Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 72 (2023) 2612–2619

Transportation Research Procedia

www.elsevier.com/locate/procedia

Transport Research Arena (TRA) Conference

Worthwhile travel time: how do travel activities contribute to perceived values of travel time? Insights from European-wide app-based travel data

Eva Malichová[a], Veronique Van Acker[b,c], Yannick Cornet[d1], Dimitris Milakis[e]

[a]University of Zilina, Faculty of Management Science and Informatics, Univerzitná 8215/1, 010 26 Žilina, Slovakia
[b]Luxembourg Institute of Socio-Economic Research (LISER), Urban Development and Mobility, Porte des Sciences 11, L-4366 Esch-sur-Alzette, Belval, Luxembourg
[c] Ghent University, Department of Geography, Krijgslaan 281 S9, B-9000 Ghent, Belgium
[d]University of Zilina, Department of International Research Projects – ERAdiate+, Univerzitná 8215/1, 010 26 Žilina, Slovakia
[e] Institute of Transport Research, German Aerospace Center (DLR), Rudower Chaussee 7, 12489 Berlin, Germany

Abstract

Perceived travel experience has not been systematically integrated in transport project appraisal. The concept of worthwhile travel time (WTT) took the first step to fill this gap by introducing four perceived values of WTT (personal and work productivity, fitness, enjoyment) and the factors influencing them. This paper takes the next step by empirically exploring the factors influencing perceived WTT through a path analysis of a European-wide, app-based dataset on travel experience. Results show that (a) perceived WTT is directly influenced by the four values of WTT, mostly by enjoyment, (b) most travel activities directly influence the four values of WTT, with "accompanying someone" being the most important one, (c) women report lower perceived WTT than men, (d) trip purpose indirectly affects perceived WTT, with travel time thus not being purely valued based on destination.

© 2023 The Authors. Published by ELSEVIER B.V.
This is an open access article under the CC BY-NC-ND license (https://creativecommons.org/licenses/by-nc-nd/4.0)
Peer-review under responsibility of the scientific committee of the Transport Research Arena (TRA) Conference

Keywords: **Worthwhile travel time; Travel experience; Travel satisfaction; Value of enjoyment; Value of productivity; Value of fitness**

1. Introduction

The importance of travel time from the travellers' perspective has been amply discussed in the literature (Banister et al., 2019; De Vos et al., 2015; Metz, 2008; Ory & Mokhtarian, 2005). Perceived travel experience has not been

[1]* Corresponding author. Tel.:+421910225841 .
E-mail address: yannick.cornet@uniza.sk

2352-1465 © 2023 The Authors. Published by ELSEVIER B.V.
This is an open access article under the CC BY-NC-ND license (https://creativecommons.org/licenses/by-nc-nd/4.0)
Peer-review under responsibility of the scientific committee of the Transport Research Arena (TRA) Conference
10.1016/j.trpro.2023.11.799

systematically integrated into transport project appraisal, leading to deprioritisation of infrastructures for modes offering a rich travel experience but no significant travel time savings. However, the factors influencing the perceived travel experience and their interdependencies have not yet been explored in a systematic way across all modes, obscuring the effort of its integration into transport project appraisal. To this effect, Cornet et al. (2021) developed the Worthwhile Travel Time (WTT) conceptual framework. Taking an explicit traveller perspective, WTT distinguishes between three types of value that travellers can gain from the travel time itself: enjoyment (e.g. when relaxing or talking with other travellers on a trip), personal or work productivity (e.g. when writing or reading while sitting comfortably in a train), or fitness (e.g. when travelling by active or shared micromobility involving some level of wanted physical effort).

This paper aims to empirically explore which are the influencing factors of perceived WTT and what are their interactions, providing insights on the conditions under which travel time becomes worthwhile. We particularly focus on the role of travel activities as potential key enablers of WTT controlling for trip and traveller characteristics.

This paper is structured as follows. Section 2 summarises the WTT framework. Section 3 presents the data, statistical methods and the choices made in terms of analytical focus applied to explore the factors influencing WTT. Section 4 presents our findings. In section 5, we discuss our conclusions proposing areas for future research and offering a reflection on potential implications of our findings for transport project appraisal.

