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## **Cycling culture and socialisation: Modelling the effect of immigrant origin on cycling in Denmark and the Netherlands**

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## **Abstract**

This paper focusses on travel socialisation by examining the effect of immigrant origin on cycling in two distinct European cycling cultures: Denmark and the Netherlands. Based on data from both countries' national travel surveys, the empirical analyses show that people of immigrant origin cycle less compared to natives. While in Denmark this effect is significant only for people of non-Western origin, in the Netherlands it is also true for people of Western origin, probably because they originate to a greater extent from non-European countries (e.g., Indonesia). In the Netherlands, the effect of non-Western origin is larger for women than for men, while we do not find a significant gender interaction in the Danish data. Individuals with residence in neighbourhoods with a higher share of people of non-Western origin are less likely to cycle, probably as the national norm to cycle is less salient here. The results cannot be fully explained by differences in socioeconomic status, car access, or level of urbanisation. We assume that cultural norms mediated by parents play a relevant role. The results lend support to policies focused on stimulating the use of the bicycle among immigrants and especially women of non-Western origin.

## **Keywords**

Mode choice; cycling; immigrants; cycling culture; national travel survey, travel socialization

## 1. Introduction

Research on mode choice has shown an increased interest in factors of travel socialisation. This includes the effect of parents' and peers' norms, attitudes and behaviour on mode choice (e.g., Döring et al. 2017; Haustein et al. 2009; Møller et al. 2018; Underwood et al. 2014), and the effect of specific events in the personal mobility biography, such as the move to a different mobility culture (e.g., de Haas et al. 2018; Klinger and Lanzendorf 2016).

Another approach to reveal the effects of travel socialisation is to examine immigrants' mobility behaviour. Immigrants live in the same mobility culture as natives, but they have additionally been exposed to other cultural influences, either directly or mediated by their parents in case of descendants. In a European context, identified differences between natives and immigrants include that immigrants use public transportation more often and cycle less (e.g., Harms 2007; Kasper et al. 2007; Welsch et al. 2016), especially immigrant women of non-Western origin (Harms 2007; van der Kloof 2015).

In contrast to immigrants in Europe, immigrants in the U.S. are *more* likely to cycle (Smart 2010). In addition, recent immigrants have different travel patterns compared to both individuals born in the U.S. and immigrants who have lived in the U.S. for longer periods of time, and travel patterns vary with place of birth (e.g., Blumenberg and Shiki 2007; Chatman 2014). Immigrants are less likely to drive alone, especially in the first years of living in the U.S. (Tal and Handy 2010). In addition, living in ethnically concentrated locations has been shown to increase carpooling for Hispanics and Asians, likely reflecting their social networks (Liu and Painter 2012; Shin 2017). Social and community networks have also been found to play a supportive role for cycling of low-income Latino immigrants (Barajas 2018).

Differences between natives and immigrants in car use and cycling can partly be explained by differences in social and demographic factors, such as lower car ownership, lower household income, lower licensure rates, and a higher population concentration in urban areas (e.g., Chatman 2014; Contrino and McGuckin 2009). However, a significant "immigrant effect" remains even when these factors are controlled for (e.g., Smart 2010). This indicates that different cultural norms could also play a role leading to different preferences (or restrictions) and choices. Similarly, a recent German study found a small effect of immigrant status on cycling, when controlling for selected demographic factors (Welsch et al. 2018).

We expect that differences in mode choice between natives and people of immigrant origin are higher, the more the (mobility) culture of the country of origin differs from the new country of residence. With regard to cycling, we thus expect to find a pronounced effect of immigrant origin on cycling in countries with a distinct cycling culture, like Denmark and the Netherlands. Furthermore, we expect that the effect is larger for non-Western (e.g., African, Asian) immigrant origin as compared to Western (e.g., European, North American) immigrant origin, and women as compared to men. This study will test these assumptions based on data from the Danish and Dutch national travel surveys.

As a second contribution, we will assess the additional influence of the share of people of non-Western immigrant origin at the neighbourhood/municipality level on people's personal cycling behaviour. We expect the share of people of non-Western origin to be reflective of a cycling norm at the neighbourhood/municipality level. Hence, we expect that the share of people of non-Western origin at the neighbourhood/municipality level will negatively affect individual cycling behaviour.

Cycling (as compared to the use of motorised modes) has many benefits both on a societal level—when contributing to a decrease of congestion and of air and noise pollution (e.g., Johansson et al. 2017; de Nazelle et al. 2011)—as well as on an individual level, where the benefits from increased physical activity clearly outweigh potential risks (e.g., Mueller et al. 2015). For immigrants in cycling countries it can have additional benefits as it may increase their mobility options and may serve as a tool of social integration, as experiences from cycling courses in Denmark (Ward 2007) and the Netherlands (van der Kloof 2015) illustrate.

This paper contributes to existing research on travel socialisation by extending it to a cross-cultural perspective<sup>1</sup>. The comparison of the results between two cycling countries is expected to offer further insight into factors that may facilitate cycling among immigrants and to provide a basis for future research and interventions to increase cycling among this population group.

