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Who are most likely to adapt their travel behaviour to changes in weather conditions? A study of weather tolerance and travel behaviour in Norway

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ABSTRACT
This study, based on two questionnaire surveys from two cities in Norway with different climate conditions, explores to which extent weather tolerance in terms of travel behaviour – here defined as using a non-motorized vehicle despite poor weather conditions (precipitation and/or cold weather) – is related to socio-demographic factors, environmental attitudes, transport habits as well as the climate conditions (coastal/inland) of where people live. Three indicators are used to measure 'weather tolerance': a) Disagreement to the statement "I always drive when it rains"; b) Willingness to walk 2-3 kilometers in minus 10 degrees Celsius or more in steady snowfall (yes/no), and c) Willingness to walk 2-3 kilometer in +20 degrees Celsius or more in steady rainfall" (yes/no). The study finds that environmental attitudes and travel habits (as perceived by the respondents) are the factors most strongly related to weather tolerance, independent on how it is measured, when other factors are controlled for. The findings suggest that policy measures to change attitudes/ increase environmental awareness as well as promoting outdoor activity in general can be effective in terms of making people choose active transportation even in poor weather conditions. This might be important steps to reduce the likelihood of car use in the future, when extreme weathers are to become more likely.

Keywords: travel behaviour, environmental attitudes, weather tolerance, climate change, sustainable travel behaviour

1. Introduction

Weather conditions impact our everyday life in several ways. Not only does the weather influence our experience of travel and outdoor activities, but it also impacts how we choose to travel, how much we travel and even the decision to carry out an out-of-home activity or not. Climate change predictions indicate higher temperatures, increase in total precipitation and more frequent and intense events of heavy rainfall [21, 22, 16]. Previous studies demonstrate large variations in transport mode choice and mobility patterns across different seasons and weather conditions. In Canada and northern USA, car traffic is reduced with snowfall [9, 26] and in Scotland and Australia with rain [17, 24]. Other studies, mainly European, reflect a positive relationship between precipitation and choice of motorized mode of travel, primarily the car, and often at the expense of cycling and walking [6, 1, 5]. In general, precipitation has a greater effect on leisure trips than on mandatory trips such as commuting to work or shopping [6]. Several studies on the effect temperature on travel behaviour report significant less cycling in winter [14, 28,

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5, 33]. Other studies show that temperature has less impact on travel mode choice than precipitation [6]. The impact of wind has received less attention, some studies find that wind has a negative effect on cycling [18, 1].
Perceptions of 'good', 'poor' and 'acceptable' weather are subjective and context-dependent [10, 27, 34]. Previous studies on the relationship between weather conditions and daily mobility has been concentrated primarily on the effects of precipitation, temperature or seasonal variations on travel behaviour in general. There is less knowledge on how people react differently in terms of travel behaviour to weather conditions and whether "weather tolerance" differ between people. The purpose of this study is to explore to which extent weather tolerance in terms of travel behaviour – here defined as active transportation or public transport despite poor weather conditions (precipitation and/or cold weather) – is related to socio-demographic factors, environmental attitudes, transport habits as well as the climate conditions (coastal/inland) of where people live.
One goal set out in the White Paper on Transport 2011 [11] is to reduce GHG emissions from the transport sector by 2030 to around 20 percent below their 2008 level. A potential increase in car use due to climate change will collide with the international goal of reducing the emissions from the transport sector. Knowledge on how people react to different weather conditions in terms of mode choice is therefore of significance in order prevent a potential increase in car use as climate changes.

2. Theoretical background and expectations

Feelings of comfort, discomfort, pleasure and safety may be perceived subjectively and differently by different individuals. For example, previous studies have shown that women and older people are more sensitive to cold weather conditions [see e.g. 23, 25, 35, 7], which can most likely be explained by variations in physical characteristics between genders and age groups. One assumption in this study is that both age and gender are associated with how people respond in terms of modifying their travel behaviour in poor weather conditions. In addition, it is likely that perceptions of weather conditions vary between contexts with different climate conditions, e.g. between people living in coastal climate as opposed to those living in the inlands. People living in a coastal climate are usually more used to precipitation and wind than people living in the inlands, and it leads us to assume that people living in the coastal climate will cope differently in terms of travel behaviour than people living in the inlands. A more recent study by Böcker et.al. [8] shows that people living in a city with coastal climate are more likely to use the car on days with precipitation than people living in a city with an inland climate.
Individual attitudes are another factor that might influence weather tolerance and how one reacts in terms of travel behaviour to poor weather conditions. Both within the sociological and psychological literature, there is a general assumption that values and attitudes influence behaviour [20, 29, 2, 32, 32]. In the literature, attitudes are influenced by a person's values, but are perceived more unstable and context-dependent than the latter [29]. In terms of weather tolerance and travel behaviour, one might for instance expect that a person who puts high value to nature and the environment and has great