2. Background

WTT unpacks and captures the quality of the travel time experience from the perspective of travellers, helping to understand the conditions under which 'lost time' can be turned into 'useful time' while travelling (Banister et al., 2019). WTT is concerned with the disaggregate and subjective measurement of well-being while travelling (Mokhtarian 2018), but in contrast with the travel satisfaction literature, it does not rely on psychometric scales such as the satisfaction with travel scale (STS) (Ettema et al., 2012). WTT complements the conventional 'derived demand' perspective where the activities at destination contribute directly and solely to well-being (Mokhtarian 2018); central to the concept of WTT are travel activities (in-vehicle activities) which can bring value in their own right, including in some cases the act of travelling itself. The value of activity-based travel time has so far been examined as a way to acknowledge the productive time for business travellers and the value of travelling itself, and to account for new ICT-enabled behaviours while travelling (Wardman & Lyons, 2016; Glenn Lyons & Urry, 2005). The WTT framework extends this approach to other types of perceived value (personal work, enjoyment and fitness) and to a wider set of influencing factors beyond basic trip characteristics such as trip purpose.

The WTT conceptual framework can be summarised as follows (Cornet et al., 2021). *Experience factors* consist of travel conditions as experienced by the traveller. These experience factors in turn affect the ability of travellers to engage in worthwhile *activities* while travelling. Negative experience factors might create unwanted physical, cognitive or emotional stressors, which force the traveller to engage in unwanted efforts (such as climbing stairs with heavy luggage or standing in a crowded bus) at the expense of engaging in wanted travel activities (such as reading a book or simply enjoying the trip). Travel activities can bring a level of *value* among three different types: enjoyment, personal or work productivity, or fitness. This perceived activity-based value then leads to an overall assessment of *perceived travel time value*, ranging between completely wasted and worthwhile. The framework includes five categories of exogenous variables which can also influence personal travel experience: 1) door-to-door trip characteristics, including trip purposes, 2) traveller characteristics e.g. age or special needs, 3) traveller attitude and preferences, 4) spatial attributes e.g. urban vs rural, and 5) temporal attributes e.g. time constraints.

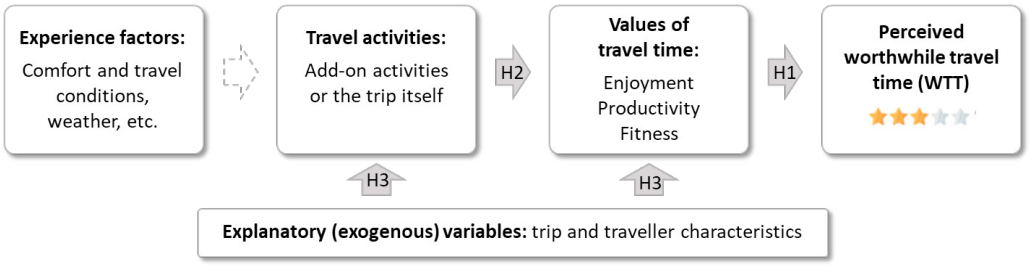

Fig. 1. Worthwhile travel time concept (simplified, derived from Cornet et al. 2021). Dotted arrow: relationship not tested in this paper.

3. Research design

3.1. *Data collection and sample*

The analysis is performed on a large, open and European-wide travel experience dataset (67,177 multimodal and door-to-door trips with 158,897 trip legs) collected through an app-based implementation of the WTT concept during 2019 by the Horizon 2020 MoTiV project in eight European countries (Belgium, Finland, France, Italy, Norway, Portugal, Slovakia, Spain) (Consonni et al., 2020). Our analysis focused on individual trip legs (instead of the whole trip) for which respondents provided evaluations for the worthwhileness of their travel time, types of value (enjoyment, personal or work productivity, and/or fitness), activities performed during travelling and experience factors. Trip characteristics (e.g. trip purpose, trip frequency, time constraints) and travel mode were also collected through the app. After cleaning for missing values on any of the variables included in the analysis, our sample was restricted to 27,706 trip legs, collected from 1,788 respondents who made 27,548 trips (Table 1) . The number of trip legs is similar to the number of trips because most respondents reported on only one specific trip leg and not multiple legs of one single trip.

Table 1. Descriptive statistics for respondents and trip legs.