The remainder of this paper is structured as follows. In the next section, the expectations formulated above are elaborated based on previous theoretical and empirical work. Section 3 introduces the data, namely the Danish and Dutch national travel surveys. This section also provides an overview of the dependent and independent variables under investigation as well as the relevant control variables. Section 4 presents the results. Section 5 summarises the main findings, discusses differences between results from Denmark and the Netherlands, and draws conclusions for future research and practise.

## **2. Theoretical and empirical background**

### **2.1 The cycling culture of Denmark and the Netherlands**

Denmark and the Netherlands are both countries with a distinct cycling culture (e.g., Carstensen and Ebert 2012; Haustein and Nielsen 2016). This is reflected in a high level of cycling (European Commission 2013), policies that support cycling, and a highly developed cycling infrastructure (e.g., Pucher and Buehler 2008). Typical for high-cycling countries, different age groups and genders are well represented among cyclists (Aldred et al. 2016), whereas in low-cycling countries, like Australia, the U.S., and the UK, women and older people are considerably underrepresented (Aldred et al. 2016; Heesch et al. 2012; Heinen et al. 2010), most likely because of higher safety concerns (e.g., Barajas 2018). A survey conducted in 17 European countries (Furian et al. 2016) placed the Danes and the Dutch in first and third place, respectively, regarding individuals' feelings of safety when cycling.

While cycling for transport is seen as a mainstream activity in Denmark and the Netherlands, people in low-cycling Western countries often perceive it as ‘odd’ (Pooley et al. 2013) or ‘uncool’ to cycle (Underwood et al. 2014). In some Eastern European and Asian countries, where it is partly very common to cycle (e.g., Albania, China), the bike and public transport are often stigmatised as transport modes for the poor, while the car serves as an important status symbol (e.g., Belgiawan et al. 2014; Pojani et al. 2017; Van et al. 2014).

Reasons for the different cycling norms and behaviours in Denmark and the Netherlands can be found in the historic development of these countries and their applied cycling policies

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<sup>1</sup> The paper is based on an abstract accepted for presentation at the hEART conference (Haustein, Kroesen, Mulalic, 2018).

(e.g., Carstensen and Ebert 2012; Koglin 2015; Lanzendorf and Busch-Geertsema 2014; Pucher and Buehler 2008). Carstensen and Ebert (2012) traced the development of cycling in different European countries over the period from the end of the 19<sup>th</sup> century to the present. They found that the introduction of the car did not entirely displace the bicycle as an attractive and flexible mode of transport in Denmark and the Netherlands. As an important explanation of this development they saw the significant role the bicycle played in the formation of both countries' national identities, which gave the bicycle a central position in transport policies. Today, the Netherlands, followed by Denmark, are the leading cycling countries in Europe—with people in the Netherlands cycling most frequently and the longest distances (European Commission 2013).

The strong cycling orientation is also reflected in (and supported by) the available cycling infrastructure in both countries, which is very dense and mostly allows for cycling on the road in areas, where no cycling paths are provided (see Table 1). In bigger cities, separate cycle tracks are the norm. Both countries are relatively dense, with many destinations typically being available within a short range. Moreover, both countries are relatively flat and have temperate climates characterised by mild winters (due to the proximity of oceans), circumstances that are all conducive to cycling.

**Table 1. Description of Denmark and the Netherlands**

	Denmark	The Netherlands
<b>General country characteristics</b>		
Inhabitants (millions)	5.78	17.08
Area (km <sup>2</sup> )	42,934	41,543
Population density (inhabitants/km <sup>2</sup> )	134.7	411.3
Topography (highest point in meter)	173	323
Weather (Average temperature January / July)	0°C / 17°C	3°C / 18°C
<b>Cycling infrastructure</b>		
Cycle paths along roads	4,631	33,000 <sup>b</sup>
Cycling and walking paths not along roads <sup>a</sup>	17,948	
Roads without cycle paths, where cycling is allowed	92,834	55,000
Roads without access for cyclists	1,505	16,569
Cycling network density (length of cycling network/country area)	2.7	2.1

Note. <sup>a</sup>Not all of them allow cycling at high speed. <sup>b</sup>Not differentiated between cycle path along and not along roads.

## 2.2 Immigrants in Denmark and the Netherlands and their travel behaviour

In this study, a person of immigrant origin is defined as someone who has either a first-generation (born abroad) or second-generation (at least one parent born abroad) immigrant origin. Western immigrant origin is defined as someone originating from a country in Europe (excluding Turkey), North America and Oceania.<sup>2</sup> Due to their socioeconomic and cultural position, people from Indonesia and Japan living in the Netherlands are also defined as people with a 'Western' origin. They are mainly people born in the former Dutch East Indies

<sup>2</sup> In an exceptional case that a person him-/herself is born abroad, but has both a Western parent and non-Western parent, the own country of birth (and not the parents') determines the category (Western / non-Western).

and people working for Japanese companies. Consequently, we also defined people in the Danish sample who originate from Japan or Indonesia as people with a “western” background. A person of Danish/Dutch origin is defined as a person who has two parents who were born in Denmark/the Netherlands and has Danish/Dutch nationality.

