Het effect van werk gerelateerde aspecten op fietsgebruik voor woon-werkverkeer

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Samenvatting

Het effect van werk gerelateerde aspecten op fietsgebruik voor woon-werkverkeer

Fietsen is goed voor het milieu en gezondheid, goedkoop en heeft relatief weinig ruimte nodig. Vanwege deze voordelen proberen overheden fietsgebruik te stimuleren in het algemeen en voor woon-werkverkeer. Ondanks dat veel factoren in eerder onderzoek van invloed blijken te zijn, is relatief weinig aandacht besteed aan het effect van aspecten, die met de werksituatie samenhangen. Dit paper probeert te achterhalen welke werkgerelateerde kenmerken, zoals kleidingstijl, mening van collega's en werkuren, de keuze beïnvloedt dat een individu een fulltime, parttime of niet-fietser is. Hiervoor is een internetsurvey gehouden in Delft, Zwolle, Midden-Delfland en Pijnacker-Nootdorp. Door het schatten van een multi nomial logitmodel is voor een aantal aspecten een effect gevonden op de kans om een fulltime of parttime fietser te zijn. De kans om een fulltime fietser te zijn is groter, indien men een fiets nodig heeft tijdens werktijd, men denkt dat collega's verwachten dat men met de fiets naar het werk moet reizen, als een individu een permanent of tijdelijk contract heeft in tegenstelling tot een gedetacheerd persoon en als een individu werkzaam is de landbouw en visserij sector of in een fabriek in plaats van bij een openbaar nutsbedrijf. De kans om fulltime fietser te zijn is kleiner als een individu spullen moet vervoeren naar het werk of tijdens werktijd en als een auto beschikbaar is voor woon-werkverkeer. Het is waarschijnlijker dat een individu een parttime fietser is als iemand een fiets nodig heeft tijdens werktijd of wanneer er soms, maar niet altijd een auto beschikbaar is voor woon-werkverkeer of als deze persoon in delfstofwinning, bouwnijverheid, handel, horeca, onderwijs, gezondheidszorg of transport, opslag en communicatie werkt in tegenstelling tot bij een openbaar nutsbedrijf. De kans is kleiner indien een privé of lease auto nodig is tijdens werktijd of indien er spullen vervoerd dienen te worden. Deze resultaten kunnen gebruikt worden om fietsen naar het werk gerichter te stimuleren.

1. Introduction

Cycling is beneficial to our environment. Compared to using public transport or cars, cycling hardly pollutes at all. No CO_2 or other exhaust gases are emitted, and cycling can therefore be considered, along with walking, as the most environmentally friendly means of transportation. Cycling also has many other advantages for the individual and society, however. For the individual, cycling is cheap and convenient for short-distance journeys and promotes good health and mental relaxation (1). For society, cycling improves public health, and this is particularly significant in view of current trends in obesity. Bicycles produce no noise pollution and also require less space for infrastructure and parking, meaning that if more people chose to use bicycles, transport-related problems such as congestion could be alleviated.

However, although researchers have shown great interest in cycling, little academic research has been carried out into how work-related factors affect rates of bicycle usage. This is remarkable because it seems evident that work-related factors will affect the mode of transport chosen. By work-related factors, we mean a series of factors including the location of the place of work within the town, the commuting distance from home, bicycle facilities at work, the route taken, the hours worked, the type of clothing required for work and whether it is necessary to travel during working hours. The attitudes of colleagues, possible including pressure regarding mode of transport choice, could also influence this choice.

Knowledge of how these work-related factors affect bicycle use would benefit employers and policy makers. It could allow policy makers to develop targeted policies, while employers could adapt the incentives they provide for specific modes of commuting and benefit from the reduced need for parking places, lower commuting costs, fewer company and lease cars, and healthier employees.

This paper aims to address this gap in our knowledge and will report the results of a bicycle survey carried out in the Netherlands with a particular focus on the relationship between the work-related factors mentioned above and the frequency of commuting by bicycle. The objective of this study is to evaluate the impact of work-related factors on whether workers choose to cycle to work and the frequency with which they cycle to work. For the purposes of this paper, cycling to work is defined as using only the bicycle for commuting; trip chaining is not taken into account. A survey was carried out among the employees of several companies in Delft and Zwolle, two medium-sized towns in the Netherlands, and among the inhabitants of the same towns and two municipalities adjacent to Delft.

The remainder of this paper is organized as follows. Firstly, we will give a short literature overview. Secondly, a more extensive description of the survey and approach will be presented. Finally, the results of this survey will be presented and the relationship between bicycle commuting rates and work-related factors will be analyzed.