Variable	Frequencies
Gender (N = 1,788 respondents)	51.2% female, 48.8% male
Age (N = 1,788 respondents)	20.2% 16 to 24 year; 62.4% 25 to 49 year; 15.3% 50 to 64 year; 2.0% 65+ year
Trip purpose (N = 27,548 trips)	23.2% home; 34.7% work & business; 31.0% maintenance (including shopping, personal tasks & picking up someone); 20.3% leisure
Trip frequency (N = 27,548 trips)	46.2% regularly; 40.8% occasionally; 13.0% first time
Trip distance (N = 27,548 trips)	81.3% less than 15km; 17.0% 15 to 100km; 1.7% more than 100km
Temperature (N = 27,706 trips)	36.5% cool (less than 15°C); 41.6% comfortable (15 - 24.9°C) ; 13.0% warm (25 - 31.9°C); 8.9% uncomfortably hot (32°C and more)
Day of week (N = 27,706 trips)	78.7% weekday; 21.3% weekend
Transport mode (N = 27,706 trips)	35.9% walking; 20.0% cycling; 13.9% public transport; 30.3% private motorized vehicle

3.2. Key variables

Respondents were asked to rate the travel time worthwhileness for their selected trip leg on a 5-point scale (1-wasted to 5-worthwhile) and then rate the type of value (i.e. productivity: paid work or personal tasks, fitness, and enjoyment) they experienced during this trip leg on a 3-point scale (‘high value’, ‘some value’, ‘no value’; transformed to a binary variable ‘high/some’ vs ‘no’ value in the analysis). Subsequently, the respondents were presented with a list of travel activities to select those conducted during the trip. Our analysis included travel activities with a minimum frequency of 1%, namely ‘accompanying someone’, ‘browsing/social media’, ‘listening to audio’, ‘talking (including phone)’, ‘eating or drinking’, ‘thinking’, the act of ‘driving and cycling’ itself. (see Cornet et al., 2019 for details on the app design and implementation).

3.3 Methodology: path analysis

In this paper, we hypothesise that: (H1) perceived worthwhileness of travel time is directly influenced by the four different values of travel time and indirectly by travel activities and trip and traveller characteristics; (H2) the four values of travel time are in turn directly influenced by travel activities and indirectly by trip and traveller characteristics; and (H3) the four values of travel time and their contributing travel activities are directly influenced by trip and traveller characteristics (see Figure 1). In other words, a set of related equations exist which is best analysed with path analysis.

Path analysis is a special type of structural equation model (SEM). In principle, SEM is used to estimate relationships between manifest variables (i.e., directly observed) and latent variables (i.e. indirectly measured by underlying indicators). In this way, SEM actually combines factor analysis with regression analysis. However, when only manifest variables are included in a set of related equations, SEM relies only on the regression aspect and is called a 'path analysis'.

A given variable can then be an explanatory variable in one equation (e.g., travel activities influencing perceived value of travel time), and at the same time an outcome variable in another equation (e.g., travel activities being influenced by trip and traveller characteristics). For that reason, SEM terminology distinguishes between 'exogenous variables' (i.e., variables not affected by other variables in the analysis) from 'endogenous variables' (i.e., variables influenced directly or indirectly by other variables in the analysis). In our analysis, trip and traveller characteristics are the only exogenous variables while travel activities, perceived values of travel time and perceived worthwhileness are all endogenous variables.

To estimate a path analysis, the covariance matrix of the observed variables is matched to a model-based covariance matrix usually using maximum likelihood (ML) estimation. Whilst ML estimation assumes multivariate normal distribution of all endogenous variables, this is less of a problem for large datasets like ours. However, large datasets are also known for their 'p-value problem' meaning that p-values quickly go to zero and might falsely indicate significant associations (Lin et al., 2013). To solve this problem, we applied ML combined with bootstrapping (Fang & Ma, 2017). Bootstrapping is a resampling method that uses random sampling with replacement from the original sample. In doing so, it provides more robust p-values.

In this paper, we used the software package IBM SPSS AMOS 28. Insignificant relationships were removed stepwise until all remaining relationships obtained p-values of 0.100 or lower. After that, modification indices were considered to see if adding certain relationships that initially were not considered could still improve model fit. AMOS suggests many additional relationships, but only those that obtained a large modification index (MI >= 100) and which made theoretically sense were added. This resulted in adding four direct effects on perceived worthwhileness. In order of importance, these were gender, cool temperature, accompanying someone, and age between 16 and 24 years old.

