Motivators to participate in the Danish bike-to-work campaign

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Abstract

The current study investigates the success of the Danish bike-to-work campaign (Vi cycler til arbejde), a best practice example of the Danish planning approach promoting modal shift with a shared vision, and innovative self-sustaining institutional programs and business solutions. Rather than relying on tax exemptions or subsidiaries, the campaign largely depends on its ability to cater for people's functional and emotional needs. Therefore the present study focuses on the role of existence, relatedness and growth in encouraging participation in the campaign. A behavioural framework was formulated, and data collected from an online survey developed during the study was used to validate the framework and estimate corresponding mathematical models.

Results indicate that (i) growth needs are positively influenced by existence and relatedness needs (ii) participation is positively related to self-actualization and negatively related to perceived cycling difficulties, (iii) social norms and bonding are a stronger contributor to competitiveness than fitness or health needs, (iv) firm's consistent participation in the campaign over several years is an important factor in the participation of its employees, (v) cycling experience is positively associated with less perceived difficulties, and (vi) needs are positively associated with cycling habits on weekdays/weekends, the availability of a mountain bike/BMX and recreational and utilitarian cycling purposes.

1. Introduction

Literature suggests that active travel in the form of cycling and walking has a lot of positive implications (see e.g. Petrunoff et al. (2016) for a recent review). Active travellers are mentally more well-being (higher life satisfaction and lower stress level) and are healthier (higher likelihood of participating in other physical activities as well as a lower cardio-vascular risk and likelihood of lifestyle-related deceases such as diabetes). Also, as travel demand for travel increases in the future it is important to consider active travel as an attractive alternative; with increasing urbanisation and demand for travel, travelling by private motorised vehicles will cause even larger congestion and pollution.

In order to facilitate an increase in active travel, it is important that people are made aware of its positive aspects. This can be sought done through campaigns. The design of these campaigns should be carefully considered, to ensure that they are attractive and effective. Only thereby is it ensured that people are motivated to participate and that the transition to active travel becomes permanent and not only during the campaign. Also, while many campaigns are directed at specific purposes (e.g., promoting the use of bicycle to work), they should induce more active travel in general.

This study will focus on the Danish bike-to-work campaign (VCTA, 2016), which promotes the use of bicycle when travelling to and from work. The Danish campaign is very successful and unique in not providing any direct monetary subsidies – it is funded by the participating firms or employees themselves. I.e. it is not the direct monetary savings or a potential tax exemption that motivates the participation and drives people to bicycle. Rather, the success seems to rely solely on its ability to cater for people's functional and emotional needs. This study seeks to identify the factors which motivate the participation in the Danish bike-to-work campaign, with special focus on the role of the basic needs of existence, relatedness and growth in encouraging participation in the campaign. In order to do so, a conceptual framework is formulated. To test the framework and identify the factors that motivate participation, two corresponding mathematical models are developed and tested on a revealed preference dataset. The dataset consists of a large number of responses to an online questionnaire designed during the study.

The remainder of the paper is organized as follows. Section 2 introduces the conceptual framework used, inspired by Alderfer's ERG theory, and formulates the two modelling forms of the framework. Section 3 describes the data collection, survey design and gives some descriptive statistics of the data collected. Section 4 presents the results of an initial factor analysis as well as the results of the structural equation models. Subsequently, discussions and conclusions are given in section 5.

