Hypothesis testing: Exploring the links between boat commuting & wellbeing

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Abstract

Background

Literature linking transport and wellbeing has been growing recently (e.g. Friman et al., 2017; and Mokhtarian et al., 2015). However, most studies do not specifically focus on a travel mode in particular, and very few papers, to our knowledge, address the case of water transport (Susilo et al., 2017). Therefore, there is a gap in appraising how people enjoy (or not) their traveling experience and daily commutes in particular (Machoney, 2015).

Objective

Therefore, the objective of this paper is to explore ways to increase travel satisfaction of commuters by promoting sustainable transport modes, focusing on inland waterways transport (IWT). In fact, boat commuting has been identified by Tanko & Burke (2017) as having a valuable non-monetary contribution to people's wellbeing (Reardon and Abdallah, 2013). In the light of this, we aim to measure the influence of wellbeing items in commuting mode decisions, and in turn, to quantify the wider impacts of boat commuting on people's wellbeing.

Methods and results

To this end, we design a survey, comprising socio demographics, travel habits, commute satisfaction and life evaluation based on the contemporary topical literature to capture individual's emotive response to travel. The survey is administered face-to-face to a random sample of 323 London commuters, whose main commuting modes are one of the three following public transportation (PT) modes: boat, DLR, and train. In complement of this *subjective* measure of wellbeing, we infer categories of emotions from collected respondents' selfies at the end of the survey as done in Walecki et al. (2017). This constitute our *objective* measure of wellbeing. Convolutional neural network (CNN) will be used in this regard to detect facial components, extract features and map participants' expressions, combining with wider existing samples (Ko, 2018; Paralleldots, 2017). Recording heart rate and blood pressure levels of commuters when using different PT modes could be a further extension of this objective measurement of wellbeing, by equipping our sampled commuters with biometric sensors. Statistically testing our hypotheses, we find that wellbeing variables rank higher in the preferences of boat commuters than in those of the non-boat users. Interestingly, 3 *profiles* of commuters seem to emerge among the respondents/pre-identified commuting mode users. In all cases, life satisfaction significantly influences travel satisfaction.

Introduction

Questions:

1. To what extent individual wellbeing (e.g. life evaluation) impacts travel preferences (e.g. commuting mode decisions).
2. To what extent travelling behaviour/movement/pattern influences individual wellbeing.

Objectives:

1. To increase travel satisfaction of commuters by promoting sustainable transport modes, focusing on inland waterways transport (IWT).
2. To understand links between transport and wellbeing through looking at life evaluation and travel satisfaction.
3. To understand the impact that experiences and emotions while travelling may have on contrasted aspects of wellbeing (Aftabuzzaman and Mazloumi, 2011), and this in order to promote sustainable transportation modes.

Theories:
Different approaches to measure wellbeing

Study	Scales/methods	Contents
Diener et al. (1985); Pavot & Diener, (1993)	Satisfaction with Life Scale (SWLS)	Five self-report statements (e.g. "I am satisfied with my life") are rated on 7-point Likert scales ranging from "totally disagree" to "totally agree".
Kahneman and Deaton, (2010)	Cantril's Self-Anchoring Scale	To ask participants to rate their current life on a "ladder" from 0 "the worst possible life for you" to 10 "the best possible life for you".
Stone et al. (1999)	Instantaneous self-reports (of specific emotions and moods)	Participants report their affective experiences during travel activity by using survey/device (e.g. smartphone).
Kahneman et al. (2004)	Day Reconstruction Method (DRM)	To list ratings of specific momentary emotions from memory of past episodes.
Watson et al. (1988)	Positive Affect and Negative Affect Scale (PANAS)	To measure the affect components both from memory (e.g. how people have felt during a past period) and as instantaneous reports of current moods.
Olsson et al. (2013) and Suzuki et al. (2014)	The multi-item Satisfaction with Travel Scale (STS)	To measure satisfaction with the most recent normal commute to and from work, either as a whole or for each stage

Source: Gao et al (2017)

Assumptions on commuters' travel satisfaction levels:

	Null hypothesis	Alternative hypothesis
Hypotheses 1 of differences among boat users and non-boat users	Commuters on boat rate wellbeing variables more favourably than non-boat users	Boat and non-boat PT users consider wellbeing variables equally in their travel decisions
Hypothesis 2 of understanding different transport mode users' characteristics	3 profiles (users of boat, DLR, and train) of commuters tend to have their own socio demographics (e.g. age, gender, stress level, etc), and level of travel satisfaction and life evaluation.	There will not be further differences among different transport mode commuters depending on different socio demographics (e.g. age, gender, stress level, etc), and level of travel satisfaction and life evaluation.
Hypothesis 3 of how life evaluation influences travel satisfaction	There is a significant effect of life evaluation variables to travel satisfaction.	There is not a significant effect of life evaluation variables to travel satisfaction.

Current research:

Study	Contents	Methodology
Ory and Mokhtarian (2005)	Travel and personal life style	Regression analysis
Spinney et al. (2009)	Transport mobility benefits Quality of life	ANOVA
Currie et al. (2010)	Subjective well-being Transport difficulties Social exclusion	Structural Equation Model
Duarte et al. (2010)	Stated happiness	Multi-linear regression analysis
Abou-Zeid and Ben-Akiva (2011)	Commute and wellbeing	Structural equation model
Bergstad et al. (2011)	Daily travel satisfaction with SWB	Regression analysis
Delbosc and Currie (2011)	Transport SWB and social exclusion	Factor analysis; ANOVA

Source: Gao et al (2017)