concerns about climate change, will be more willing to travel by an environmental friendly mode of transport, even in poor weather conditions, than a person who discards potential threats posed by climate changes.

Several dimensions are important in any discussion about the relation between attitudes and behaviour. The attitude and the act must be at the same level. Ajzen and Fishbein [3] point to the fact that attitudes often have several dimensions and behaviour cannot be predicted on the basis of one of the dimensions alone. Attitudes are not static, they can change over time and bring about inconsistency between attitude and behaviour. According to the theory of cognitive dissonance, either the attitude or the act has to change if the two are to be in accordance [13]. Anabel [4] points to the fact that different attitudes can result in the same behaviour.

Attitudes must also be accessible (in the memory/mind) [12] if they are to have an impact on behaviour. This is the strength of the association between the object/phenomenon and assessment of it. Surveys will often "demand" that respondents answer questions about which they have no opinion or about which they have made up attitudes. Awareness of the problem/phenomenon will be a basis for the attitude. We can also assume that level of education might influence the attitudes through awareness.

Finally, alternative choices will sometimes not be assessed because the behavioural pattern is more or less fixed in habits and routines [36]. Garwill et al. [15] point to the fact that there might not be a relation between values, attitudes and behaviour because of habits. Habits influencing modal choice on daily trips are usually formed by several factors such as opportunities and constraints in resources, time and space, e.g. responsibility for others, transport resources, geographical location and access to transport services. The freedom to choose a specific transport mode is not necessarily the same for all people, and a person with strong environmental friendly attitudes might not have the opportunity to choose an environmental friendly means of transportation, given his or her constraints in resources, time and space [19]. One expectation in this paper, is that there is an association between travel habits and how one reacts to poor weather conditions in terms of travel behaviour.

The expectations of links between factors and their associations with weather tolerance in this paper are summarized in figure 1. The red arrows in figure 1 indicate the associations explored in this paper.