2. Method

The behavioural framework for this study is based on the ERG theory (Alderfer, 1969) under the hypothesis of its usefulness for describing peoples need for participating in the Danish bike-to-work campaign. Alderfers' ERG theory assumes that a person has three core needs which are the material *existence* lower-order needs (exercise, health, time and monetary saving), needs to maintaining a interpersonal *relatedness* with other people (togetherness and peer-acceptance), and a personal development or *growth* needs (self-esteem, competiveness and mastery, self-identity as a cyclist, and self-actualization with respect to environmental sustainability and fitness). In this study, two model forms of the behavioural framework are hypothesized and graphically represented in Figure 1. The first model forms a framework where the bike-to-work participation are directly associated with existence, relatedness, growth and difficulties where model 2 forms a behavioural framework

where growth needs are hypothesised to be influenced by the needs of existence and relatedness need.
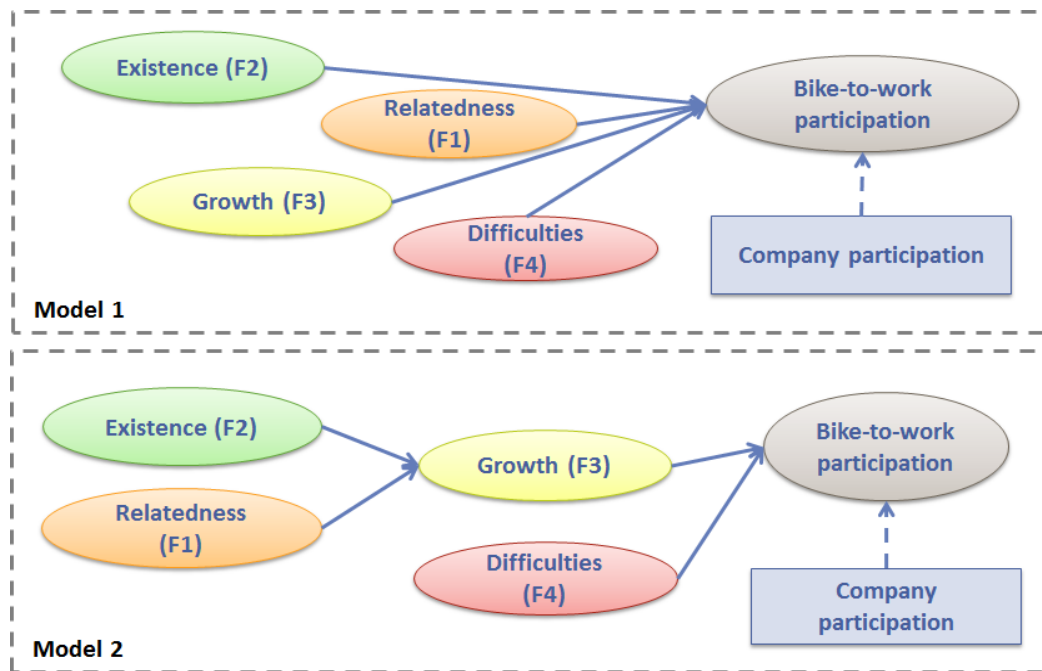

Figure 1: Two representations of the behavioural framework

The hypothesized behavioural framework was investigated via the formulation of two corresponding structural equation models (SEM). These models are particularly useful in accommodating the latent nature attitudinal constructs with the observed nature of travel patterns and socio-economic characteristics. Specifically, the SEM models in this study contained three sets of equations: measurement equations (eq. 1), structural equations linking the latent attitudinal constructs to the person characteristics, cycling habits and work place (eq. 2), and structural equations relating the latent attitudinal constructs to participation in the bike-to-work campaign (eq. 3).

$$I_{dn} = Z^{*}_{ln}\alpha_d + \upsilon_{dn} \quad and \quad \upsilon_n \sim N\left(0, \Sigma_{\upsilon}\right) \quad for\ d = 1,...,D \tag{1}$$

$$Z^{*}_{ln} = SC_{ln}\beta_{l1} + CH_{ln}\beta_{l2} + CA_{ln}\beta_{l3} + \omega_{ln} \quad and \quad \omega_n \sim N\left(0, \Sigma_{\omega}\right) \quad for\ l = 1,...,L \tag{2}$$

$$R^{*}_{in} = Z^{*}_{ln}\beta_r + \xi_{in} \quad and \quad \xi_n \sim N\left(0, \Sigma_{\xi}\right) \quad for\ i = 1,...,I \tag{3}$$