In 2015, 11.6% of the population in Denmark was of immigrant origin (Ministry of Immigration, Integration and Housing 2015), mostly of non-Western immigrant origin (64.4%). Persons of Turkish origin constituted the largest group (9.4% of all persons with immigrant origin). Many of these are descendants of Turks who came in the 1960s to work in the Danish industrial sector. The five next largest groups originated from Poland (6.0%), Germany (4.9%), Iraq (4.7%), Lebanon (3.9%), and Pakistan (3.6%).

In the Netherlands in 2018, 22.6% of the population was of immigrant origin, roughly twice the share seen in Denmark. Similar to Denmark, the majority were of non-Western immigrant origin (56.2%), and people of Turkish origin constituted the largest immigrant group (10.4%). The five next largest groups originated from Morocco (10.1%), Indonesia (9.4%), Germany (9.2%), Surinam (9.1%), and Poland (4.2%) (Statistics Netherlands 2018).

Harms (2007) looked into the mobility behaviour of the four (at that time) biggest immigrant groups with non-Western origin in the Netherlands, which were Turks, Moroccans, people from Surinam, and the Antilles. The groups showed great differences regarding the number of trips, travel time, and covered distances both from each other and from the population of Dutch origin. While differences could partly be explained by varying social or spatial factors, some differences remained when those factors were controlled for. Most pronounced was that Turkish and Moroccan women often stayed at home for the whole day and cycled to a much lesser extent than all other groups, which the authors explained as stemming from different cultural and/or religious traditions. According to a study on adolescents’ bicycle use for transportation (de Bruijn et al. 2005), adolescents of parents born abroad were almost three times less likely to use the bicycle than their Dutch counterparts. Similarly, Bere et al. (2008) found a negative significant effect of non-Western origin on bike commuting to school when controlling for other potentially relevant factors. These results indicate that descendants internalise their parents’ norms and behaviour in relation to cycling.

When explaining the share of bicycle use in different Dutch cities, Rietveld and Daniel (2004) found the percentage of foreigners in a city to have a negative effect. The authors concluded that “cycling seems to be a travel alternative that has only a low probability of being included in the choice set of immigrants with a different cultural background” (p. 546), and at the same time they suggested that the inclusion of ethnic background in travel surveys would allow for sharper results. Ethnic background was added to the Dutch travel survey in 2010.

While (to the best of our knowledge) the effect of immigrant origin on cycling has not yet been examined in Denmark, we expect similar differences between persons of native and other origins as found in the Netherlands, in particular when immigrants live in more segregated neighbourhoods, where norms from the countries of origin may be more persistent. This assumption is in line with a U.S. study (Smart, 2012), which found that individuals – but in particular immigrants – living in neighbourhoods with higher immigrant shares were more likely to use alternative modes to the car than individuals living in non-immigrant neighbourhoods. A higher share of immigrants is expected to influence behaviour both through descriptive norms about what can be observed as the “normal” travel behaviour

and through injunctive norms, that is which behaviour is actively approved or disapproved by the local (immigrant) community. The latter might particularly play a role in lower cycling frequencies of immigrant women (van der Kloof, 2015).

## **2.3 Research hypotheses**

Relying on the background of previous research, we hold the following hypotheses:

Hypothesis 1a: People of Western immigrant origin cycle less than people of native (Danish or Dutch) origin.

Hypothesis 1b: People of non-Western immigrant origin cycle less than people of Western immigrant origin.

Hypothesis 1c: Women of non-Western immigrant origin cycle less than men of non-Western immigrant origin.

As stated in the introduction, we expect the share of people of non-Western origin to be reflective of a cycling norm at the neighbourhood/municipality level. Hence, we expect that a higher share is associated with less cycling:

Hypothesis 2a: The share of people of non-Western immigrant origin at the neighbourhood/municipality level has a negative effect on individual cycling behaviour.

Based on the expected relevance of social and cultural norms for cycling, which has so far mainly been indicated in qualitative studies, we additionally expect that people of non-Western origin will be more inclined to follow up on their cultural norm of ‘not cycling’ when they are supported by this norm at the neighbourhood/municipality level. For people of native origin, being surrounded by people with a non-cycling norm may have less relevance, as they grew up with native parents and thereby internalised a cycling norm:

Hypothesis 2b: The effect under 2a is stronger for people of non-Western immigrant origin compared to people of native origin.

Hypotheses 1a–c will first be examined based on descriptive data from both countries’ national travel surveys. To ensure that differences between natives and immigrants are not (only) due to differences in other variables (such as income or car ownership), a series of binary logistic regression (logit) models will be estimated, where these variables will be controlled for. These regression models will also be used to test Hypotheses 2a and 2b, as the following method section will describe in more detail.