4. Results

4.1 Perceived worthwhileness of travel time

Only a few trip legs received a worthwhileness score of 2 or lower (13.1%), and many trip legs received high scores of 4 or even 5 (26.7%, respectively 36.7%). This results in an average score of 3.8 out of 5, indicating that many respondents perceived their travel time as relatively worthwhile. Respondents mainly valued their trip legs for enjoyment (55.5% some to high value), followed by personal tasks (38.8%) and fitness (38.7%), and finally by paid work (12.2%). The main activities conducted during the trip were the following: 'accompanying someone' (14.4%), 'browsing or social media' (3.4%), 'listening to audio' (8.5%), 'talking (including phone)' (9.9%), 'eating or drinking' (1.9%), 'thinking' (12.1%), the act of 'driving and cycling' itself (3.7%, respectively 8.6%).

4.2 Direct effects of travel activities on perceived value and perceived worthwhileness of travel time

Travel time is clearly much more than wasted time: all four perceived values of travel time have a significant and positive impact on perceived worthwhileness. This means that overall ratings of worthwhileness are higher for people who value their travel time for especially enjoyment ($\beta = 0.247$), but also for fitness ($\beta = 0.192$) or productivity (personal task: $\beta = 0.201$ and paid work: $\beta = 0.118$). The four perceived values of travel time, in turn, are each influenced by various travel activities. Each perceived value of travel time is discussed in more detail in order of their importance to perceived worthwhileness.

The perceived value of enjoyment is significantly influenced by all travel activities included in the analysis. Cycling, talking, accompanying someone, eating, thinking, browsing social media, and listening to audio have a positive impact on the enjoyment of travel time. The act of driving is the only travel activity that is negatively associated with the enjoyment of travel time, indicating how the use of a private motorised vehicle might be a burden to some people. Out of all travel activities, accompanying someone and listening to audio are the two most important ones stimulating the enjoyment of travel time (both β's = 0.090). Travelling together with other people contributes to enjoyment, but listening to audio (e.g., music, audiobooks) which is often done when travelling alone has the same effect.

All travel activities, except cycling and listening to audio, have a significant and positive impact on the perceived value of personal tasks. This is understandable given that it is practically almost impossible to perform personal tasks while travelling by bike or while listening to audio. Out of all significant travel activities, the activity of thinking while travelling is most important when travel time is valued for personal tasks ($\beta = 0.094$).