where Z^{*}_{ln} is the value of latent construct l for person n, I_{dn} is the value of an indicator d of the latent construct Z^{*}_{ln} as perceived by person n, SC_{ln} is a vector of socio-economic characteristics, CH_{ln} is a vector of cyclists' cycling habits, CA_{ln} is a vector of work place characteristics, and R_{in} is a vector of previous participation in the bike-to-work campaign. Error terms are expressed as elements μ_{dn}, ω_{ln}, and ξ_{in} of the vectors following a normal distribution with respective covariance matrices Σ_{ω}, Σ_{υ} and Σ_{ξ}, while parameters to be estimated are α_d, β_{l1}, β_{l2}, β_{l3}, and β_r. Considering D indicators translates into writing D measurement equations and estimating a (D×1) vector α of parameters (i.e., one parameter is estimated for each equation), while considering L latent constructs translates into writing L structural equations and estimating an (M×L) matrix of β parameters (i.e., M parameters are estimated for each equation).

The model was estimated with M-Plus. The vector α of parameters of the measurement equations and the vectors β's of parameters of the structural equations were estimated simultaneously by using Maximum Likelihood with Huber-White covariance adjustment (Yuan and Bentler, 2000) and standard errors from the White's sandwich-based estimator that produces robust statistics in the presence of non-normality of the indicators and the categorical variables (White, 1980). Goodness-of-fit (Browne and Cudeck, 1993) was evaluated with the traditional descriptive measure of chi-square test alongside the Root Mean Square of Approximation (RMSEA) and the weighted root mean square residual (WRMR).

3. Data

The data for the analysis were collected via a custom-designed web-based questionnaire which seeks to understand the "secret" behind the success of the Danish bike-to-work 'Vi cykler til arbejde' campaign.

The Danish 'Bike-to-work' campaign

The Danish bike-to-work program started in 1997, and has become an annual tradition. Bike-to-work provides the opportunity for firms and employees to experience the positive aspects of active commuting. The 30-days campaign, which takes place during the month of May, is a prize-winning team competition across firms competing on cycling days and distance. During the campaign, the participating individuals and teams receive information regarding their monetary savings, burnt calories, sparred CO_2 emissions and reduction of sick days. In contrast to bicycle subsidy benefit or taxation exemptions, the campaign relies on funding from the private sector, as it is financed by the participating firms, with a fee of 7 Euros per participating employee. In the year 2014, 70,884 employees from 6,933 workplace teams took part in the campaign, producing 10 million cycling kilometres in over 820 thousand cycling days.

Survey administration

The data was collected as an online revealed preference survey, which was designed based on a focus-group consisting of cyclists or people interested in cycling. The survey was distributed among 9,553 firms across various industrial sectors in Denmark with more than 10 employees. Respondents were given the chance of winning one of several gift cards – the total value of the incentives (gift cards) were 3,300 DKK.

The survey collects information on individual socio-economic characteristics, workplace characteristics (size, location, sector) and cycling habits, as well as information related to the ERG needs existence, relatedness and personal grow. The attitudinal items were measured on a 5-point Likert scale. In order to facilitate the possibility to model the influence of the ERG needs, the questions concerning these are designed in a way allowing each question to be related to only one need.