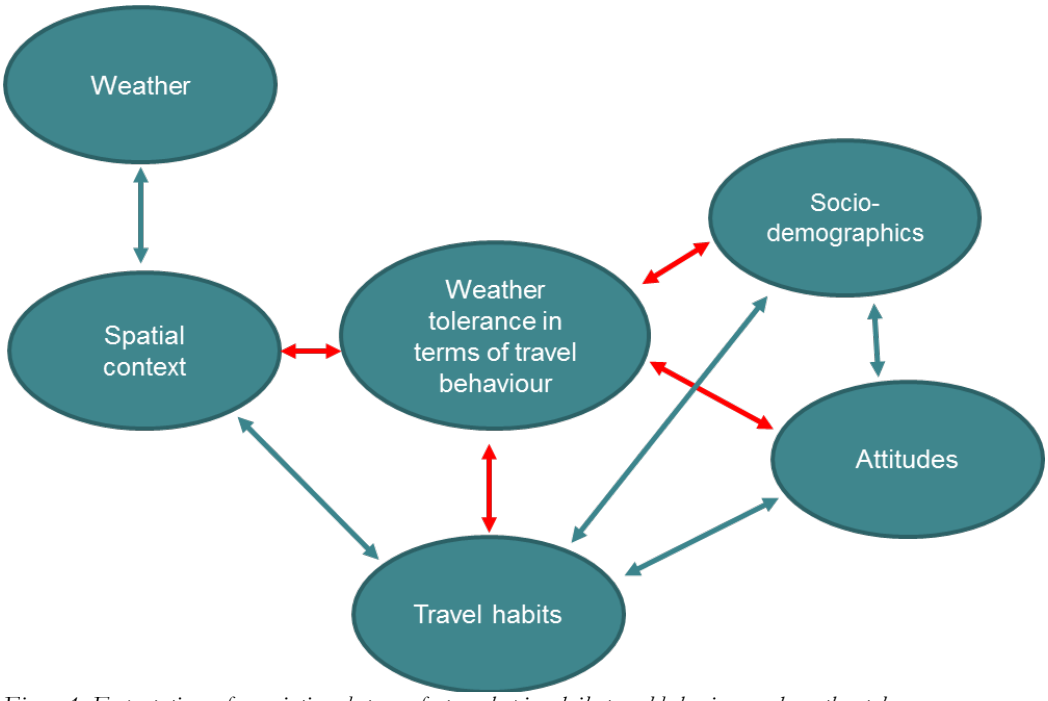

Figure 1. Expectations of associations between factors shaping daily travel behaviour and weather tolerance

3. Data and Methods

3.1 Case cities – Oslo and Stavanger

Oslo and Stavanger were selected as cases in Norway because these cities differ in size, prevailing weather conditions, and daily travel behaviour

Oslo, the capital of Norway, has a population of approx. 650 000 and this doubles when the greater urban area is included. Stavanger has about 130 000 inhabitants and 250 000 when the adjacent municipalities are included. The average temperatures of the two cities differ throughout the year – in Oslo the winter temperature is lower and the summer temperature higher than in Stavanger. In the winter months (December to March) the precipitation (mostly rain) in Stavanger is double that (more snow than rain) in Oslo.

Table 3.1 Travel mode choice in the two cities and quality of public transport. National travel survey (NTS) 2013/14.

Transport mode everyday travel and quality of public transport	Oslo	Stavanger
By foot	32	24
Cycle	5	8
Car	37	58
Public transport	26	10
Have very good public transport in the neighbourhood*	83	64

**Less than 1 km from home to bus stop/terminal and at least four departures per hour.*

An analysis based on the National Travel Surveys 2013/14, shows that the choice of transport mode for everyday mobility is different between the two cities, see table 3.1 In Oslo, people walk and use public transport much more than in Stavanger, where the car is the most used mode of transport. The quality of public transport is much better in Oslo than in Stavanger.

3.2 The surveys

The surveys were carried out in the period 26.11.2015 – 11.12.2015, with a total of 2,097 responded, 1,060 in Oslo and 1,037 in Stavanger/Sandnes. The target group was 18 years or older inhabitants in these two urban areas.

The surveys were conducted via TNS Gallup's Internet panel – GallupPanelet. All respondents in Oslo were panel members. In Stavanger/Sandnes it was necessary to supplement the existing panel with an additional sample from the population database of TNS Gallup. This part of the sample was recruited via SMS. Of the total sample in this urban area, 469 came from the Panel and 568 responded via SMS.

The response rates from the two data collection methods were very different: 57.3% from the panel and only 4.5% of those who received the survey via SMS. The data was weighted by gender, age and education according to the public statistics available from Statistics Norway.

The questions put forth in this survey can be grouped within the following: perceptions of weather and seasons, values and attitudes related to transport and weather, habits, commuting and shopping trips and opinions on climate change and it's effects, and information about socio-demographic characteristics and transport resources.

3.3 The sample

The sample comprises panel respondents from both cities and an extra sample from Stavanger recruited by SMS.

Table 3.2 Sample in Oslo and Stavanger. Unweighted data

	N	Percent
Oslo, panel	1060	50.5
Stavanger, panel	469	22.4
Stavanger, SMS	568	27.1
Total	2097	100.0

In this study, we limited the sample to those who responded that they are either working or attending school: N=1663 (Oslo N= 855; Stavanger N=808). The reason for this limitation was to ensure that we exclusively included people who travel on a regular basis.

3.4 Indicators of weather tolerance

In this study, two questions are used develop three indicators of weather tolerance. The first question relates to how respondents travel when it rains. The respondents were asked how much they disagree/agree to the following statement:

"I always use the car when it rains"

The respondents could answer on a five point scale from disagree to agree. Only respondents with access to a car and a driving license received this question. Figure 3.1 shows how they responded to this question.