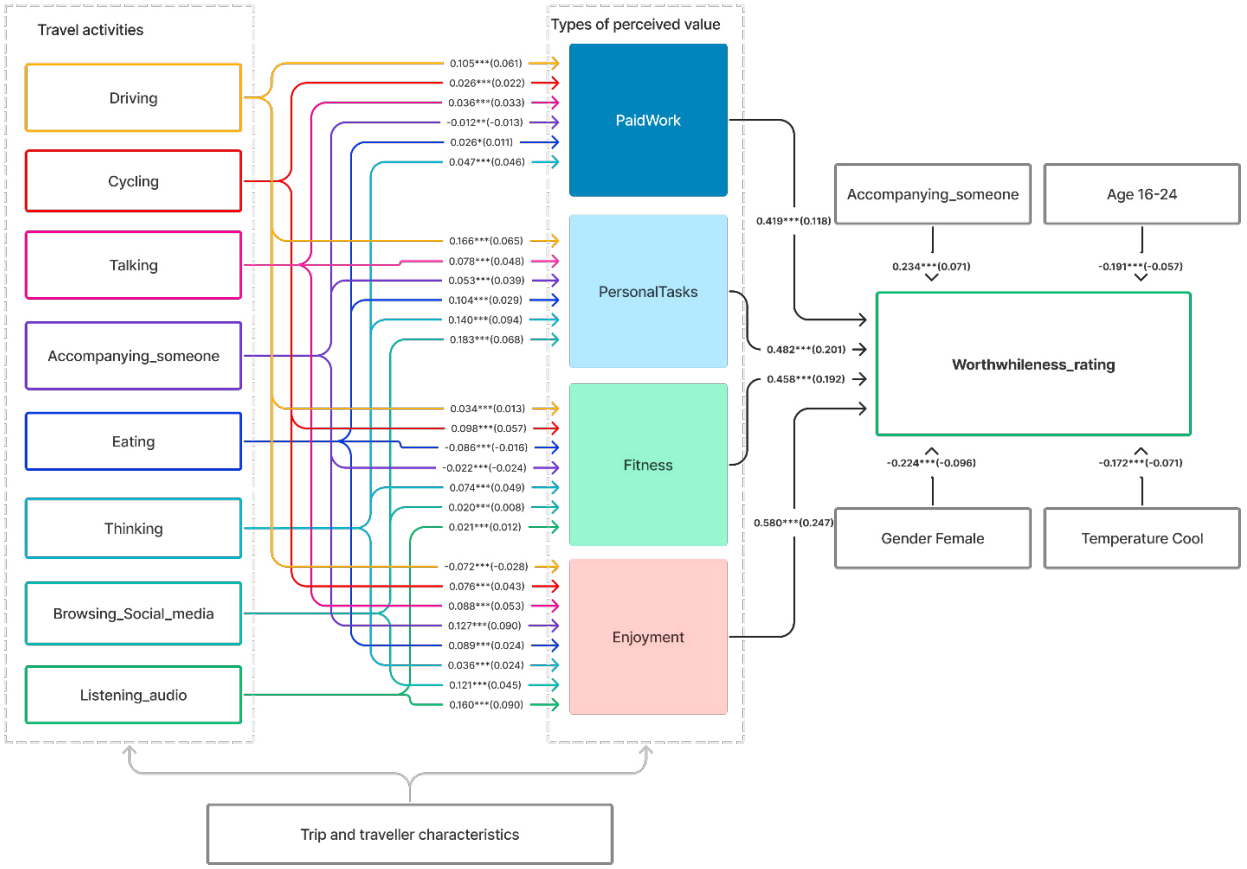

Fig. 2. Path diagram of the relationships between endogenous variables. Effects of exogenous variables are presented in Table 2 for clarity.
Note: standardised coefficients between parentheses; *** p <= 0.010, ** 0.010 < p <= 0.050, * 0.050 < p <= 0.100
Model fit: Chi^2 = 10962.055 with df = 119 and p = 0.000; CFI = 0.907; TLI = 0.613; RMSEA = 0.057

The perceived value of fitness is significantly influenced by all travel activities, except talking. Most of the significant travel activities (i.e., driving, cycling, thinking, browsing social media, listening to audio) have a positive effect on the valuation of travel time for fitness reasons. Only the travel activities of accompanying someone and eating are negatively associated with the perceived value of fitness. Out of all significant travel activities, the most important one is related to cycling (β = 0.057). Cycling is thus not only a means to get to your destination, but the act of cycling itself contributes to one's health and some people also value the time spent cycling for its fitness benefits.

Finally, all travel activities except browsing on social media and listening to audio have a significant influence on the perceived value of paid work. Valuing travel time for paid work is positively associated with the act of driving and cycling, talking, eating and thinking. It is only negatively associated with accompanying someone. Out of all significant travel activities, the most important one is related to driving (β = 0.061). The act of driving might allow people to perform work-related activities (e.g., answering phone calls) while travelling, but it might also be a transition phase between home and work explaining why people value the time spent driving for paid work reasons.

4.3 Total effects of travel activities and exogenous variables on perceived worthwhileness of travel time

Because of the interaction between travel activities and perceived values of travel time, travel activities also have an indirect effect on perceived worthwhileness of travel time (see Table 2). All travel activities have a significant and positive indirect effect on worthwhileness. Out of all travel activities, accompanying people seems to have a 'special' position in the (conceptual) model. It not only has an indirect effect on perceived worthwhileness of travel time through the interaction with the four perceived values of travel time, but accompanying has also a direct effect on

worthwhileness. While such a direct effect of travel activities on worthwhileness was initially not hypothesised, modification indices of the path analysis indicated that adding such a direct effect improves model fit. Accompanying someone therefore seems to directly result in a higher rating of perceived worthwhileness of travel time. Due to the combination of a direct and indirect effect, accompanying someone is the most important travel activity (β = 0.096).

Table 2. Indirect and total effects of exogenous variables and travel activities on perceived WTT.