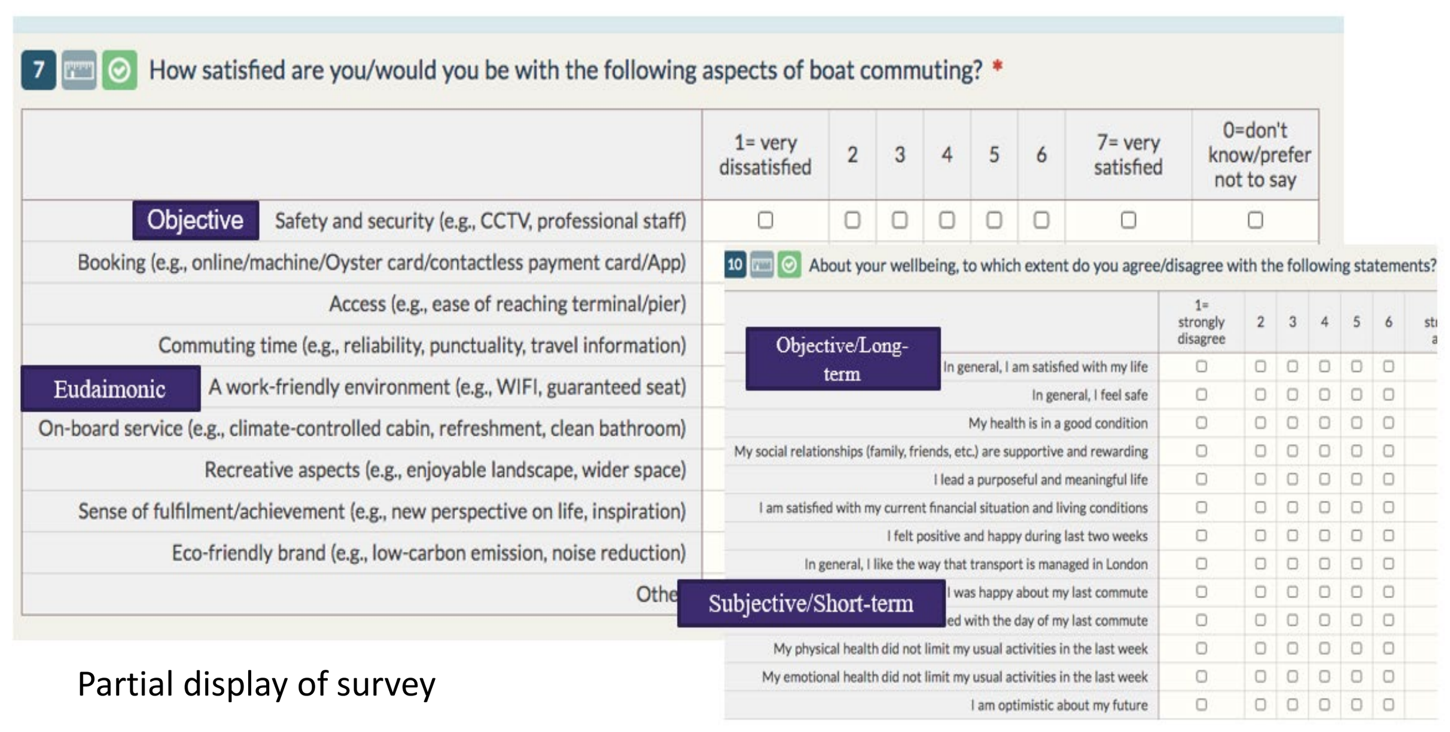
Methods

Data collection procedure and measurement concepts

Data are collected in London, the United Kingdom. London is the capital and the largest city of the United Kingdom, standing on the River Thames in south-eastern England, with a population of 8.6 million people (Transport for London, 2017).

Subjective measurement of wellbeing: Survey

With the objective to increase the travel satisfaction of commuters by promoting sustainable transport modes (e.g. boat commuting) and reducing urban mobility disruptions, the survey comprises socio-demographics, travel satisfaction and habits, and life satisfaction. The concept of wellbeing cannot be expressed by just one definition (Popova, 2017), which renders difficult its evaluation. To avoid partial solutions and get comprehensive overview of wellbeing components, I insert wellbeing questions in travel habits and satisfactions, as well as life satisfactions.



Partial display of survey

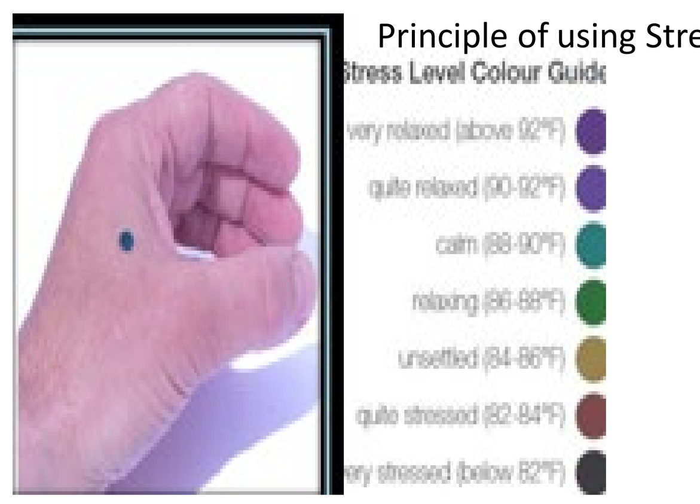
Objective measurements of wellbeing: StressDots © and Facial emotion recognition

Survey is a self-reported measurement, which is not accurate sometimes because passengers tend to have wrong feelings. Based on that, I consider an objective measurement of wellbeing, which is to use StressDots © for capturing passengers' stress level and to use an Application for capturing passengers' facial emotions.

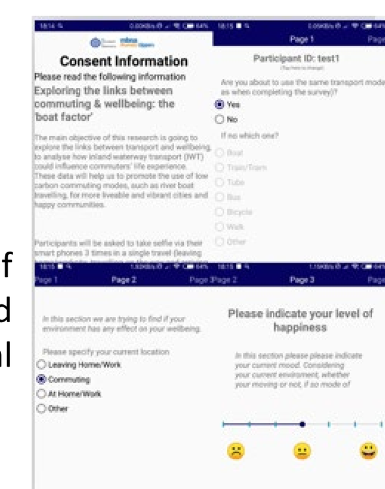
There are very few empirical studies on the differences between various modes of commute on commuters stress and mood (Javadian, 2014). *StressDots ©* a galvanic skin response sticker which reveals participants' stress level by human's relaxation status (changes of muscle tension and blood vessels).