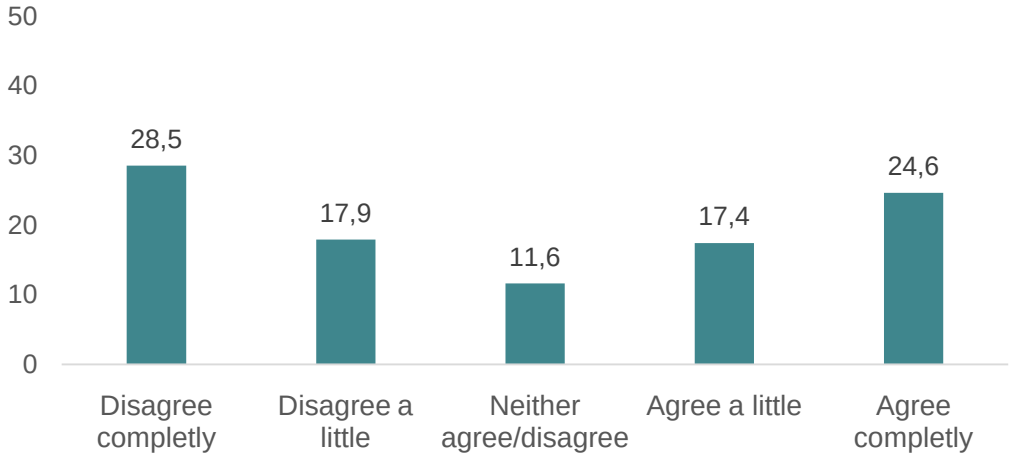

Figure 3.1 Responses to the statement "I always use the car when it rains". Percent. N=1221.

The other question used as an indicator of weather tolerance, is related to the willingness to walk in different weather conditions. All respondents were asked to answer the following question:
"In which combinations of temperature and precipitation are you willing to walk?"

Respondents could answer several alternatives of precipitation on each alternative of temperature. How the respondents answered to this question can be seen in figure 3.2.

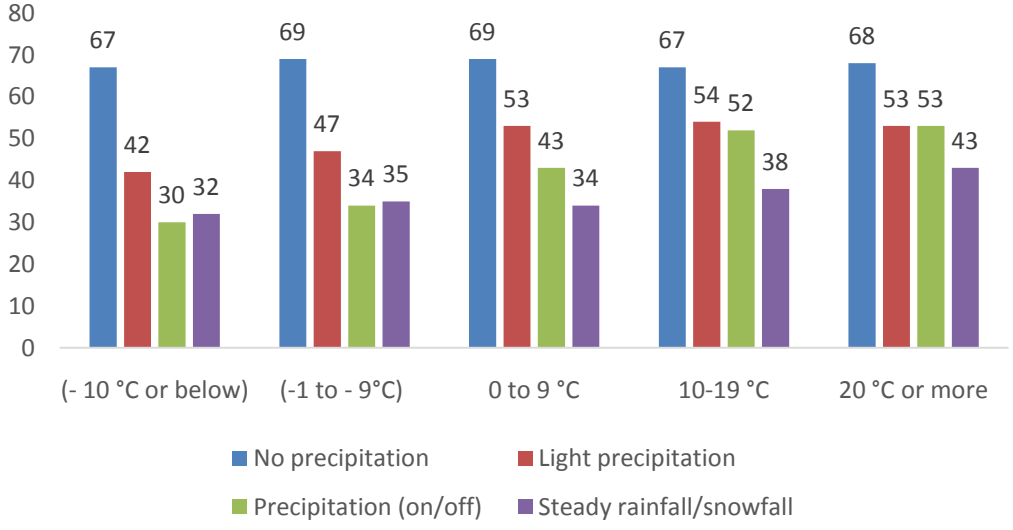

Figure 3.2 Percentage of respondents willing to walk in different combinations of temperature and precipitation. N=1663

In this study we have used the two following combinations of precipitation and temperature as indicators of weather tolerance:

- Willingness to walk 2-3 kilometers in minus 10 degrees Celsius or more in steady snowfall (yes/no)
- Willingness to walk 2-3 kilometer in +20 degrees Celsius or more in steady rainfall (yes/no)

3.4 Environmental attitudes and transport habits

In order to capture environmental attitudes, respondents were asked to indicate the degree to which they agreed/disagreed (on a five-point scale) on several statements about the environment. Analyses (correlation analysis and factor analysis) show that answers to these statements are highly correlated. This means that the questions posed manages to capture only one dimension in terms of environmental attitudes: those that are pro-environment and those who are not concerned about the environment. A factor analysis shows that the following statement has the highest correlation with the other statements about environment: *«Pollution from car traffic is not as serious as they say».* 64 percent of the respondents reported that they agreed completely or a little to this statement, 18 percent reported that they neither agreed nor disagreed, while 18 percent reported that they disagreed a little or completely. This question is used as an indicator of environmental attitudes in this paper.