2. An overview of the literature

In the recent past, many aspects have been found to influence bicycle use and bicycle commuting. This section gives a brief overview of the literature concerning both the factors influencing bicycle use and bicycle commuting.

(2-3) found that the built environment affects cycling, though this does not seem to be the most important aspect. Bicycle use is higher when the distances travelled are shorter, and this effect sometimes occurs as a result of a compact city form with small block sizes, high densities or mixed use (4-11). (12-14) found that cyclists prefer

dedicated cycling infrastructure. Bicycle paths which are separated from motorized traffic are generally considered safer. The naturally occurring topographic situation also influences rates of cycling. (6-8, 15-17) show that the presence of inclines decreases the amount of cycling. Remarkably, (14) conclude that experienced cyclists actually prefer a hilly landscape to a flat landscape, though this preference does not result in increased commuting by bicycle. (8, 18-19) conclude that bicycle parking facilities and showers at work are valued by cyclists, though these facilities do not actually encourage people to cycle to work more often (20). Weather can also affect bicycle use negatively. (6, 21-23) found that rain and temperature influences bicycle use negatively. Finally, psychological constructs have been found to influence rates of bicycle use: a more positive personal attitude towards cycling, stronger ecological beliefs, the perception of more positive attitudes towards cycling on the part of others, and a more positive public image of the bicycle will all make it more likely that an individual will choose to cycle to work (24-28). Most research assumes that the decision to cycle to work is taken after long consideration of all the various possibilities and their outcomes. However, if a certain behavior is repeated, it can be habit-forming, resulting in less consideration of other options and less inclination to consider new information or change their habits (29-30).

3. Research design

Study area

This study was carried out in four municipalities in the Netherlands: the medium-sized towns of Zwolle (approximately 115,000 inhabitants) and Delft (approximately 100,000 inhabitants), and two more rural municipalities adjacent to Delft: Midden-Delfland (17,000 inhabitants) and Pijnacker-Nootdorp (38,000 inhabitants). The two towns are an ideal place to conduct bicycle research because both towns have high rates of bicycle usage (28.2% and 32.6% of all trips ending in Delft or Zwolle, respectively). For commuting, the share of bicycle use in Delft and Zwolle is 22.1% and 27.5%, respectively, for all trips ending in those towns[1].

Survey

In April/May 2008 we conducted an internet survey among (1) employees of several employers in Delft and Zwolle, including TU Delft, the Reinier de Graaf Hospital, housing authorities and a receivables management company, and among (2) the inhabitants of the municipalities mentioned above. Using local authority address data, a total of 22,000 letters were randomly sent to the inhabitants of these municipalities as potential respondents, inviting them to participate (10,000 in Delft, 6,000 in Zwolle, 3,000 in Pijnacker-Nootdorp and Midden-Delfland). E-mails were also sent to the employees of the companies mentioned (just under 3,500). The exact number of e-mails sent is uncertain, because the e-mails were distributed internally by the companies. These letters and e-mails asked the respondents to log into an internet questionnaire.

A total of 5,434 people participated (3,659 inhabitants, 1,775 employees), resulting in 4,306 useable completed questionnaires; 331 people informed us that they did not wish to participate, although no response had been requested in the event of not wishing to participate. The relatively low response rate was due to several factors. Firstly, since this research focuses on commuting, only employed people were able to participate. As we did not know who was employed, many unemployed people (especially in the younger and older groups) were also sent invitations to participate. People working from home,

[1] Based on Dutch data on travel behavior: Mobiliteits Onderzoek Nederland 2006

too, were unable to participate as the questionnaire did not match their personal situation. Secondly, many foreigners live in the selected towns, but do not speak sufficient Dutch, particularly in the municipality of Delft. Thirdly, some individuals could have been invited to participate twice (both as an inhabitant and an employee). In the letter to the inhabitants, respondents were asked to cooperate in the research among employees if they were also employed at the selected companies. Fourth, the files provided by the local municipalities contained some errors: combinations of names and addresses were sometimes incorrect. A number of letters were returned marked 'moved'. Fifth, some letters were sent to individuals living in care or nursing homes, who were unable to fill in the questionnaire. Sixth, the amount of time needed to fill in the questionnaire (20-40 minutes) may have discouraged some people. Finally, the lack of a computer or internet connection was sometimes given a reason for not participating. Because of above reasons, it is hard to determine a realistic response rate, but the result was a broad sample of the population, including many cyclists.