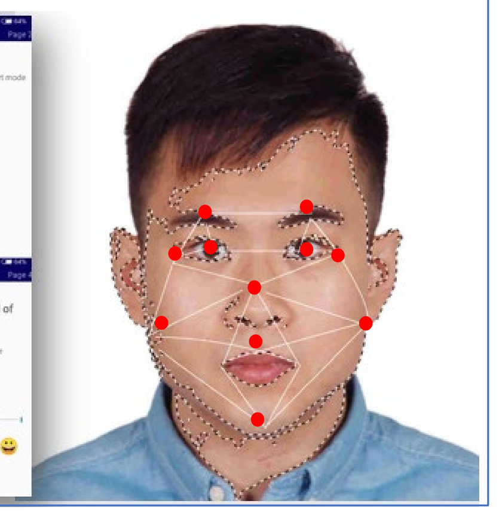
For ethical consideration, Mr Terry Brett and I design a mobile application to save data to University OneDrive when capturing passengers' facial images. From these pictures, I will then use facial emotions recognition techniques to predict feelings about transportation. Conventional neutral network (CNN) algorithm will be used to identify facial images and predict emotions (Ko, 2018).

Principle of using StressDots ©



Partial display of Application and principle of facial emotion recognition





Sample description and data validation

		Observations	Percentage (%)
Commuting mode	Boat	115	35.6
	DLR	101	31.3
	Train	107	33.1
Age	18-24	46	14.2
	25-34	111	34.4
	35-54	129	39.9
	55-64	30	9.3
	Overall 65	7	2.2
Gender	Male	177	54.8
	Female	146	45.2
Education level	GCSEs	26	8.0

To ensure the survey provides sound, consistent, and relevant information, reliability and validity are tested by using exploratory factor analysis (EFA) (Litwin, 1995).

Results of factor analysis

Index 1: Self-fulfilment	Index 2: Basic needs	Index 3: Subjective experiences
• Work-friendly environment • On-board service • Recreative aspects • Sense of fulfilment • Eco-friendly brand	• Safety and security • Booking • Access	• London transport management • Satisfaction for last commute • Satisfaction for last day

I also test the Means and Cronbach's Alphas for each index, which supports the validity of this study.

Results and discussions-

First Hypothesis testing

Independent-Sample t Tests, Comparing Boat Users' and Non-boat Users' Satisfaction

	Boat users		Non-boat users		Mean differences	p	Effect size (Cohen's d)
	M	SD	M	SD			
Index 1	5.787	1.100	4.479	1.475	1.307	0.000	0.877
Index 2	6.160	0.998	5.355	1.275	0.804	0.001	0.647
Index 3	5.656	1.120	5.043	1.443	0.613	0.001	0.448
Overall travel satisfaction	5.851	0.857	4.873	1.205	0.978	0.000	0.822

The aim of Hypothesis 1 is to examine the possible existence of a satisfaction gap between boat users and non-boat users of PT. Analyses are made of satisfaction with travel satisfaction comparing commuters frequently using boat with commuters frequently use non-boat transport modes (e.g. DLR and train). To do so, I perform independent t tests. Null hypothesis is accepted.

Second Hypothesis testing

		Boat		DLR		Train	
	Variables	Mean	*Score	Mean	*Score	Mean	*Score
Life evaluation	In general, I feel safe	6.10	7	5.65	6	5.58	6
	My health is in a good condition	6.12	7	6.07	7	5.81	6
	My social relationships (family, friends, etc.) are supportive and rewarding	6.18	7	6.21	7	5.86	6
	I lead a purposeful and meaningful life	5.88	6	6.04	7	5.85	6
	I am satisfied with my current financial situation and living conditions	5.76	6	5.42	6	5.17	6
	I felt positive and happy during last two weeks	5.99	6	5.80	6	5.48	6
	I am optimistic about my future	6.25	7	6.29	7	5.80	6
	My physical health did not limit my usual activities in the last week	6.15	7	6.37	7	6.05	7
	My emotional health did not limit my usual activities in the last week	6.25	7	5.65	6	5.88	6
	Overall life evaluation	6.07	7	6.00	6	5.71	6

*Note: 1=0.00-1.00 (Very bad); 2=1.01-2.00 (Bad); 3=2.01-3.00 (Slightly bad); 4=3.01-4.00 (Moderate); 5=4.01-5.00 (Slightly good); 6=5.01-6.00 (Good); 7=6.01-7.00 (Very good)

Hypothesis 2 aims at specifying profiled transport mode users. I use the Measurable Indicator Scoring Technique (MIST) . From partial of the table, I can see different transport mode users tend to have their own and profiled characteristics, which proves null hypothesis is accepted. For instance, boat users tend to be elder, richer, and with higher education and travel satisfaction.