Descriptive statistics

The survey yielded a total of 2,489 questionnaires of which 2,057 (83%) were completed without missing data and thus served the basis for the subsequent data analysis and model estimation. 59 % of the respondents are women, and the respondents are reasonably distributed across the span of typical age when active on the labour market (Figure 2).
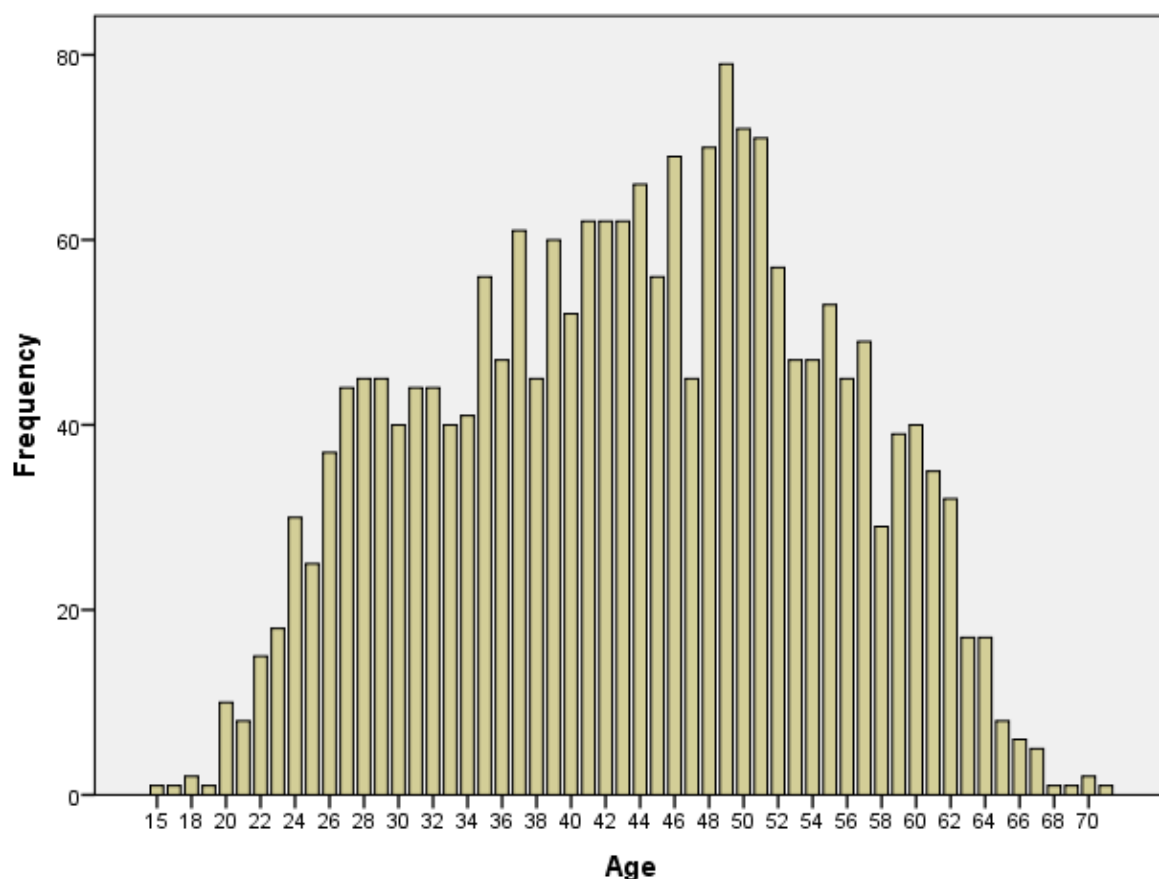
Figure 2: Respondents age distribution

In terms of geographically work place location, 52% of the respondents are working on Zealand, most of them in the Copenhagen Region (44%), 23% in Central Denmark Region, 6% in North Denmark Region and 19% in Region of Southern Denmark . Most of the respondents (81%) have access to a regular bike, whereas 19% have access to a mountain bike or BMX, 20% to a racer bike and 4% to an electric bike. Among the respondents, 76 % have access to one bike, 23% to two or more bikes and only 1% do not own a bike.

The cycling habits of the respondents show that there is a mix in number of days cycled on a weekly basis: 55% of the respondent cycle 4 days a week or more, but at the same time 21% cycle rarely or never. The distance cycled per week day also varies greatly: 37% cycle less than 5 km, 30% between 6 and 10 km, 22% between 11 and 20km, and 11% more than 21 km. Most of the respondents use the bicycle for utilitarian purposes, as 30% views it only as a commuting mode and 63% views it as both a commuting mode and a sport activity, while only 7% use the bicycle exclusively for exercise.