Questionnaire

The questionnaire was presented as a survey on the mode of transport chosen by the respondent to travel to and from work, and the reasons behind this choice. The specific aim - to find out more about bicycle use - was kept unknown to the respondents in order to avoid a bias towards cyclists or people with a favorable opinion towards cycling. The questionnaire was placed on the internet and could be accessed using a special link. The survey included questions about the respondents' personal and socio-economic situation, their work situation, their attitudes, habits and experiences, their chosen mode of transport for traveling to and from work and the reasons behind this choice. Of particular interest for our research were the questions focusing on work-related factors: the sector in which the respondent worked, the type of clothes worn to work, whether they had to transport heavy or bulky objects, the number of different sites they worked at, the use of transport during working hours, and the mode of transport used to travel to work.

Variables

The choice of mode of transport, the dependent variable, was determined by asking a number of questions. First the respondent was asked whether he or she used one or several modes of transport to commute to work over the past year. Literally, the respondent was asked: "did you always travel with the same transportation mode to your current work location over the past year? (please tick 'no' if you travelled using a different mode of transport more than twice last year)". Answering either 'yes' or 'no' led to the question: "which modes of transport do you use to travel to work?". The possible answers were: car, bicycle, public transport, walking, a combination of car and bicycle, a combination of public transport and bicycle, a combination of public transport and walking, a combination of car and public transport and another mode. If only one mode was used, the respondent was labeled as a full-time cyclist. If a person indicated that he or she sometimes cycled to work, the respondent was assigned to the part-time cyclist group. If cycling was never the main mode of transport, the respondent was assigned to the non-cyclist group.

In the questionnaire to inhabitants, the respondents were asked which sector they worked in. In the questionnaire to employees, this was unnecessary because this information was already known. We also asked about the respondents' employment status (permanent contract, temporary contract, temporary employer through an employment agency, being temporary personnel from another company or on

secondment), the regularity and number of working hours, the need to transport objects (heavy or bulky objects), number of working locations, employers and whether the respondent used a mode of transport during working hours. If the respondent used a particular mode of transport during working hours, they were asked which mode they used. Respondents were also asked about the clothes they wore at work, with the options: suit, smart clothes, special working clothes, casual clothes. Finally, the respondents were asked about their colleagues' expectations of their choice of mode of transport. The question was: "which mode of transport do you think that most people at work expect you to use to travel to work?"

4. Empirical Results

This section discusses the relationship between cycling to work and working conditions. In order to achieve the aim of this paper, we divided the respondents into three groups: 'full-time cyclists', 'part-time cyclists' and 'non-cyclists'. 61% of the respondents belonged in the non-cyclist group (n=2,638), 15% (645) in the full-time cyclist group, and 24% (1,023) indicated that they were part-time cyclists.

To start with, we compared the three groups of cyclists with the work-related factors: the sector worked in, the job position, employment status, regularity of work hours, clothing worn at work, the need for transport during office hours, the need to transport objects, the number of employers, the number of working days, and the opinions of colleagues. Secondly, a multi nominal logit model (MNL) was estimated with these variables used as independent variables, along with age, gender, ethnicity, being a student, having a driver's license, car availability and education.

4.1 Descriptive results

Sector

The sector in which a person works is related to the decision to cycle to work. Respondents working in public service companies and the building or constructing sector are less likely to use the bicycle to travel to work than other respondents, whereas respondents working in research and education or in the health sector are more likely to be full- or part-time cyclists. Remarkably, a high percentage of people working in the industrial manufacturing sector were also found among the part-time cyclists. Again, a high percentage of full-time cyclists was found in the education and research sector, a low percentage within public service companies and in the building or construction sector. These findings corresponded partly with our expectations. People working at universities or high schools see many of their students cycling, and seeing others cycling can encourage you to cycle, too (31). The low share of cyclists in public service companies was unexpected, since status is not very important in this sector. The low proportion of cyclists here could be explained by the need to use a car during working hours or the need to transport objects. These aspects will be discussed below.

Job Position

The position a person works in also relates to some extent to the decision to cycle. Those working as managers were found more frequently in the group of non-cyclists, and less often in the group of full-time cyclists. Those working in administrative positions or in research, education or health are more likely to be full-time cyclists and were found more than average in the group of full-time cyclists. The links that we found between job position and bicycle commuting are plausible. People in management positions, for

example, are more likely to have a company car, wear suits and work irregular hours are therefore cycle less. These aspects are discussed below.

Terms of employment

There is also a relationship between a worker's terms of employment and his or her decision to cycle to work. Employees working on a temporary basis and employees sent on secondment are more likely to be in the group of non-cyclists. Employers with a temporary contract or temporary workers for employment agencies were statistically more frequently found in the group of full-time cyclists. It was uncertain whether it was the terms of employment that affect cycling or whether it was in fact distance or income that were the determining factors.