## **3. Method**

### **3.1 Data**

The Danish and Dutch national travel surveys (NTSs) collect data on people’s travel behaviour continuously throughout the year. Participants are selected randomly from the respective population registers of both countries. They both include a one-day travel diary to

measure people's travel behaviour and additional questions covering relevant background characteristics of respondents.

In the Danish case, data were available for six years, namely 2006–2011. In total, 51,879 respondents participated in these years and are included in the present analysis. With respect to the Dutch NTS, data were available from one year only, namely 2014. In this year 27,031 individuals participated in the survey and are included in the analysis. The inability to obtain data from the same time frames obviously makes the comparison of the results (i.e., the parameter estimates in the logit models) across both data sets more complicated, as any differences may be due to the different time frames for the surveys. Yet, there is no reason to believe that these estimates will strongly change over time.

To study the influence of local norms on people's cycling behaviour, the individual-level data of the NTSs were enriched with municipality-level data in the Danish case and neighbourhood-level data in the Dutch case. In the Danish case, these data were obtained from the administrative registers. In total, 98 municipalities are represented in the data, which on average consist of 56,000 residents (in 2011). In the Dutch case, the data were obtained from Statistics Netherlands. Here, 3,352 neighbourhoods are included, consisting on average of 4,353 residents.

### **3.2 Measures**

The one-day travel diary captures many aspects of people's travel behaviour, amongst them the number of trips, travel distances, and travel times (for each mode). As such, multiple measures were available to operationalise our main dependent variable (i.e., cycling behaviour). For this study, we chose a straightforward operationalisation: whether or not a person made *at least one* cycling trip on the day of the survey. While travel distances and times more precisely measure the extent of people's travel by bicycle, they are also more strongly affected by measurement errors (since they are self-reported). In addition, a straightforward operationalisation also allows a straightforward model (a binary logit model), which provides an easy comparison of the parameter estimates across both data sets.

The main independent variable related to a person's origin. Here, we considered three categories: native origin (both parents born in Denmark/the Netherlands), Western immigrant origin (either the person himself/herself or at least one of his/her parents born in a Western foreign country), and non-Western immigrant origin (either the person himself/herself or at least one of his/her parents born in a non-Western foreign country). Hence, we did not discriminate between first- and second-generation immigrant origin, because this information was not available in the Dutch data.

In addition to origin, the following individual-level variables were included in the models as relevant control variables: gender, age, education level, occupational status, household disposable income, car license ownership, number of household members, and household car ownership. The definitions of these variables (and the used answering categories in case of nominal outcomes) were the same across both data sets. The urban environment was also considered a relevant concept to be included as a control variable, but for this concept no consistent operationalisation was present; in the Danish data set the city size (expressed as the number of inhabitants) was available and used to measure this concept, whereas in the Dutch data set the level of urbanisation (expressed as the address density in a 1-kilometer radius around the respondent's place of residence) was available and used.

At the municipality/neighbourhood level, the main independent variable related to the proportion of residents of non-Western origin (compared to the entire population in the respective municipality/neighbourhood), which was defined in the same way as the respective individual-level variable, that is by considering both first-generation immigrants and descendants of immigrants as people of (non-Western) immigrant origin. In addition to this variable, the share of households with low income (slightly differently operationalised) and the share of residents with social assistance (consistently operationalised) were included as relevant control variables at the municipality/neighbourhood level.

Table 2 presents an overview of the variables discussed above in the Danish and Dutch data sets. In both data sets, people of immigrant origin were underrepresented compared to the whole population, in particular people of non-Western origin. The implications of this are discussed in the final section.