To capture travel habits, the respondents were also asked to state the degree to which they agree/disagree (five-point scale) on the following statements:

- To cycle is typical of me
- To use the car as a driver is typical of me
- To use public transport is typical of me
- Walking is typical of me

These questions can to a certain extent also indicate "transport identity", but the main focus here is on respondents' typical transport behaviour.

3.5. Statistical analyses

The logistic regression procedure available in SPSS was assessed to perform the empirical analyses.

We have explored three separate models, one for each indicator of weather tolerance/intolerance:

- Model I: "I always drive when it rains" (agree/disagree on a five-point scale)
- Model II: "Willingness to walk 2-3 kilometers in minus 10 degrees Celsius or more in steady snowfall" (yes/no)
- Model III: "Willingness to walk 2-3 kilometer in +20 degrees Celsius or more in steady rainfall" (yes/no)

The model specifications were developed in line with the expectations of what are important determinants for weather tolerance/intolerance outlined in figure 1. The model specifications are as follows: age, gender, education, driving license (only for model II and III), city/context, environmental attitudes and travel habits.

Those who reported that they agreed or agreed a little to the statement "I always drive when it rains" were coded as "agree to statement". The dependent variable in Model I is thus a dichotomous variable of those who agree to the statement and those who do not have any opinion or disagree a little or strongly to the statement. In order to avoid tautological explanations, in this case a high correlation between those being a typical car driver and agreement to the statement "I always drive when it rains", we also excluded those who reported themselves as a typical car driver. What we explore in Model I is thus what are the determinants for agreeing to the statement ("I always drive when it rains") when people do not regard themselves as typical car drivers. In addition, we only included those who are aged 18 or more and those who report having access to a car in the household, so to include only those who actually have an option to drive.
In model II and III all respondents were included as all respondents are likely to be able to walk for a certain distance (2-3 kilometers).

4. Results

4.1 Factors associated with agreeing to the statement "I always drive when it rains"

A logistic regression analysis was performed to assess the effect of various factors on the agreeing to the statement "I always drive when it rains" (Model I), where less agreement to this statement is used as an indicator of weather tolerance. The results of this analysis are shown in table 4.1.

Table 4.1. Factors associated with the agreement to the statement "I always drive when it rains". N=642.

	Exp (B)	**Sig.**
Gender (male)	(-) .630	n.s.
Age (high)	(-) .995	n.s.
Education (high)	1.136	n.s.
Driving license (yes)	2.011	n.s.
City (Stavanger)	2.347	**
«Pollution from car traffic is not as serious as they say» (agree)	1.445	**
Cycling is typical of me (agree)	1.015	n.s.
Using public transport is typical of me (agree)	(-) .882	n.s.
Walking is typical of me (agree)	(-) .682	**

**p<0,010

Agreement to the statement "I always drive when it rains" is positively associated with living in Stavanger and agreement to the statement "pollution from car traffic is not as serious as they say". Perceiving oneself a typical "walker" is however negatively associated with agreement to the statement "I always drive when it rains".
In sum, the results suggest that those how are more weather tolerant are those who live in Oslo, those who expose environmental friendly attitudes and those who are more likely perceive walking as part of their transport habits.

The results from Model II and Model III, are shown in table 4.2.

Table 4.2 Factors associated with willingness to walk in different combinations of precipitation and temperature

Determinants for willingness to walk 2-3 kilometer in respectively -10 degrees Celsius in steady snowfall and +20 degrees C in steady rainfall. N=1663.

