**−0.91**	**9.07**	**0.65**	**9.35**	0.31	1.54
Rental (e-)scooters in neighb.	0.23	0.73	**−0.63**	**16.5**	0.77	4.91	0.41	4.24	−0.21	0.76
Cox and Snell R^2	0.06		0.20		0.51		0.21		0.25	
Nagelkerke R^2	0.16		0.26		0.72		0.41		0.52	

Table 6
Linear regression models for travel duration/distance and ordered regressions for perceived (PT) accessibility (Coef. = Coefficient; S.C. = standardised coefficient; underlined: sig. at $p < 0.05$; bold: sig. at $p < 0.01$).

	Travel duration		**Travel distance**		**Perceived accessibility**		**Perceived PT accessibility**	
	Coef.	S.C.	Coef.	S.C	Coef.	Wald	Coef.	Wald
Ease of Travel								
Travel options	**−3.00**	**−0.11**	**−8.06**	**−0.20**	0.23	5.28	0.11	0.99
Travel skills	0.88	0.03	3.27	0.08	**0.76**	**66.4**	**1.01**	**79.3**
Travel motivation	**2.13**	**0.08**	**5.39**	**0.13**	−0.03	0.31	0.07	0.94
Travel quality	**−7.24**	**−0.27**	**−3.41**	**−0.08**	0.08	1.54	−0.11	1.71
Personal characteristics								
Age	**0.26**	**0.14**	0.02	0.01	0.01	2.05	0.01	4.69
Gender (woman)	**3.41**	**0.07**	1.48	0.02	0.14	2.22	−0.04	0.10
Residential location (London)	**−20.4**	**−0.39**	**−31.8**	**−0.42**	−0.15	1.37	−0.34	5.63
Travel disability	1.18	0.01	**10.6**	**0.06**	**−0.67**	**9.82**	**−0.67**	**6.91**
UCL status (ref: student)								
Administration	**5.30**	**0.09**	2.24	0.03	**−0.42**	**8.02**	−0.03	0.04
Teaching/research staff	**4.48**	**0.08**	4.47	0.05	−0.22	2.66	−0.22	2.01
Professorial staff	1.34	0.02	5.42	0.06	−0.30	2.70	0.06	0.08
Travel mode availability								
Driving license	−0.97	−0.02	−0.47	−0.01	−0.03	0.10	−0.01	0.00
Car ownership	**2.95**	**0.06**	**7.29**	**0.10**	−0.01	0.01	−0.06	0.22
Bicycle ownership	−0.49	−0.01	3.07	0.04	−0.07	0.53	−0.09	0.66
PT discount card	−0.21	−0.00	4.01	0.05	0.00	0.00	−0.00	0.00
Bus/tram stop in 10 min.	0.89	0.02	−3.23	−0.04	−0.02	0.05	0.11	0.86
Under/overgr. stop in 10 min.	**−9.07**	**−0.19**	**−9.90**	**−0.13**	−0.02	0.02	0.22	2.70
Train station in 10 min.	0.69	0.01	−0.33	−0.00	−0.13	1.91	−0.24	4.68
Rental (e-)bikes in neighb.	**−3.36**	**−0.07**	−4.91	−0.06	−0.06	0.23	0.02	0.01
Rental (e-)scooters in neighb.	1.09	0.02	**13.2**	**0.14**	−0.03	0.06	−0.10	0.32
R^2	0.66		0.51					
Adjusted R^2	0.66		0.50					
Cox and Snell R^2					0.15		0.18	
Nagelkerke R^2					0.18		0.21	

motivation has a positive effect. This is in line with studies finding that people with limited travel options (no easy access to car or PT) have longer travel distances and durations (e.g., Guzman et al., 2017; Lucas et al., 2016). Living outside of Greater London, owning a car and not having an underground/overground station nearby also stimulate long distances and durations. Both perceived accessibility and perceived PT accessibility (for PT users) are positively affected by travel skills (although the explained variances (i.e. R^2s) are rather low)). This finding is in line with Pot et al. (2023) finding that having skills to use PT positively influence perceived accessibility. Additionally, having a travel disability negatively impacts perceived accessibility levels, a result also found by some other studies (Friman & Olsson, 2023; Márquez et al., 2019). Similar to mode choice, it seems that the effect of EoT on travel duration/distance and perceived accessibility is partly explained by the residential location and travel mode availability (for duration/distance), and travel disability (for perceived accessibility), elements which are important predictors of EoT (Table 3).