4. Results

Initially, exploratory factor analysis elicited the ERG needs and perceived difficulties for cycling. The indicators in the survey show good internal consistency (Cronbach's Alpha = 0.847) and good sampling adequacy at the overall level (Kaiser-Meyer-Olkin = 0.880). Most relevantly, exploratory principal axis factor analysis with Varimax orthogonal rotation uncovered the expected following four factors: "existence needs", "relation needs", "growth needs" and "perceived difficulties for cycling in general", see Table 1. These four factors were considered with their respective indicators in the SEM measurement equations.

Table 1 – Results of the Factor analysis

Question	Rotated component matrix			
	Relation	*Existence*	*Growth*	*Difficulties*
I would like to improve my physical shape	.054	**.793**	.124	-.012
I connect cycling with a more healthy lifestyle	.064	**.836**	.070	-.089
I get my daily exercise	.068	**.785**	-.002	-.054
I love to cycle and breathe fresh air	.043	**.765**	.010	-.126
I save money by taking the bike to work	.049	**.424**	.080	.055
I don't like to be dependent on public transport	.065	**.318**	.023	-.049
I am generally in a better mood when I bike to work	.115	**.636**	.065	-.143
I like the cohesiveness among the cyclist at my workplace	**.678**	.170	.273	-.045
Co-workers which are important for me, bike to work	**.814**	.074	.072	.049
Co-workers which are important for me, support me in taking the bike to work	**.798**	.137	.136	.022
Co-workers which are important for me, expect me to bike to work	**.778**	.081	.102	.037
Most of my work colleagues bike to work	**.423**	-.069	-.019	.195
I think the mood is better at my workplace during bike-to-work campaign	**.683**	.048	.309	.065
I want to participate in the bike-to-work campaign since most of my colleagues participate	**.640**	.010	.268	.075
I think it is good that there is possibilities talk or exchange funny emails with my co-workers about the bike-to-work campaign	**.623**	.057	.412	.010
I think it is good that there is a possibility to compete with my colleagues against other bike-to-work teams	**.559**	.062	.519	-.013
I like to compete against my work colleagues	.231	.007	**.806**	.022
I like to challenge and be challenged by my work colleagues	.236	.042	**.807**	.022
I bike because I consider myself as green	.128	**.428**	.182	.060
I bike because I consider myself to be health conscious	.071	**.591**	.259	-.019
I bike because I consider myself as a dedicated cyclist	.100	**.406**	.248	-.010
I consider cycling to work during the campaign more as a sport activity	.274	.153	**.648**	.027
I cycle more and longer when I need to document my activity	.206	.120	**.677**	.050
I like to win some of the nice prices in the bike-to-work campaign	.138	.171	**.576**	.039
My road to work is too difficult	.018	-.002	-.016	**.588**
Distance to work are too long	-.008	-.067	.026	**.507**
There are too many non-safe roads in my area	.033	.000	-.010	**.616**
There are too many cyclists on the bicycle lanes	.086	-.077	-.063	**.649**
I have not access to a bathroom at my workplace	-.005	-.006	-.039	**.624**

There are no good bike parking at my workplace	*.022*	*-.029*	*.016*	***.624***
There is a dress code at my workplace	*.045*	*-.039*	*.075*	***.642***
I normally deliver or pick up kids on the way	*.027*	*-.078*	*.150*	***.384***
I am normally too tired to cycle	*.051*	*-.148*	*.050*	***.543***

Turning to the SEM models, goodness-of-fit indices revealed that Model 2 is by far better suited to the data than Model 1 (see Figure 1). For Model 1, the CFI is 0.795, the RMSEA is equal to 0.068, and the WRMR is 4.124, whereas for Model 2, the CFI is 0.910, the RMSEA is equal to 0.047, and the WRMR is 2.858. Accordingly, the model estimates and their P-value are presented only for Model 2. Estimates for the structural equations linking the ERG needs to cyclists' and person characteristics are shown in Table 2, and estimates for the structural equations linking the participation in the bike-to-work campaign to the ERG needs and the firm participation history are shown in Table 3.