	Willingness to walk 2-3 km in minus 10 °C or less in steady snowfall (agree)		**Willingness to walk 2-3 km in 20+ °C in steady rainfall (agree)**	
Variable	Exp (B)	Sig.	Exp (B)	Sig.
Gender (male)	1.873	**	1.154	n.s
Age (young to old)	(-) .992	n.s.	(-) .990	*
Education (higher)	1.193	**	1.257	**
City (Stavanger)	(-) .910	n.s.	(-) .837	n.s
«Pollution from car traffic is not as serious as they say» (agree)	(-) .815	**	(-) .789	**
"Cycling is typical of me“ (agree)	1.192	**	1.19	**
"Going by public transport is typical of me“ (agree)	(-) .955	n.s.	(-) .927	n.s.
"Walking is typical of me“ (agree)	1.338	**	1.368	**
"Driving a car is typical of me“ (agree)	(-) .899	*	(-) .841	**

*p<0,05, p<0,01

There are many similarities between the two models as for factors associated with both willingness to walk in cold weather (minus 10 °C or less) and the willingness to walk in warm weather (20 °C or more), both with steady snowfall/precipitation: Having higher education and perceiving oneself as a typical cyclist and a typical walker are all positively associated with both willingness to walk in respectively cold and warm weather, while agreement to the statement "Pollution from car traffic is not as serious as they say" and to perceiving oneself as a typical car driver ("Driving a car is typical of me") are negatively associated with the willingness to walk both in cold and warm weather. In none of the models, residential location has no significant association with either the willingness to walk in cold weather or the willingness to walk in warm weather.

The major difference between the two models are the effect of respectively age and gender. While age does not have a significant effect on the willingness to walk in cold weather with steady snowfall, age is negatively associated with the willingness to walk in warm weather with steady precipitation. Moreover, while being a male has a positive effect on the willingness to walk in cold weather, gender has no effect on the willingness to walk in warm weather. This difference is hard to explain, but it might relate to the difference in realism of the situations that are questioned. The question about willingness to walk in warm weather with precipitation is more likely to be realistic situation and something that more people have experienced that that of walking in cold weather with steady snowfall. That more men are likely to defy and be willing to walk in cold weather

with steady snowfall might be an expression of masculinity independent of age – something that men could consider themselves doing, but not necessarily have done. In the more realistic situation, the age effect on willingness to walk in warm weather with steady precipitation might be regarded as a general age effect, that older people in general are less likely to walk in poor weather conditions, as shown in previous studies.

5. Discussion and conclusions

Many of the expectations concerning factors associated with weather tolerance are met, but the results diverge depending on the indicators used for weather tolerance.
The effect of age on weather tolerance as measured in this study is not clear. Age has no effect on the agreement to the statement "I always drive when it rains", when other factors are controlled for. In addition, and even more peculiar, age has no effect on the willingness to walk in cold weather in steady snowfall, while it does have a negative effect on the willingness to walk in steady precipitation. The difference between the two latter results might be explained by the degree of realism in the two situations questions; one is more realistic and common while the other is more unrealistic and extreme. The share of people responding to be willing to walk in cold weather with heavy snowfall is also smaller than those who are willing to walk in warm weather with steady precipitation (respectively 43 to 34 percent). In addition, the results show that men are more likely to say that they are willing to walk in cold weather with steady snowfall than women, when other factors are controlled for, while gender has no effect on the willingness to walk in warm weather with steady precipitation, which might suggest that to be willing to walk in extreme weather (combination of low temperatures and steady snowfall) is an expression of masculinity, independent of age.
Education was not found to be associated with agreement to the statement "I always drive when it rains", but higher education was found to be positively associated with the willingness to walk in both cold and warm weather with steady precipitation. This might be explained by differences in the samples. In the multivariate analysis of "I always drive when it rains" respondents perceiving themselves as habitual drivers are not included. Analysis shows that there is a high correlation between perceiving oneself as respectively a typical public transport user, a typical cyclist and a typical walker, which indicate that there is little variation in the sample in regard to education. Among the sample used in the multivariate analysis of willingness to walk in different combinations of temperatures and precipitation, there are greater differences in education. In these analyses we do find a positive association between education and the willingness to walk in both cold and warm weather with steady snowfall/precipitation.
As for geographical location, we find a positive association between agreeing to the statement "I always drive when it rains" and living in Stavanger, with a more coastal climate. One conclusion from this could be that type of climate influence weather tolerance in terms of travel behaviour. However, the effect of city/residential location might also be explained by differences in the public transport offer in these two cities. According to the National travel survey in 2013/14 84 percent of people living in Oslo has a very good public transport offer (in terms of frequency and proximity to public transport stop) while only 63 percent in Stavanger reports the same. In this study, we did