	Indirect	Total		Indirect	Total
Exogenous variables			Temperature, comfort. (ref.)		
Trip purpose			**Temperature, cool**	**0.010** (0.004)**	**-0.163*** (-0.067)**
Home	0.034*** (0.012)	0.034*** (0.012)	Temperature, warm	-0.070*** (-0.020)	-0.070*** (-0.020)
Work & business	0.040*** (0.016)	0.040*** (0.016)	Temperature, uncomfortably hot	-0.066*** (-0.016)	-0.066*** (-0.016)
Maintenance	0.073*** (0.029)	0.073*** (0.029)	Age, 25 to 49 years (ref.)		
Leisure	0.102*** (0.035)	0.102*** (0.035)	**Age, 16 to 24 years**	**0.096*** (0.029)**	**-0.095*** (-0.028)**
Transport mode, walking (ref.)			Age, 50 to 64 years	-0.042*** (-0.014)	-0.042*** (-0.014)
Transport mod, public transport	-0.164*** (-0.049)	-0.164*** (-0.049)	Age, 65 years and more	-0.045*** (-0.006)	-0.045*** (-0.006)
Transport mode, cycling	0.137*** (0.047)	0.137*** (0.047)	**Gender, female**	**-0.023*** (-0.010)**	**-0.248*** (-0.106)**
Transport mode, private motorised	-0.190*** (0.075)	-0.190*** (0.075)	***Travel activities***		
Distance, less than 15km (ref.)			Driving	0.098*** (0.016)	0.098*** (0.016)
Distance, 15 to 100 km	0.053*** (0.017)	0.053*** (0.017)	Cycling	0.100*** (0.024)	0.100*** (0.024)
Distance, more than 100 km	0.120*** (0.013)	0.120*** (0.013)	Talking	0.104*** (0.027)	0.104*** (0.027)
Trip frequency, regularly (ref.)			**Accompanying someone**	**0.084*** (0.025)**	**0.318*** (0.096)**
Trip frequency, occasionally	0.018*** (0.008)	0.018*** (0.008)	Eating	0.073*** (0.009)	0.073*** (0.009)
Trip frequency, first time	0.018** (0.005)	0.018** (0.005)	Thinking	0.142*** (0.040)	0.142*** (0.040)
Weekend	0.060*** (0.021)	0.060*** (0.021)	Browsing or social media	0.168*** (0.026)	0.168*** (0.026)
			Listening (including phone)	0.102*** (0.024)	0.102*** (0.024)

Note: standardised coefficients between parentheses; **** p <= 0.010, ** 0.010 < p <= 0.050, * 0.050 < p <= 0.100
Variables in bold also have a direct impact on the perceived WTT as already shown in Figure 2.

Table 2 presents the indirect and direct effects of exogenous variables on perceived WTT. Exogenous variables included trip and traveller characteristics (i.e., trip purpose, transport mode, distance, trip frequency, weekday/weekend, temperature, age, and gender). All exogenous variables have a significant indirect effect on the perceived WTT. These indirect effects exist because we hypothesised that exogenous variables influence first the travel activities and the perceived values of travel time, and then the perceived values influence the perceived WTT.

All four trip purposes have a positive indirect effect on perceived WTT. For example, respondents who travel for leisure, maintenance, or returning home are more likely to accompany someone, which subsequently has a positive direct effect on the perceived values of personal work and leisure, and eventually on the perceived WTT. Out of all trip purposes, leisure has the largest indirect effect on the perceived WTT (β = 0.035), followed by maintenance (β = 0.029), work and business (β = 0.016), and home (β = 0.012). Our analysis did not report a significant direct effect of trip purposes on perceived WTT. Thus, our results indicate that contrary to the classical utility theory in transport, travel time is valued for the activities one can perform on the move and not only for reaching a destination.

Regarding transport modes effects, the positive indirect effect of cycling on perceived WTT mainly exists because the use of a bike as a transport mode is also valued for the act of cycling itself, which subsequently influences the perceived value of travel time for enjoyment and fitness. The use of public transport, on the other hand, discourages various travel activities such as talking, thinking, eating and accompanying someone, which eventually results in a negative indirect effect on perceived values and the perceived WTT. Findings for car use are mixed. Car use is valued for the act of driving itself as a travel activity, which subsequently has a positive effect on the perceived values of travel time for paid work, personal tasks and surprisingly also fitness. However, the act of driving has a negative

impact on the perceived value of enjoyment and because this value is most important for the perceived WTT, car use eventually has a negative indirect effect on perceived WTT.

Contrary to travel satisfaction studies, our findings on perceived WTT indicate that trips longer than 15 km are considered more worthwhile compared to shorter trips. This finding suggests that a minimum distance is required to perform certain activities while travelling, otherwise one is 'stuck with a short trip' leaving not much room for engaging in any travel activity, making the travel time even more meaningless. This is also partly confirmed by our path analysis: all travel activities are more likely to occur on trips with distances longer than 15 km, except for accompanying someone for which no significant difference exists with trips shorter than 15 km. Furthermore, driving as the act of travelling itself is positively associated with trips between 15 and 100 km, but there is no significant difference between trips shorter than 15 km and trips longer than 100 km.