Regularity of working hours

People with irregular working hours are more often part-time cyclists than people with a regular working time schedule. Irregular working hours could result in having to travel in the dark more often. Since darkness has been named by respondents in past surveys as a reason not to cycle (20, 25), irregularity of working hours can be assumed to reduce the chance of being a full-time cyclist.

Clothing

The clothes people wear to work influences the decision about whether to cycle to work. People who always or sometimes wear a suit to work are less likely to be cyclists. Other clothing, such as smart clothing or special work clothes, seems not to have an effect. People wearing casual clothes to work are more likely to be cyclists. These results were in line with our expectations. People may be afraid to damage their suit while cycling and therefore choose not to cycle to work. Secondly, people wearing suits may be more likely to work further away from home, and commuting by bicycle is not feasible for that reason. Thirdly people wearing a suit may have more appointments outside their principal place of work, meaning that they need to travel more and possibly over larger distances. The bicycle may not be the best option for them.

Traveling during office hours

Sometimes it is necessary to travel during working hours. In general, people who do not need to travel during working hours are more likely to be full-time cyclists, while employees who travel during working hours are less inclined to cycle to work. In particular, employees who use a private car or leased car during working hours decide not to cycle to work. For journeys with a company-owned car, this effect does not seem to exist. However, if a bicycle is needed during working hours, many people cycle to work as well.

Transportation of large or heavy objects

If people need to transport large or heavy objects, they do not usually cycle to work. This finding seems logical, because one of the negative aspects of traveling by bicycle is the difficulty of transporting heavy objects.

Number of working days

As the number of working days increases, respondents are less often full-time cyclists, but more often non-cyclists. The distance travelled to work may also play a role, because for those who work fewer days per week, working close to home is more (time) efficient.

Number of working hours

As the number of working hours increases, the percentage of non-cyclists increases and the percentage of full-time cyclists decreases. Since the number of working hours relates to the number of working days, the same explanation as above may apply to explain this effect.

Number of working locations
Working at a number of locations results in less cycling. Respondents with more than three working locations are only rarely full-time cyclists. This seems plausible, because as well as traveling to work, these respondents would need to travel between these working locations. They would therefore probably need to travel longer distances in one day and may choose a mode of transport more convenient for longer distances.

Opinions of colleagues
The social work context also affects which mode of transport individuals choose. If a person believes that his or her colleagues expect them to travel to work by bicycle, the chances are higher that they will indeed cycle to work, either full-time or part-time. People who perceive that their colleagues want them to commute with a form of transport other than the bicycle are more likely to belong to the non-cycling group. These findings correspond with the assumptions of psychological theories such as the theory of planned behavior (32). This theory assumes that one's perception of the opinion of others is among the factors which influence one's likelihood of behaving in a certain way.

Socio-economic situation
Besides work-related factors, socio-economic factors also affect rates of commuting by bicycle. Less well-educated people more frequently belong in the group of non-cyclists, but also more frequently in the group of full-time cyclists. Overall, highly educated people cycle the least. According to our data, women cycle more than men. Income has a negative effect on cycling: as income rises, the rate of bicycle use drops. Age and ethnicity have a more equivocal relationship with cycling. Respondents under 25 are more often full-time cyclists, but respondents aged 25-54 are more frequently part-time cyclists. Dutch natives are full-time cyclists the most often, while Western European Union immigrants are part-time cyclists more often. Immigrants from other countries cycle less than both of these groups.

4.2 Multinomial logit model
To test the above results, and to explore the relationship between work-related factors and the rate of bicycle use (non-cyclists, part-time cyclists and full-time cyclist), a multinomial logit model was estimated using STATA/SE 10.0. This model is significant with $p=0.00$ and has a pseudo-R-square of 0.247 having 3,693 observations. A second model also included income. Income was omitted from the first model due to the excessive number of missing values (over 600). This second model has a pseudo-R-square of 0.252 based on 3,058 observations. Table 1 shows the results. Being a part-time or full-time cyclist is compared to being a non-cyclist.

Sector
The sector in which a person works determines cycling behavior to some extent. Full-time cyclists are more likely to work in agriculture and fishing or in the manufacturing sector than in public utility services. People working in mineral production, the building and construction trade, the hotel and restaurant sector, transport, storage and communication companies, finance and insurance, education and health or health care are more likely than respondents working in public utility companies to be part-time

cyclists. If income is included in the analysis, the influence of the sector declines: the sector worked in has no effect on being a full-time cyclist and a significant effect is present for part-time cyclists for fewer sectors. The results are similar to the above crosstabs. Respondents working in public utility companies cycle markedly less than respondents working in other sectors. It is unclear what causes this effect. Income seems to explain it partially, as the effect declines after income is included in the model.

Job position

The MNL-model estimated does not show a significant effect of job position type on cycling behavior.