Table 2 – Estimates of the structural equations explaining the ERG needs

Existence			Relatedness		
Variable	Est.	P-value	Variable	Est.	P-value
Male	-0.315	0.000	Male	-0.159	0.000
Age	0.004	0.037	Distance to work 0-5km	0.117	0.124
Utilitarian and recreation	0.488	0.000			
Workplace sector:			**Workplace sector:**		
Education sector	0.077	0.076	Arts, entertainment, sport	0.099	0.106
			Prof and tech. services	-0.218	0.025
Mountain bike, BMX …	0.122	0.013	Mountain bike, BMX …	0.101	0.041
			Roadbike (Racer)	0.090	0.082
Daily cycling :			**Daily cycling:**		
11-20km on weekday	0.344	0.000	6-10km on weekdays	0.083	0.108
21-30km on weekday	0.39	0.000	6-10km on weekends	0.106	0.024
31-40km on weekday	0.701	0.000	11-20km on weekends	0.183	0.012
> 40km on weekday	0.624	0.000	31-40km on weekends	-0.245	0.060
6-10km on weekends	0.108	0.021	>40km on weekends	0.221	0.007
11-20km on weekends	0.136	0.054			
21-30km on weekends	0.247	0.034			
>40km on weekends	0.161	0.082			
Cycling to work:			**Cycling to work:**		
2-3 days of month	0.238	0.007	Bicycle + transit	0.224	0.116
1 day of week	0.201	0.069			
2-3 days of week	0.269	0.001			
4-5 days of week	0.316	0.000			
Every day	0.463	0.000			
Growth			Difficulties		
Variable	Est.	P-value	Variable	Est.	P-value
Age	-0.011	0.000	Age	-0.009	0.000
Mountain bike, BMX …	0.129	0.010	Utilitarian and recreation	-0.073	0.055
			Has lived in DK since child	-0.189	0.003
Workplace sector:			**Workplace sector:**		

Variable	Estimate	P-value	Variable	Estimate	P-value
Manufacturing	0.270	0.005	Manufacturing	-0.114	0.114
Financial and real estate	-0.318	0.019	Public utilities	-0.187	0.147
Education	-0.182	0.000			
Daily cycling :			**Daily cycling :**		
31-40km on weekdays	0.197	0.169	31-40km on weekdays	0.197	0.169
31-40km on weekends	0.505	0.001	21-30km on weekends	-0.242	0.020
>40km on weekends	0.134	0.129	>40km on weekends	-0.224	0.010
			Cycling to work:		
Relatedness factor	0.815	0.000	2-3 days of month	-0.164	0.017
Existence factor	0.346	0.000	1 day of week	-0.164	0.094
			2-3 days of week	-0.340	0.000
			4-5 days of week	-0.524	0.000
			Every day	-0.575	0.000
			Distance to work:		
			6-10 km	-0.399	0.000
			11-15 km	-0.243	0.000
			16-20 km	-0.164	0.022

When examining the estimates of the structural equations in Table 2, the ERG needs and difficulties for cycling are mainly related to number of days and distance cycled in weekdays and weekend and age.

Existence needs are stronger for female respondents and respondents working with education. Respondents using the bike for exercise *and* transport (0.488) have a higher existence need than respondents who only using the bike for one purpose. The existence need is highest for respondents who are dedicated cyclists and cycle more than 30 km in weekdays and uses the cycle to work every day.

The *relatedness* need in terms of togetherness and peer-acceptance are stronger for females and lower for respondents working in the professional, scientific and technical service sector (-0.218). Respondents cycling between 31 and 40 km in weekends have much less need for relatedness to other people than respondents cycling less. Respondents using the bike together with public transport as transportation to work (0.224) have a higher need for relatedness with other people than respondents taking the car, public transport or bike all the way.