**Table 2. Sample descriptives**

Variables (at the individual level)	Categories	Danish NTS <sup>a</sup> (N=51,879)	Dutch NTS <sup>a</sup> (N=27,031)
Cycling trip on day of the survey	No (%)	80	66
	Yes (%)	21	34
Origin	Native origin (%)	95	86
	Western immigrant origin (%)	2	8
	Non-Western immigrant origin (%)	2	6
Gender	Female (%)	53	52
	Male (%)	47	48
Age	Mean (SD)	49.54 (15.06)	45.85 (19.29)
Education level <sup>b</sup>	Low (primary or lower vocational education or general upper secondary school) (%)	27	35
	Intermediate (intermediate vocational education or short-/medium cycle higher education) (%)	27	35
	High (bachelor, college or university) (%)	46	30
Occupational status	Student (%)	5	15
	Employed (%)	65	51
	Housekeeper (%)	1	6
	Other (%)	28	28
Household disposable income	Less than 10,000 Euro (%)	1	3
	10,000–20,000 Euro (%)	7	28
	20,000–30,000 Euro (%)	13	39
	30,000–40,000 Euro (%)	14	19
	40,000–50,000 Euro (%)	13	6
	More than 50,000 Euro (%)	52	5
Car license	No (%)	11	21
	Yes (%)	89	79
City size (*1,000 inhabitants) (Danish data set)	Mean (SD)	275 (463)	
Level of urbanisation (number of residential addresses in a 1-kilometer radius around the place of residence) (Dutch data set)	Not urban (less than 500) (%)	15	
	Slightly urban (500–1,000) (%)	25	
	Moderately urban (1,000–1,500) (%)	21	
	Very urban (1,500–2,500) (%)	25	
	Extremely urban (over 2,500) (%)	15	
Number of household members	Mean (SD)	2.52 (1.22)	2.81 (1.36)
Household car ownership	No car (%)	21	10
	One car (%)	61	52
	Two cars (%)	17	32
	More than two cars (%)	1	6
<b>Municipality/neighbourhood variables</b>	<b>Categories</b>		
Share of non-Western immigrant origin	Mean (SD)	0.02 (0.02)	0.10 (0.11)
Share of households with low income (< €30,000) (Danish data set)	Mean (SD)	0.22 (0.07)	
Share of households with low income (less than 40th percentile) (Dutch data set)	Mean (SD)		0.36 (0.12)
Share of residents with social assistance	Mean (SD)	0.03 (0.02)	0.02 (0.02)
Year of survey	2006 (%)	9	
	2007 (%)	15	
	2008 (%)	14	
	2009 (%)	20	
	2010 (%)	25	
	2011 (%)	18	

Note. <sup>a</sup> Values might not add up to 100% due to rounding errors.

### **3.3 Modelling strategy**

Using as the dependent variable whether the respondent made at least one trip by bicycle on the day of the survey (or not), two logit models were estimated for each data set, the first with only the main effects and a second including two additional interactions, which were based on the expectations formulated in Section 2.2. To account for non-linear effects related to age, a squared component of this variable was included. In addition, non-linear effects were also expected for the categorical variables household income and household car ownership, which were accounted for by including a series of dummy variables. Finally, for the Danish data set, dummies were also included for the various years to account for possible structural trends in cycling behaviour over time (e.g., Nielsen et al. 2016).

## **4. Results**

To gain an initial understanding of the effect of a person's origin on his/her cycling behaviour, we first examined the bivariate relationship between these variables. Table 3 presents the results of this analysis and additionally breaks down the relationship by (1) gender and (2) a dummy variable indicating whether the share of non-Western immigrant origin at the municipality/neighbourhood level was greater than 10% or not, thereby capturing the interaction effects formulated in Hypotheses 1c and 2b.

The results of the Dutch data set indicate that, in line with Hypothesis 1a, people of Western immigrant origin have a smaller probability of having made a cycling trip on the day of the survey than people of native origin. Moreover, in line with Hypothesis 1b, people of non-Western immigrant origin have a smaller chance to have cycled (29%) than people of Western immigrant origin (31%), although the difference is quite small. The breakdown by gender reveals that, in line with Hypothesis 1c, especially women of non-Western origin cycle less. In fact, for men there is no significant effect of origin on cycling behaviour. Finally, the second interaction (Hypothesis 2b) is also confirmed, that is, individuals of non-Western origin seem to cycle less when they are immersed in a significantly non-Western neighbourhood (10% or larger share of non-Western immigrants).

The results of the Danish survey deviate to some extent from the Dutch results. As expected, we find that a much higher percentage of native Danes had a cycling trip (21%) than did immigrants of non-Western origin (12%). However, when comparing native Danes with immigrants of Western origin, the latter are rather more likely to have had a cycling trip (23%). We find similar patterns within the subgroups of men and women and in municipalities with a low and high share of non-Western origin.

**Table 3. Bivariate relationship between origin and cycling behaviour**

Made a cycling trip on day of the survey							
Danish NTS	Origin	No (%)	Yes (%)	N	Chi-square	df	p-value
Full sample	Native	79	21	49417	58.2	2	<0.000
	Western	77	23	1221			
	Non-Western	88	12	1241			
Female	Native	77	23	26309	33.9	2	<0.000
	Western	77	23	662			
	Non-Western	87	13	626			
Male	Native	81	19	23108	27.1	2	<0.000
	Western	77	23	559			
	Non-Western	88	12	615			
Share of non-Western origin is below 10%	Native	79	21	48985	52.2	2	<0.000
	Western	77	23	1209			
	Non-Western	88	12	1169			
Share of non-Western origin is above 10%	Native	81	19	432	5.6	2	0.063
	Western	75	25	12			
	Non-Western	92	8	72			
<b>Dutch NTS</b>							
Full sample	Native	66	34	23230	29.5	2	0.000
	Western	69	31	2123			
	Non-Western	71	29	1678			
Female	Native	64	36	12113	34.7	2	0.000
	Western	68	32	1110			
	Non-Western	74	26	864			
Male	Native	67	33	11117	4.4	2	0.111
	Western	70	30	1013			
	Non-Western	69	31	814			
Share of non-Western origin is below 10%	Native	66	34	16954	7.5	2	0.023
	Western	70	30	1210			
	Non-Western	66	34	433			
Share of non-Western origin is above 10%	Native	64	36	6276	37.7	2	0.000
	Western	68	32	913			
	Non-Western	73	27	1245			