Terms of employment

A worker's terms of employment have a major effect on cycling. Compared to respondents working on temporary basis in another company, people with a steady or temporary contract or working through a temporary employment agency are more likely to be full-time cyclists. Only a minor effect is visible on part-time cycling. If income is added as an independent variable, people with a permanent contract or who are on secondment are more often part-time cyclists than people being temporary personnel from another company.

These results were in line with our expectations. People with a contract are more likely to live closer to their work since they do not change their place of work often. Moreover, some jobs, especially jobs with people who are temporary borrowed to another company come with a car. Thirdly, temporary worker from another company are sometimes expected to travel to work by car by their superiors.

Regularity of working hours

Respondents with regular working hours have when income is included higher probabilities to be a full-time cyclist.

Clothing

The type of clothes worn at work was not significant at a 90% confidence interval to being a bicycle commuter. This was unexpected, because we assumed that wearing a suit may be a disadvantage when cycling. The suit could become dirty, and for women in particular, some clothing is not suitable for cycling. At an 80% confidence interval, this was found to be partly true: people wearing smart clothes or special work clothes were more likely to be a part-time cyclist than those wearing suits.

Traveling during office hours

People needing a private or leased car, a motorcycle or scooter for traveling during office hours have a smaller chance of being a full-time cyclist commuter; needing a private or leased car or taxi also decreases the probability of being a part-time bicycle commuter. The need for a bicycle during office hours increases the chance of being either a full-time or part-time cyclist. This seems logical, because if a bicycle is needed during office hours, a bicycle will be available. Although many companies provide bicycles, using one's own bicycle has some advantages: the bicycle is adjusted for the height and comfort of the employee and it enables the user to travel directly from home to the appointment, or the other way around. Needing a car during office hours, by the same logic, makes commuting by car a good option, because commuting by car means a car is also available during office hours.

Transportation of heavy or bulky objects

In comparison to respondents who never have to transport objects, respondents who sometimes or often need to transport objects are less often full-time or part-time cyclists than non-cyclists. This finding is sound, because transporting objects by bicycle is difficult and therefore a major impediment to using a bicycle.

Number of working days, hours and working locations

The number of working days, hours and locations does not affect the rate of bicycle commuting.

The opinions of colleagues

Colleagues who expect a person to travel to work by bicycle, or colleagues who do not have an opinion about the mode of transport used increase the chance of bicycle commuting. More part-time and full-time bicycle commuters were present among the respondents who indicated that they thought their colleagues expected them to commute by bicycle. This finding indicates that the social working environment is a significant factor in determining the mode of transport for commuting. However, there could be another explanatory factor: if people go to work by bicycle every day, they may also believe that colleagues expect them to commute by bicycle as well.

Socio-economic situation

In addition to the work-related factors, the MNL-model was estimated with several socio-economic aspects. Firstly, the option of commuting by car is found to influence bicycle commuting. If a car is available for commuting, whether permanently or only sometimes, then people are less likely to be full-time cyclists than if no car is available. In comparison to non-cyclists, part-time cyclists more often have a car available for commuting sometimes, rather than never. The availability of a car would appear to influence commute mode choice. However, self-selection could be present: if a person wants to commute by car, he or she is more likely to ensure the availability of a car.

Full-time students and those working and studying simultaneously are less often full-time cyclists than non-students. This is surprising since student levels in cities have been found to correlate positively with bicycle use rates (32-35). Level of education, age or nationality could explain the differences in our survey, rather than the mere fact of being a student. Part-time cyclists are more often aged between 25-54, of Dutch nationality and have a medium or high level of education, in comparison to non-cyclists. Income affects cycling negatively: compared to individuals with an income of over €3,000 per month, people with an income of under €1,500 are more often full-time cyclists. We found no significant effect for the variables of having a driver's license and gender on bicycle commuting.

Table 1: multi nomial logit models

		MNL model excluding income						**MNL model including income**					
		ft cyclist			**pt cyclist**			**ft cyclist**			**pt cyclist**		
	variables	rrr	P>|z|		rrr	P>|z|		rrr	P>|z|		rrr	P>|z|	
sector	**agriculture and fishing**	3.592.005	0.090	**	1.416.037	0.542		2.287.554	0.334		1.489.058	0.566	
	mineral producing	3.20e-14	1.000		329.265	0.090	**	3.77e-13	1.000		7.192.016	0.019	***
	industry	2.467.964	0.097	**	2.291.748	0.009	***	1.810.089	0.300		2.137.977	0.028	***
	building and construction	.5335056	0.447		2.109.916	0.058	**	.40565	0.295		1.988.153	0.107	*