Table 2 also shows how regular and habitual trips are considered less worthwhile compared to occasional and first time trips. This might seem strange at first sight as we expected irregular trips to be associated with stress and therefore having a negative impact on perceived WTT. This may have been counterbalanced by the excitement that could also be associated with such irregular trips. However, we cannot fully capture this by the data collected so far. Also note that the relative importance of trip frequency is not that high compared to other variables.

Travel time is considered more worthwhile when travelling during the weekend. During the weekend trips are less constrained by time and people might be feeling less stressed compared to travelling on weekdays. Our path analysis shows how people value their travel time on weekends especially in terms of fitness and enjoyment, which then explains why trips during the weekend are considered more worthwhile compared to trips on weekdays.

Furthermore, trips during days with comfortable weather are considered more worthwhile compared to days with cool, warm or uncomfortably hot temperatures. Our path analysis indicates how especially on days with high temperatures, people are less likely to engage in activities while travelling, and this explains why they value their travel time less for paid work, personal tasks, fitness and enjoyment and eventually also consider travelling on warm and hot days as less worthwhile. Results for travelling on cool days are more mixed. Cool temperatures have a direct and positive impact on cycling as a travel activity, and thus seem not to discourage the appreciation of the cycling activity. Moreover, cool temperatures are also associated with higher perceived values of fitness and enjoyment compared to comfortable temperatures. However, these positive effects of cool temperatures do not counterbalance the many other negative effects (indirectly via other travel activities, or even directly on perceived WTT).

People aged 50 years and more are generally less positive about the worthwhileness of travel time. The path analysis shows how this negative indirect effect mainly exists because older people are less likely to engage in travel activities and because of that they have lower perceived values of travel time for paid work, personal tasks, fitness and enjoyment, which eventually explains why they perceive their travel time as less worthwhile compared to younger people. Results of the youngest age group (16 to 24 year old) are more mixed. One of these direct effects (see Figure 2) shows how 16 to 24-year old significantly perceive their travel time as less worthwhile compared to older age groups taking into account the direct effects on perceived WTT. However, as soon as the younger group participates in activities while travelling, and in particular in talking with others, browsing social media and listening to audio, they might still value their travel time as worthwhile. Nevertheless, this positive indirect effect via engagement in travel activities is not large enough to compensate for the negative direct effect.

Finally, there also appears to be a gender difference regarding perceived WTT, with women perceiving their travel time generally as less worthwhile compared to men. Gender has a negative indirect effect on perceived WTT because women are less likely to engage in activities while travelling such as talking, thinking and browsing social media, and they generally value their travel time less for paid work, personal tasks and fitness compared to men. On the other hand, women are more likely to engage in activities such as accompanying someone and eating compared to men, and they generally value their travel time more for enjoyment compared to men. But these positive indirect effects on perceived WTT do not counterbalance the many negative indirect effects. Moreover, gender has a significant and strong direct effect on perceived worthwhileness. This finding indicates that important gender differences exist in perceived WTT, independent from whether women engage in activities while travelling or not.

5. Conclusions

Our research explored empirically the influencing factors of WTT and their interactions, providing insights into the conditions under which travel time becomes worthwhile. We did this by applying a path analysis (SEM) based on the conceptual framework of WTT (Cornet et al. 2021, Fig.1). We focused in particular on the role that travel activities can play in creating value for travellers. According to the conceptual framework, travel activities are expected to

translate into a high overall WTT, compared to conditions under which no or little valuable travel activities are possible. Our conclusions based on our results are as follows.

First, the perceived WTT is directly influenced by the four perceived values of WTT (i.e. personal and work productivity, enjoyment and/or fitness). Although previous research has primarily focused on the value of 'paid' work productivity during travel, we identified the value of enjoyment to present the highest association with perceived WTT, followed by the value of 'unpaid' productivity gained by engaging in personal tasks and by the value of fitness (gained from active and semi-active modes, including walking).

Second, most travel activities have a direct impact on each of the four perceived values of WTT and an indirect impact on overall perceived WTT. For example, enjoyment is particularly enabled by listening to music and accompanying someone; personal productivity by the ability to browse the internet and engage in thinking; fitness by the act of cycling. The travel activity 'accompanying someone', was also found to have a significant direct impact on overall perceived WTT.