While these bivariate associations shed some initial light on the effects of a person's origin on his/her cycling behaviour, it is important to account for confounding variables by estimating multivariate models. Table 4 presents the parameter estimates and standard errors of the estimated models. The results of the main-effect-only models indicate that, controlling for relevant socio-demographic and economic factors, Western immigrant origin has a negative effect on the probability of having made a cycling trip. Yet, it only reaches statistical significance in the Dutch data set, so Hypothesis 1a has to be partly rejected. In line with Hypothesis 1b, non-Western origin has an even stronger negative effect on individuals' propensity to cycle compared to both native origin and Western immigrant origin. Both of these contrasts were found to be significant (this was tested by running additional models in which Western immigrant origin was used as the reference category). In both data sets, the share of people of non-Western origin (included here as a continuous variable) has a negative effect on individuals' propensity to cycle, confirming Hypothesis 2a.

**Table 4. Parameter estimates of the binary logit models**

Variable/interaction	Categories	Danish NTS		Dutch NTS	
		Main-effect only	With interactions	Main-effect only	With interactions
<b>Origin</b> (ref: native)	Western immigrant origin	-0.118 (0.072)	-0.118 (0.072)	-0.175*** (0.052)	-0.185*** (0.052)
	Non-Western immigrant origin	-0.882*** (0.092)	-0.682*** (0.184)	-0.688*** (0.065)	0.447* (0.208)
<b>Gender</b> (ref: male)	Female	0.138*** (0.024)	0.140*** (0.024)	0.068* (0.028)	0.094** (0.029)
<b>Origin × gender</b>	Interaction between non-western origin and female		-0.156 (0.180)		-0.506*** (0.121)
<b>Age</b>	Continuous	0.050*** (0.006)	0.050*** (0.006)	-0.008*** (0.001)	-0.008*** (0.001)
<b>Age squared</b>	Continuous	-0.0005*** (0.0001)	-0.0005*** (0.0001)	-0.0002*** (0.00006)	-0.0002*** (0.00006)
<b>Level of education</b> (ref.: low)	Intermediate	-0.029 (0.033)	-0.029 (0.033)	-0.062 (0.037)	-0.057 (0.037)
	High	0.160*** (0.029)	0.160*** (0.029)	0.159*** (0.041)	0.160*** (0.041)
<b>Occupational status</b> (ref.: Other)	Student	0.740*** (0.065)	0.742*** (0.065)	0.938*** (0.077)	0.949*** (0.077)
	Employed	0.154*** (0.038)	0.154*** (0.038)	-0.093* (0.045)	-0.091* (0.045)
	Housekeeper	-0.103 (0.120)	-0.101 (0.120)	0.186** (0.068)	0.199** (0.068)
<b>Household disposable income</b> (ref.: < €10,000)	€10,000–20,000	-0.338*** (0.096)	-0.337*** (0.096)	0.155 (0.079)	0.160* (0.08)
	€20,000–30,000	-0.272*** (0.095)	-0.270*** (0.095)	0.282*** (0.079)	0.287*** (0.079)
	€30,000–40,000	-0.221** (0.096)	-0.220** (0.096)	0.406*** (0.083)	0.411*** (0.084)
	€40,000–50,000	-0.078 (0.098)	-0.076 (0.098)	0.394*** (0.096)	0.400*** (0.097)
	> €50,000	0.044 (0.097)	0.046 (0.097)	0.381*** (0.102)	0.389*** (0.102)
<b>Car license</b> (ref: no)	Yes	0.075* (0.039)	0.074** (0.039)	-0.465*** (0.047)	-0.470*** (0.047)
<b>City size (1,000 inhabitants)</b> (Danish NTS)	Continuous	0.0002*** (0.00003)	0.0002*** (0.00003)		
<b>Level of urbanisation</b> (Dutch NTS) (ref: not urban)	Slightly urban			0.105* (0.046)	0.098* (0.046)
	Moderately urban			0.245*** (0.048)	0.222*** (0.048)
	Very urban			0.278*** (0.049)	0.242*** (0.05)
	Extremely urban			0.483*** (0.062)	0.453*** (0.062)
<b>Number of household members</b>	Continuous	0.053*** (0.012)	0.052*** (0.012)	0.136*** (0.013)	0.138*** (0.013)
<b>Number of cars in the household</b> (ref.: 0 cars)	One car	-1.006*** (0.037)	-1.005*** (0.037)	-0.419*** (0.052)	-0.414*** (0.052)
	Two cars	-1.939*** (0.050)	-1.938*** (0.050)	-1.009*** (0.061)	-1.004*** (0.061)
	More than two cars	-1.986*** (0.113)	-1.986*** (0.113)	-1.359*** (0.086)	-1.350*** (0.086)
<b>Share of non-Western immigrant origin<sup>a</sup></b>	Continuous	-1.125* (0.599)	-1.0016* (0.611)	-2.054*** (0.212)	-1.661*** (0.225)
<b>Share of non-Western immigrant origin<sup>a</sup> × origin</b>	Interaction between share of non-Western immigrant origin and non-Western origin		-2.654 (2.928)		-1.825*** (0.386)
<b>Share of households with low income<sup>b</sup></b>	Continuous	1.969*** (0.179)	1.965*** (0.179)	0.556** (0.187)	0.545** (0.187)
<b>Share of residents with social assistance</b>	Continuous	-1.123* (0.615)	-1.124* (0.616)	0.796 (1.298)	0.752 (1.299)
<b>Year of the survey (Danish NTS)</b> (ref.: 2006)	2007	-0.133*** (0.047)	-0.133*** (0.047)		
	2008	-0.023 (0.047)	-0.022 (0.047)		
	2009	-0.004 (0.045)	-0.005 (0.045)		
	2010	-0.064 (0.046)	-0.065 (0.046)		
	2011	-0.043 (0.047)	-0.043 (0.047)		