	trade, hotel and restaurant	1.235.155	0.725		2.823.296	0.004	***	.9452123	0.929		2.313.759	0.035	***
	transport, storage and communication	2.376.387	0.159	*	1.956.138	0.091	**	1.535.967	0.513		1.538.086	0.335	
	finance and insurance	141.764	0.584		2.486.143	0.015	***	1.493.556	0.552		2.413.668	0.034	***
	education and research	2.023.472	0.174	*	1.709.571	0.069	**	1.371.335	0.560		1.502.926	0.204	
	health care	1.663.066	0.344		2.321.405	0.007	***	1.139.036	0.818		2.081.006	0.031	***
	other services	1.003.983	0.994		1.583.301	0.125	*	.7361001	0.588		1.484.626	0.225	
	government	137.126	0.549		1.587.867	0.122	*	.9966046	0.995		1.408.075	0.292	
	other	1.335.403	0.587		1.388.729	0.286		.8268574	0.734		1.432.925	0.280	
function	technical	1.070.434	0.825		1.095.219	0.654		1.195.722	0.602		1.058.814	0.799	
	administrative	1.007.339	0.978		1.180.027	0.345		1.049.067	0.871		1.143.511	0.487	
	financial, law	1.011.908	0.969		1.131.408	0.508		1.132.403	0.711		1.144.449	0.516	
	research, education, health	1.064.866	0.815		.9977733	0.990		1.150.772	0.639		108.248	0.690	
	police, army	1.170.105	0.803		.744795	0.510		1.262.832	0.746		.6035942	0.326	
	other	.9326564	0.786		.8416289	0.310		.9166831	0.762		.8213859	0.297	
employment	permanent contract	1.33e+09	0.000	***	2.695.643	0.133	*	1.23e+09	0.000	***	4.185.414	0.071	**
status	temporary contract	1.21e+09	0.000	***	2.082.769	0.279		1.10e+09	0.000	***	3.056.882	0.168	*
	through employment agency	6.78e+08	0.000	***	1.685.331	0.477		4.81e+08	0.000	***	2.484.662	0.295	
	sent on secondment	3.49e+08	.		2.861.609	0.141	*	2.94e+08	.		5.355.896	0.048	***
	other	1.92e+09	0.000	***	3.047.568	0.105	*	1.22e+09	0.000	***	3.902.117	0.099	**
regular hours	no	.8918461	0.402		1.126.337	0.233		.7775464	0.099	**	1.095.383	0.408	
clothing style	FT casual clothing	113.304	0.786		1.348.409	0.236		1.129.962	0.804		1.184.451	0.533	
	PT suit	.4231832	0.224		1.292.702	0.387		.3587403	0.202		1.114.676	0.738	
	FT smart clothing	1.626.383	0.284		1.378.393	0.188	*	1.652.462	0.301		1.294.666	0.323	
	FT special work clothing	1.077.433	0.879		1.519.238	0.141	*	1.128.689	0.818		1.444.112	0.233	
	other clothing combination	1.081.214	0.867		1.393.246	0.189	*	.8813874	0.802		1.236.744	0.435	
need for	lease car	.2292357	0.021	***	.4692191	0.001	***	.2425774	0.063	**	.4448832	0.001	***
transport	own car	.1582836	0.000	***	.7063107	0.003	***	.1450048	0.000	***	.7056273	0.007	***
	company car	1.160.871	0.484		1.097.818	0.537		1.084.776	0.733		1.121.228	0.491	
	motorcycle	.1472373	0.077	**	.9863262	0.967		.2003191	0.150	*	.9922163	0.984	
	scooter	.0744715	0.002	***	.6891327	0.389		.0362947	0.004	***	.7026685	0.475	
	bicycle	4.958.057	0.000	***	2.798.605	0.000	***	5.430.202	0.000	***	2.908.785	0.000	***
	public transport	.7420537	0.158	*	1.037.776	0.788		.8965896	0.637		1.065.866	0.674	
	taxi	.7474349	0.603		.5109721	0.095	**	.4016771	0.193	*	.5832716	0.202	
	other	.8211009	0.539		.7733487	0.293		.7087128	0.367		.9492351	0.846	
transport of objects to work	always	.1633063	0.006	***	.2490584	0.000	***	.240495	0.030	***	.187261	0.000	***
	sometimes	.3528206	0.000	***	1.096.097	0.369		.3468253	0.000	***	1.039.821	0.729	
working days	<2	1.165.575	0.783		.8532217	0.717		1.543.663	0.479		142.235	0.484	
	2-3	.9997516	1.000		.8660672	0.686		103.239	0.955		126.589	0.569	
	3-4	1.407.019	0.477		.9310209	0.818		1.577.752	0.391		1.285.683	0.490	
	4-5	1.205.523	0.680		1.068.512	0.816		1.324.529	0.575		1.357.352	0.363	
working hours	<8	1.456.241	0.770		.577455	0.466		.9062546	0.943		.6110415	0.588	
	8-16	2.749.954	0.421		.8634335	0.832		1.797.211	0.661		.9132671	0.915	
	16-28	1.507.091	0.740		.8066627	0.743		1.081.773	0.952		.8806385	0.876	
	28-36	.6074307	0.684		.654445	0.504		.5203909	0.615		.8403952	0.825	
	36-40	.8093204	0.862		.6187093	0.443		.7496483	0.823		.8278154	0.808	
	40-60	.5102463	0.579		.5174079	0.288		.4591869	0.544		.6935015	0.636	
working	1	1.393.036	0.369		1.052.691	0.820		1.055.839	0.894		1.060.093	0.820	
locations	2	.8261526	0.635		.8829904	0.617		.6544647	0.345		.9051274	0.724	
	3	1.515.259	0.416		1.092.689	0.794		1.055.327	0.923		1.104.852	0.788	
opinion of	bicycle	1.717.978	0.000	***	693.983	0.000	***	1.662.055	0.000	***	6.803.251	0.000	***
colleagues	public transport	.6840477	0.378		1.280.065	0.301		.7623097	0.544		109.766	0.720	
about how to travel	on foot	.8819669	0.835		1.026.234	0.953		.7455332	0.669		1.028.428	0.953	
to work	other	6.83e-14	1.000		.7172468	0.682		7.87e-13	1.000		1.059.922	0.948	