not have the opportunity to control for the quality of the public transport supply, and the effect of city/residential location is not easy interpretable. However, looking at the results from the multivariate analyses of willingness to walk in different combinations of temperature and precipitation, there is no significant effect of city/residential location and the willingness to walk. This might suggest that the weather tolerance is not so different between people living in these two cities, especially considering that the questions on willingness to walk are less related to other transport alternatives available, and are more directly related to how willing one is to expose oneself to poor weather conditions.

For all three indicators of weather tolerance used, we find that environmental attitudes and transport habits are associated with weather tolerance, that is the likelihood of using active mode of transportation in poor weather conditions. Those who consider themselves as typical walkers and/or cyclists are more likely to defy poor weather conditions in terms of travel behaviour while the opposite is true for those who consider themselves as typical drivers. Moreover, there is a negative association between agreeing to the statement "Pollution from car traffic is not as serious as they say" and using other means of transportation than the car or being willing to walk in poor weather conditions. This suggests that attitudes and habits are important for how people react to changes in weather conditions, when other factors such as age, gender, education and city/residential location are controlled for.

It is difficult to trace and measure habits, and to which extent they influence values and attitudes or vice versa. Although transport habits might be formed at a later life stage, many habits might be formed in the early childhood years. If you are used to being active outdoors and in nature in different weather conditions already at young age, you might be more weather tolerant in adult life than a person that has spent much of his or her childhood indoors. Children who are used to being outdoors in all types of weather conditions might also develop a special fondness for nature and the outdoors which again might influence their attitudes to the environment when becoming conscious adult individuals, which again might influence their travel habits in daily lives. This study has not been able to solve the puzzle about the direction of association between attitudes and behaviour: Whether environmental friendly attitudes make people choose more active, exposed and environmental friendly transport modes despite poor weather conditions or whether being a regular (typical) user of active transportation modes make a person more environmental friendly in terms of attitudes. However, the results from this study strongly suggests that there are positive associations between attitudes and habits, and that these factors are important for how people react to weather conditions, when other factors are controlled for. The results suggest that policy measures for increasing outdoor activity are warranted. If people develop good habits in terms of outdoor activity, they can also become used to more active transportation. These measures can also be important from a health perspective. In addition, the results of this study suggest that measures for increasing awareness about the effect of car use on the environment and the climate can also be effective, as attitudes are important for how a person react to weather conditions in terms of travel behaviour.