	<b>Constant</b>	-2.324*** (0.168)	-2.327*** (0.168)	-0.757*** (0.133)	-0.824*** (0.134)
<b>Model fit</b>	Log likelihood (intercept-only)	-26,459	-26,459	-17,230	-17,230
	Log likelihood (final)	-24,732	-24,812	-15,799	-15,779
	McFadden's Rho square	0.065	0.065	0.083	0.084
	Number of observations	51,879	51,879	27,031	27,031

**Notes.** Standard errors are presented in parentheses.

<sup>a</sup> In Denmark the share refers to the municipality, in the Netherlands to the neighbourhood.

<sup>b</sup> The operationalization of this variable slightly differs between the Danish and Dutch dataset (see Table 2).

\*,\*\*, \*\*\* indicate that estimates are significantly different from zero at the 0.05, 0.01, and 0.001 levels, respectively.

Turning to the models with interactions, the Dutch results indicate that especially women of non-Western origin cycle less, which confirms our Hypothesis 1c. However, the main effect of non-Western immigrant origin switches from negative to positive, indicating that, compared to natives, only women of non-Western origin cycle less and not men of non-Western origin. In addition, the interaction between non-Western origin and the share of people of non-Western origin in the neighbourhood is also significant and negative in the Dutch data set, which confirms Hypothesis 2b. As already indicated by the descriptive results, both interaction effects are not significant in the Danish data. Thus, all hypotheses were confirmed based on the Dutch data, while only Hypothesis 1b and 2a were confirmed based on the Danish data.

## 5. Discussion and conclusions

In this study, we showed based on NTS data, that people of immigrant origin cycle less than people of native Danish or Dutch origin. In both countries, the effect of immigrant origin was significant for people of non-Western origin, while the effect of Western origin was only significant in the Netherlands. We can see two possible reasons for this. First, it may be related to the different composition of Western immigrants in Denmark and the Netherlands: in Denmark, the largest immigrant groups are Poles and Germans, and apart from people from the former Yugoslavia, other Scandinavians (Norwegians, Swedes) are also relevant groups. Germany and Sweden are among the top five European cycling countries, and in Poland cycling is also more popular than in many other European countries (European Commission 2013). For people of these countries, the (even) better infrastructural conditions and higher cycling norm in Denmark and the Netherlands are likely to encourage them to cycle more than in their country of origin. In the Netherlands, people from Indonesia constitute the largest immigrant group and are classified as having a 'Western' immigrant origin. Compared to European countries, cycling in this country is much less widespread (e.g., Hook 2010), although recent and country-wide statistics are difficult to find.

A second reason might lie in the high registration tax for cars in Denmark (105-150% of value), which might demotivate car owners to bring their cars when moving to Denmark and motivate them to cycle instead. This may explain that—based on descriptive data—immigrants of Western origin cycle even more than native Danes. However, when controlling for car ownership in the logit models, we find a trend towards less cycling for immigrants of Western origin in Denmark, which means that they—under comparable conditions—rather cycle less compared to native Danes. All in all, we think that differences between native Danes and Dutch and immigrants with Western origin are rather neglectable and for the significance of the effect in the Dutch dataset, the different categorisation (i.e. including people from Indonesia) might be decisive.

Another effect that could only be found in the Dutch data is that women of non-Western origin cycle less than men of non-Western origin. In both Denmark and the Netherlands,

women are in general more likely to cycle, which is typical for high-cycling countries (e.g., Aldred et al. 2016). The smaller gender difference within the group of non-Western immigrants in Denmark as compared to the Netherlands may be related to different integration policies in both countries. Denmark has traditionally rejected multiculturalism (Meer et al. 2015) and has an ‘exclusionist’ integration model, which may imply that immigrants in Denmark perceive a higher pressure to adapt to Danish norms and practises as compared to immigrants in the more multicultural Netherlands with an ‘inclusive’ integration model (though the country sharpened its integration policies in 1998 with a legislative act concerning newcomers to the country, Ikram et al. 2015). It may be relevant to examine in more depth which specific rules or policies have a positive effect on successful integration, including acceptance of gender equality, when assuming that it is cultural or (the interpretation of) religious rules that prohibit cycling among non-Western girls and women, which has been suggested by previous research (e.g., Harms 2007; van der Kloof 2015).