	does not matter	4.619.586	0.000	***	3.178.562	0.000	***	4.442.149	0.000	***	2.894.664	0.000	***
car availability	**always**	.2174621	0.000	***	1.014.841	0.925		.2096609	0.000	***	.9507194	0.770	
	more than 50%	.4572747	0.001	***	2.239.032	0.000	***	.4697626	0.004	***	2.046.187	0.001	***
	less than 50%	.4914934	0.001	***	1.561.066	0.022	***	.5417376	0.008	***	1.605.159	0.025	***
driver's license	**yes**	.7373429	0.157	*	.7761139	0.255		.8032601	0.357		.9102658	0.703	
gender	**women**	.8073161	0.172	*	.8448622	0.143	*	.8052212	0.221		.8902634	0.367	
age	**<25**	1.392.665	0.324		1.403.489	0.216		1.388.641	0.357		1.317.905	0.349	
	25-54	.9588523	0.790		1.356.909	0.017	***	.944225	0.744		1.379.855	0.023	***
ethnicity	**Dutch**	1.400.554	0.435		210.907	0.035	***	1.310.369	0.585		1.725.135	0.144	*
	western EU	1.068.123	0.937		2.195.131	0.185	*	1.415.334	0.695		1.952.708	0.295	
education	**medium**	1.115.311	0.544		1.473.186	0.012	***	1.122.635	0.562		1.720.651	0.002	***
	high	1.347.527	0.118	*	1.957.255	0.000	***	13.874	0.125	*	2.134.607	0.000	***
student	**FT**	.3557409	0.003	***	.8163426	0.471		.3741683	0.009	***	.8632835	0.622	
	PT	.732432	0.324		1.125.478	0.534		.4751046	0.050	***	.9658222	0.869	
	some courses	1.142.972	0.546		1.192.793	0.242		1.346.937	0.236		139.959	0.048	***
income	**<1500€**							2.176.238	0.055	**	.9845185	0.949	
	1500-3000€							1.357.807	0.392		.9126539	0.622	

*** = 95% confidence

** = 90% confidence

* = 80% confidence

4.3 Overview

Most of our findings corresponded with our initial expectations. On the one hand, having a car at home provides the opportunity to travel to work by car, and this reduces the chance of bicycle commuting. Needing a car for work has a similar effect on the rate of bicycle use. The need to transport heavy or bulky objects to work reduces the rate of bicycle use for commuting. Respondents whose colleagues expect the respondent to travel to work by car logically reduces the chance of bicycle commuting. However, there could be another factor which explains this finding. If people go to work by car every day, they may imagine that their colleagues expect them to commute by car, and this becomes a self-fulfilling prophecy. Moreover, other aspects (among them distance and personal situation) may also influence the expectancy of colleagues and might thereby discourage a person from bicycle commuting. On the other hand the need for a bicycle during office hours increases the probability of being a full-time cyclist. Those with a steady or temporary contract are more often full-time cyclists than those temporary lent to another company. The distance traveled and terms of employment could be significant in explaining this result.