Third Hypothesis testing

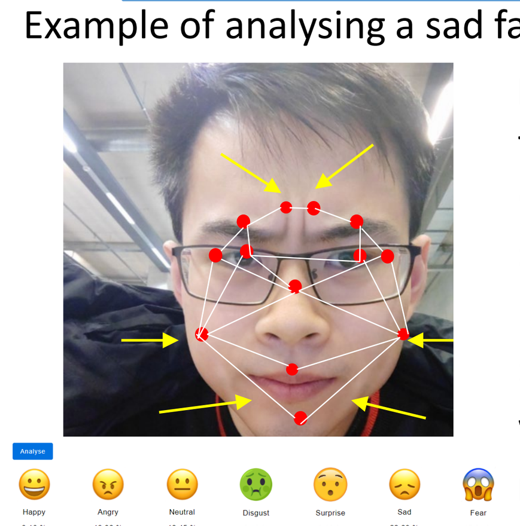
		Estimate	Sig.
Threshold	[Travel_satisfaction= 1]	0.896	0.262
	[Travel_satisfaction= 2]	2.645	0.000
	[Travel_satisfaction= 3]	3.873	0.000
	[Travel_satisfaction= 4]	4.621	0.000
	[Travel_satisfaction= 5]	5.849	0.000
	[Travel_satisfaction= 6]	7.451	0.000
Location	In general, I feel safe	0.441	0.000
	My health is in a good condition	0.476	0.002
	My social relationships (family, friends, etc.) are supportive and rewarding	0.163	0.293
	I lead a purposeful and meaningful life	-0.491	0.001
	I am satisfied with my current financial situation and living conditions	0.184	0.049
	I felt positive and happy during last two weeks	0.294	0.012
	I see myself as calm and reserved	0.102	0.322
	I am optimistic about my future	0.009	0.948
	My physical health did not limit my usual activities in the last week	-0.102	0.389
	My emotional health did not limit my usual activities in the last week	-0.012	0.929

The following general estimated equation was obtained:. $Logit = a_j - [+0.441(In\ general, I\ feel\ safe) + 0.476(My\ health\ is\ in\ a\ good\ condition) - 0.491(I\ lead\ a\ purposeful\ and\ meaningful\ life) + 0.184(I\ am\ satisfied\ with\ my\ current\ financial\ situation\ and\ living\ conditions) + 0.294(I\ felt\ positve\ and\ happy\ during\ last\ two\ weeks)]$. Where $a_1 = 0.896, a_2 = 2.645, a_3 = 3.873, a_4 = 4.621, a_5 = 5.849,\ a_6 = 7.451$ are the values for the six intercepts a_j.

The aim of Hypothesis 3 is to understand if and how life evaluation influences travel satisfaction. The ordinal logistics regression (OLR) analysis is adopted in order to estimate the weight of the life evaluation variables (Eboli and Mazzulla, 2009). The OLR tests reveals that life evaluation has significant influence to travel satisfaction, especially for the above-mentioned variables.

Proof of evidence from objective measurement of wellbeing and Next step

Example of analysing a sad face



Results from facial emotion recognition reveal most of participants indicate accurate feelings in the survey. It proves the validity of research findings. Results from StressDots © are not significant. OLR cannot be used when the raking of categories is close (Menard, 2002). Structural equation modelling (SEM) will be used in future. Doing so, I can understand the complex relationships among different variable (Weston and Gore, 2006).In next step, we will use devices to capture objective wellbeing data, such as fitbit to capture heart rate, and facial emotion recognition.

References

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