Difficulties for taking the bike to work and participate in the bike-to-work campaign are perceived lowest for respondents which can be described as dedicated cyclists and cycle between 31 and 40 km in weekdays (-0.249) and between 21 and 30 km in weekends (-0.242). Respondents who have lived in Denmark since childhood perceive the difficulties for taking the bike to work lower than other respondents. The perceived difficulties increase with the respondents distance to work and decrease with the number of days normally cycling to work.

The needs for personal development or *growth* are stronger for mountain bike and BMX owners together with dedicated cyclists who cycle between 31 and 40 km in weekdays (0.197) and weekends (0.505). The *growth* ERG need is positively influenced by the *relatedness* and *existence* needs.

Table 3 – Estimates of the structural equations explaining the bike-to-work participation

Variable	Estimate	P-value
Firm participates every year	2.141	0.000

Firm participated a few times	1.339	0.000
Firm participated in 2016	0.704	0.020
Firm never participated	-0.432	0.000
Growth factor	0.172	0.000
Difficulties factor	-0.164	0.000

When examining the estimates of the structural equations in Table 3, the respondent participation in the bike-to-work campaign are directly and positively connected with firm participation. The *Growth* needs which was positively influenced by *existence* and *relatedness* needs is directly and positively connected with participation in the bike-to-work campaign (0.172). The perceived difficulties for cycling to work influence the bike-to-work participation negatively (-0.164).

5. Discussion and conclusions

The current study investigates the success of the Danish bike-to-work campaign, a best practice example of the Danish planning approach promoting modal shift with a shared vision, and innovative self-sustaining institutional programs and business solutions. The campaign largely depends on its ability to cater for people's functional and emotional needs, and therefore the present study focuses on the role of existence, relatedness and growth in encouraging participation in the campaign.

A behavioural framework was formulated, and data from an online survey was used to validate the framework and estimate corresponding mathematical models. Factor analysis revealed that the design of the survey (and the answers) allowed the ERG needs and difficulties related to cycling to stand out clearly. The analysis showed the perceived cycling difficulties is the only factor that are significantly related to cycling distance, and that social norms and bonding are a stronger contributor to competitiveness than fitness or health needs. I.e., people seem to compete due to social norms or to get a better relation to their colleagues, rather than due to a desire to become more fit and healthy.

Two SEM models were estimated successfully. The results of these showed that the model formulation in which growth needs are hypothesized to be influenced by the needs of existence and relatedness clearly outperforms the model formulation where the bike-to-work participation are directly associated with existence, relatedness, growth and difficulties. The results of the best performing model show that growth is positively related to existence and relatedness needs, which seems reasonable since people with high existence and relatedness needs must be expected to have higher needs for personal development and self-actualization. Participation in the bike-to-work program is positively related to self-actualization with respect to competitiveness (growth) and negatively related to perceived cycling difficulties. This seems reasonable, since the need for self-actualization with respect to competitiveness should encourage participation in the campaign in which it is possible to compete with others, whereas perceived difficulties related to cycling to work should discourage participation. In relation to the participation in the campaign, the estimates show that firms' consistent participation over several years is an important factor in the participation   of its employees.

The estimated parameters reveals that the needs are positively associated with cycling habits on weekdays and on weekends, the availability of a mountain bike/BMX, and cycling purpose for utilitarian and recreation. Also, habitual cyclists who have lived in Denmark since childhood and who cycle greater distances with higher frequency experience less difficulties. Therefore cycling experience is positively associated with less perceived difficulties.

Summarizing, the present study has contributed to understanding the needs underlying people's participation in the very successful Danish bike-to-work campaign. Such understanding is essential in the need to provide attractive and effective campaigns in order to motivate employees to voluntarily engage in bike-to-work campaigns, with the ultimate goal of promoting a shift from car-oriented travel towards sustainable active travel.

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