As expected, we found that living in areas with high shares of non-Western immigrants has a negative effect on cycling, as the national cycling norm is probably less salient here. While we expected this effect to be stronger for non-Western immigrants than for the rest of the population, we could only prove this interaction effect in the Netherlands. This may reflect methodological concerns, as segregation was operationalised at the neighbourhood level in the Netherlands, while it was only possible to measure it at the municipality level in Denmark, which is probably too imprecise to show the related effects. The negative main effect of the share of non-Western origin would support policies to spread immigrant groups evenly over neighbourhoods and cities, instead of concentrating them. In the Netherlands, such policies have been promoted to stimulate the better integration of immigrant groups in general (Dagevos 2009; Gijsbert et al. 2010). As the present study indicates, such policies could also be beneficial to increase cycling among people of immigrant background, in particular when combined with targeted offers, such as cycling courses and campaigns. However, as we only controlled for city size (DK)/level of urbanisation (NL), other bikeability variables (e.g., Nielsen and Skov-Petersen, 2018) might explain some of the differences related to residential location and should additionally be taken into account in future studies.

The results show that immigrants in countries with a strong cycling culture cycle less than natives, in particular when they originate from non-Western countries. These differences cannot be fully explained by a different socioeconomic status, car access, or level of urbanisation, as these factors were controlled for in the analyses. Instead, we assume that experiences and cultural norms mediated by parents play a relevant role here, in particular as it is especially non-Western women who cycle less. However, results should be interpreted with care, as the design does not allow for any causal interpretations and some results could only be shown in the Dutch data. Studies based on longitudinal data and studies explicitly measuring norms and attitudes related to cycling of both natives and immigrants would be relevant to validate our assumptions.

It would also be interesting to model the effect of cycling share and national culture (e.g., power distance, individualism vs. collectivism; masculinity vs. femininity; Hofstede 2001) separately. This would probably lead to a better understanding of the mechanisms of socialisation that are relevant for immigrants’ uptake of cycling: Is it rather the actual use of a mode in the country of origin that determines how fast people assimilate to the travel behaviour in the new country or the symbolic value of the mode, which seems to be related to national culture: In countries with a higher power distance (i.e. countries in which it is

accepted and expected that power is distributed unequally, e.g., Albania, India, China), the car has a distinct positive symbolic value, while using public transport and cycling is associated with low social status (e.g., Belgiawan et al. 2014; Pojani et al. 2017; Van et al. 2014). This is different in countries with low power distance (e.g., Scandinavian countries). For cycling, other societal norms might be relevant as well, for example femininity versus masculinity. Both Denmark and the Netherlands are described as feminine societies (Hofstede, 1983), in which social gender roles overlap and quality of life and people are valued higher than achievement and monetary rewards. In both countries, religion only plays a minor role. Whether these are generally good societal preconditions for cycling could be subject to future research.

A limitation of this study is that the main independent variable (origin) only included three categories (native, Western immigrant origin and non-Western immigrant origin). As such, no distinctions could be made between, for example, first and second generation immigrant origin or between people with one parent born abroad versus people with two parents born abroad. It would be relevant and interesting to discriminate more categories in future research. Related to this limitation is that immigrants, and in particular immigrants of non-Western origin, are underrepresented in both national travel surveys, probably because of language barriers. We expect that those immigrants who participated are better integrated than those who refused to take part. This implies that the effects we found (as well as effects found in similar quantitative studies) are most probably underestimated. For future studies focussing on immigrants' mobility, scholars should consider making questionnaires also available in other languages to yield more accurate effect estimations based on higher response rates.

In conclusion, we are convinced that it is relevant to invest in the support of cycling for immigrants and descendants in countries where cycling is a safe transport mode that provides many advantages on an individual and societal level. As one possible measure to support the uptake of cycling of new residents, municipalities could provide information packages that inform about the regional cycling culture and practise, including an offer for cycling courses. Some Danish and Dutch municipalities already offer cycling courses for immigrants, targeting women in particular (e.g., Broeken 2018; Thomsen-Mühlbrand et al. 2017). In highly segregated neighbourhoods, it may additionally be relevant to identify and educate selected people (of both genders) of immigrant origin who could serve as role models and contacts for cycling in their neighbourhood and combine this with local cycling campaigns and events. Similar to an existing service of native language partners for new residents in Denmark ([swaplanguage.com](http://swaplanguage.com)), a relevant initiative could also be to convey volunteer 'cycling partners' to new residents who help practise cycling in their new country.

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## **Conflict of interest statement**

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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