Third, women are less likely to engage in travel activities and therefore they report lower perceived WTT than men. They are also more likely to be accompanying someone, which underlines their traditional caring responsibilities in households, highlighting the importance of a gendered approach in transport planning. Young people find satisfaction by the ability to engage in various travel activities, but results indicate that these activities (talking with others, browsing or listening to music) only partially compensate for their feeling of wasting their time while travelling, therefore suggesting they are simply trying to 'kill time'.

Fourth, the trip purpose only has an indirect effect on perceived WTT, which suggests that travel time is much more than the purpose of travel. This outcome supports the growing literature arguing that the value of travel is not purely derived by the utility theory in transport.

Future research could (a) disaggregate the analysis by mode to better assess and understand modal specificities of the outcomes presented here, (b) include experience factors in the model, which are mostly mode-specific (e.g. seating availability in public transport, or the presence of safe infrastructures for cycling). Mode-specific path analysis would allow the expression of perceived WTT as a function of the perceived values of travel time, travel activities, experience factors and trip and traveller characteristics as described in the WTT conceptual framework. This could in turn pave the way for integrating quantitatively WTT in conventional transport appraisal methods.

References

Banister, D., Cornet, Y., Givoni, M., & Lyons, G., 2019. Reasonable Travel Time – The Traveller's Perspective. In R. Hickman, B. M. Lira, M. Givoni, & K. Geurs (Eds.), A Companion to Transport, Space and Equity - NECTAR Series on Transportation and Communications Networks Research, pp. 336.

Consonni, C., Basile, S., Manca, M., Boratto, L., Pourhashem, G., Kováčiková, T., Freitas, A., & Cornet, Y., 2020. MoTiV: a Dataset of European User Mobility for Behavioral-Data. https://doi.org/10.5281/zenodo.4027465

Cornet, Y., Barradale, M. J., Bernardino, J., & Lugano, G., 2019. Worthwhile Travel Time: Design Challenges of Capturing the User Experience by Smartphone. 2019 Smart Cities Symposium Prague, pp.1–9. https://doi.org/10.1109/SCSP.2019.8805706

Cornet, Y., Lugano, G., Georgouli, C., & Milakis, D., 2021. Worthwhile travel time: a conceptual framework of the perceived value of enjoyment, productivity and fitness while travelling. Transport Reviews, pp. 1–24. https://doi.org/10.1080/01441647.2021.1983067

De Vos, J., Mokhtarian, P. L., Schwanen, T., Acker, V. Van, & Witlox, F., 2015. Travel mode choice and travel satisfaction : bridging the gap between decision utility and experienced utility. Transportation 43, pp. 771-796. https://doi.org/10.1007/s11116-015-9619-9

Ettema, D., Friman, M., Gärling, T., Olsson, L. E., & Fujii, S., 2012. How in-vehicle activities affect work commuters' satisfaction with public transport. Journal of Transport Geography, 24, pp. 215–222. https://doi.org/10.1016/j.jtrangeo.2012.02.007

Fang, K., & Ma, S., 2017. Analyzing large datasets with bootstrap penalization. Biometrical Journal, 59(2), pp. 358–376.

Lin, M., Lucas, H. C., & Shmueli, G., 2013. Too big to fail: Large samples and the p-value problem. Information Systems Research, 24(4), pp. 906–917. https://doi.org/10.1287/isre.2013.0480

Lyons, G., & Urry, J., 2005. Travel time use in the information age. Transportation Research Part A: Policy and Practice, 39(2–3), pp. 257–276.

Metz, D., 2008. The Myth of Travel Time Saving. Transport Reviews, 28(3), pp. 321–336. https://doi.org/10.1080/01441640701642348

Mokhtarian, P. L., 2018. Subjective well - being and travel : retrospect and prospect. Transportation, 46(2), pp. 493-513.

Ory, D. T., & Mokhtarian, P. L., 2005. When is getting there half the fun? Modeling the liking for travel. Transportation Research Part A: Policy and Practice, 39(2-3 SPEC. ISS.), pp. 97–123. https://doi.org/10.1016/j.tra.2004.09.006

Wardman, M., & Lyons, G., 2016. The digital revolution and worthwhile use of travel time: implications for appraisal and forecasting. Transportation, 43(3), pp. 507–530. https://doi.org/10.1007/s11116-015-9587-0

Acknowledgements

This publication was realized with support of Operational Program Integrated Infrastructure 2014 - 2020 of the project: Innovative Solutions for Propulsion, Power and Safety Components of Transport Vehicles, code ITMS 313011V334, co-financed by the European Regional Development Fund.