Three aspects were unexpectedly found to significantly influence whether an individual is a full-time or part-time cyclist. These were the sector worked in, being a student and needing a motorcycle or scooter during office hours. Firstly, respondents working in agriculture and fishing or the manufacturing sector are more often full-time cyclists than workers in public utility services. Income differences, and therefore the possibility of spending money on transport, may cause this result. Secondly, being a student has a negative effect on being a full-time cyclist. Students generally cycle more than other people, and it is therefore surprising that being a full-time student lowers the probability of being a full-time bicycle commuter. Thirdly, the effect of needing a motorcycle or scooter on being a full-time cyclist is remarkable, although if there is a need for using a motorcycle or scooter during work, it seems logical that this mode of

transport would be used for commuting as well and that these respondents do not commute by bicycle for this reason.

Remarkably, some aspects that had been expected to influence bicycle use were not found significant: the number of working days, hours and location, and having a driver's license. An increase in working days and hours was thought to decrease bicycle use because the distances between living and working locations may increase with the amount of working hours. A higher number of working locations may also create a need for more traveling and, presumably, traveling over larger distances. Because cycling is more suitable for shorter distances, we assumed that having several working locations would have a negative influence on bicycle commuting. No effect was found for having a driver's license, either. Car availability is probably the more significant factor here.

In some previous research, a relationship was found between cycling and gender, with men cycling more than women. Although our data suggest that women cycle more than men, in our estimated MNL-model women are indeed less often full-time cyclists than men are, for an 80% confidence interval.

5. Conclusion

In the literature, cycling and commuting by bicycle are found to be related to several variables. Until now, however, little attention had been given to the effect of work-related factors on bicycle use. The aim of this paper has been to look at this relationship, including factors such as the sector an individual works in, the type of job position they have, their terms of employment, the regularity of their working hours, the clothes they wear to work, the need to use a mode of transport during working hours, the need to transport objects, the number of employers, the number of working days, the opinions of colleagues, the age, gender and ethnicity of the individual, whether they have a driver's license, whether they are a student and whether they have a car available for commuting. To this end, an internet survey was conducted among employees and inhabitants in four municipalities in the Netherlands, the country with the highest rates of bicycle use in the world (36).

On the basis of the multinomial logit model, several variables were found to be statistically significant. At a 90% confidence interval, full-time cyclists need a bicycle during working hours, need not to transport objects, perceive that colleagues expect them to commute by bicycle, are not temporary lent to another company but have a steady or temporary contract, need a bicycle during office hours or work in the agricultural, fishing or manufacturing sectors rather than the public services, in comparison to non-cyclists. Respondents less likely to be full-time cyclists compared to non-cyclists were those who have a car available for commuting (possibly only some of the time), or need a car, motorcycle or scooter during office hours.

Being a part-time cyclist is related to several factors, in comparison to being a non-cyclist. At a 90% confidence interval, factors which lower the likelihood of being a part-time bicycle commuter are the need to transport heavy or bulky objects during working hours every day and the need to use a taxi or car during office hours. On the other hand, the following respondents have a higher probability of being a part-time cyclists than non-cyclists: those who perceived that their colleagues expect them to travel to work by bicycle, those who needed a bicycle during working hours, those who had the option of commuting by car, those who needed a bicycle during office hours and those who worked in the mineral production, building and construction, trade, hotel and restaurant,

transport, storage and communication, finance and insurance, education and health care sectors compared to respondents working in public utility companies.

These findings provide several challenges for future research. Firstly, our model tests for a relationship between the dependent and independent variables. However, no causal relationship can be drawn from these findings. It is possible that people have a positive attitude towards cycling or a preference for cycling as opposed to using the car or public transport, and therefore self-select them with respect to characteristics of working conditions (for an overview of residential self-selection: see 37). To obtain a better understanding of the causal relationships, additional research could include panel data research or direct questions concerning this causality. Secondly, some factors which determine whether a person cycles to work could vary from one day to the next, such as clothing or the need to transport objects. Additional research could focus on related variations and their impact on the daily choice of whether to commute by bicycle.

As mentioned in the introduction, our findings could be important for policy makers and employers. An increase in commuting by bicycle could benefit employers due to the reduced need for parking places, lower costs for commuting, company and lease cars, and healthier employees. Employers could encourage cycling by providing bicycles for (short distance) business trips for car commuters, providing company cars for business trips during working hours so that people would not need to commute by car simply because they need their car during working hours, developing an explicitly pro-cycling culture at work, and using financial stimuli to encourage bicycle commuting. Policy makers could use fiscal means to encourage bicycle commuting, develop employer-related policies (voluntary or compulsory), make business parks more cycle-friendly and demonstrate employer-related measures by implementing measures to encourage cycle themselves in their role as employers.

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