4. Discussion and conclusion

This is the first study that examined the EoT concept. Using a factor analysis on twelve statements, four factors were created in line with the four elements of EoT, i.e., travel skills, travel motivation, travel options, and travel quality. Hence, the four element structure as proposed by De Vos (2024b) seems reliable and solid. Results from the linear regressions showed that living in greater London, not having mobility impairments, and short distances to PT and rental (e-)bikes positively influence EoT elements. This indicates that more urban areas (with higher density and land use mix), a better spatial coverage of the PT network, and more extensive rental (e-)bikes schemes can make it easier for people to travel.

In a next step, we looked at the impact of EoT on travel to campus and the perceived accessibility of this campus, while also controlling for personal characteristics and travel mode availability. Travel mode choice seems affected by EoT, especially by travel options. Having multiple travel options has a negative effect on train use, while a positive effect on walking and cycling. The effects of other EoT elements are less clear. This may suggest that train users travel by train partly because they have no other options to travel to campus. Hence, a large share of them may be captive train users. On the other hand, having various travel options stimulates active travel, suggesting that walking and cycling is often the preferred way of travel, and that most active travellers are choice travellers (in line with e.g., De Vos, 2018; Humagain et al., 2021; Stark et al., 2019). Travel duration and travel distance are negatively affected by travel options and travel quality, indicating that those who do not have a lot of options and those who cannot travel in a desired way have long trips to campus. Hence, these long trip seem to be performed out of necessity. These outcomes seem in line with studies indicating that transport disadvantage/poverty results in long trips (e.g., Guzman et al., 2017; Lucas et al., 2016). In sum, respondents with high levels of travel options and travel quality seem to have ample freedom to choose how to travel and mostly perform short trips, often on foot or by bicycle. Finally, we found that EoT has a positive impact on perceived campus accessibility. Especially those with high levels of travel skills perceive the campus as easily accessible. In general, this suggests that those who can easily travel also find access to destinations easy, stimulating participation in out-of-home activities and enhancing quality of life. Travel motivation seems to have relatively weak effects on travel behaviour and perceived accessibility. Being motivated to travel stimulates cycling but has no effect on the use of other modes, while it also seems to positively affect travel distance and duration. In other words, those who like to travel do not seem to mind long trips, an outcome also found by De Vos and Witlox (2016).

Policy makers and urban planners can try to increase EoT by creating more compact, mixed-use neighbourhoods with good PT services and available rental (e-)bicycles. By doing so, people can travel more easily and will have more freedom in choosing how to travel, most likely stimulating short trips with active travel modes, making transport more environmentally sustainable. Furthermore, it will probably increase perceived accessibility and therefore out-of-home activity participation, which can lower social exclusion an increase levels of subjective well-being.

Although we believe that this study provides valuable insights into people's ability to travel, and how this impacts travel behaviour and activity participation, we encourage future studies to delve deeper into this topic. For instance, we invite researchers to 1) test the used statements in other contexts and 2) examine additional statements and possible alternatives (e.g., for the two statements removed from our factor analysis). Doing so can strengthen the internal consistency of the four EoT elements, making the EoT measurement more reliable. Additionally, we acknowledge that our measures of residential location and access to PT and (e-)bikes were rather crude, and therefore encourage future studies to incorporate more fine-grained measures of these EoT determinants. Doing so may explain the variance in EoT elements better, which was relatively low for travel motivation in this study. Finally, since we performed convenience sampling (targeting students and staff of one university) and focused on trips to campus and perceived accessibility of this campus, this study should be regarded as exploratory. Hence, future studies should ideally be performed in other geographical contexts and with more representative/balanced samples, and other types of trips and destinations.

CRediT authorship contribution statement

Jonas De Vos: Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Long Cheng:** Writing – review & editing. **Yuerong Zhang:** Writing – review & editing. **Kailai Wang:** Writing – review & editing. **Milad Mehdizadeh:** Writing – review & editing. **Mengqiu Cao:** 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.

Data availability

The data that has been used is confidential.

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