References

1. Aaheim, H.A, Hauge, K. E. (2005) Impact of climate change on travel habits. A national assessment based on individual choices. CICERO report 2005:07. Oslo. CICERO Center for International Climate and Environmental Research.
2. Ajzen, I. (1991) The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes*, 50, 170-211
3. Ajzen, I., Fishbein, M. (1980) Understanding attitudes and predicting social behaviour. Englewood Cliffs: Prentice Hall.
4. Anabel, J. (2005) 'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying travel behaviour segments using attitude theory. *Transport Policy* 12, 65-75
5. Bergström, A., Magnussen, R. (2003) Potential of transferring car trips to bicycle during winter. Transportation Research Part A, 37, 649-666.
6. Böcker, L., Dijst, M., Prillwitz, J. (2013b) Climate change impacts on mode choices and travelled distances: a comparison of present with 2050 weather conditions for the Randstadt Holland.
7. Böcker, L., 2014. Climate, Weather and Daily Mobility. Transport Mode Choices and Travel Experiences in the Randstad Holland. PhD-thesis, Urban and Regional research centre Utrecht (URU), Faculty of Geosciences, Utrecht University.
8. Böcker, L., Uteng, T. 2018. Weather and daily mobility: an international cross-comparison of Dutch, Norwegian and Swedish city regions. Work in progress. Institute of Transport Economics.
9. Datla, S., Sharma, s. (2010) Variation of impact of cold temperature and snowfall and their interaction on traffic volume. Transportation Research Record, 2169, 107-115.Dreborg, K.H. (1996) Essence of backcasting, Futures 28, 813–828.
10. Denstadli, J.M., J.K.S. Jacobsen og M. Lohmann (2011). Tourist perceptions of summer weather in Scandinavia. Annals of Tourism Research, 38(3), 920-940.
11. European Commission 2011. Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. White paper. European Commission. Brussels, Belgium.
12. Fazio, R. H. (1986) How do attitudes guide behaviour? In Sorrentino, R. M., Higgins, E. T. (eds) *Handbook of motivation and cognition*: *Foundation of social behaviour,* 204-243. New York, Guildford Press.
13. Festinger, L. (1957) A theory of cognitive dissonance. Evanston, Ill.: Row, Peterson and Company.
14. Fyhri, A., Hjorthol, R. (2006) Barns fysiske bomiljø, aktiviteter og daglige reiser. TØI report 869/2006. Oslo. Institute of Transport Economics
15. Garwill, J., Latila, T., Brydsten, M. (1994) *Livsvärden och val av transportmedel.* Umeå: Transportforskningsenheten, University of Umeå.
16. Hanssen-Bauer, I.; Drange, H.; Førland, E.J.; Roald, L.A.; Hisdal, H.; Lawrence, D.; Nesje, A.; Sandven, S.; Sorteberg, A.; Børsheim, Y.; Sundby, S.; Vasskog, K.; Ådlandsvik, B., 2009, Climate in Norway 2100 (In Norwegian). Norsk Klimasenter 136
17. Hassan, Y.A., and Barker, J. J. (1999) The impact of unseasonable or extreme weather on traffic activity within Lothian region, Scotland. Journal of Transport Geography, 7, 209-213
18. Heinen, E., Maat, K., Van Wee, B. (2011) Day-to-day choice to commuting or not by bicycle. Transportation Research Record: Journal of the Transportation Research Board, 2230, 9-18.
19. Hägerstrand, T. (1970). What about people in the regional sciences? *Papers of the Regional Sciences Associations*, 24, 7-21.
20. Ingelhart, R. (1977). The silent revolution – changing values and political styles among Western publics, Princeton, Princeton University Press.
21. IPCC: Intergovernmental Panel on Climate Change (2013) Climate change 2013: The Science Base. Working Group I Contribution to the Fifth Assessment Report. Cambridge University Press.
22. IPCC: Intergovernmental Panel on Climate Change (2014) Climate change 2014: Impacts, Adaptation, and Vulnerability. Working Group II Contribution to the Fifth Assessment Report.
23. Karjalainen, S. (2012) Thermal comfort and gender: a literature review. Indoor air, 22 (2), 96-109.
24. Keay, K., Simmonds, I. (2005) The association of rainfall and other weather variables with road traffic volumes in Melbourne, Australia. Accident Analysis and Prevention, 37, 109-124.

25. Kenawy, I., Elkadi, H. (2012) Effect of personal and cultural diversity on outdoor thermal comfort perception. Proceedings of the 8th International Conference on Urban Climate and 10th Symposium on the Urban Environment, Dublin, Ireland, 1-4.
26. Knapp, K. K., Smithson, L. D. (2000) Winter storm event volume impact analysis using multiple multiple-source archived monitoring data. Transportation Research Record: Journal of the Transportation Research Board, 1700, 10-16.
27. Meze-Hausken, E. (2008) On the (im-)possibilities of defining human climate thresholds. Climatic Change, 89(3–4), 299–324.
28. Müller, S., Tscharaktschiew, S., Haase, K. (2008) Travel-to-school mode choice modelling and patterns of school choice in urban areas. Journal of Transport Geography, 16, 342-357.
29. Rokeach, M. (1973) *The nature of human values*. New York, Free Press.
30. Schwartz, S. H. (1977) Normative influence on altruism. In L. Berkowitz (ed.) Advances in experimental social psychology, vol 10, 221-279. New York: Academic Press
31. Schwartz, S. H. 1992. Universals in the Content and Structure of Values – theoretical Advances and Empirical Tests in 20 Countries. *Advances in Experimental Social Psychology*, 25, 1-65.
32. Schwartz, S. H. (2003). A proposal for measuring value orientation across nations. *The Questionnaire Development Package of the European Social Survey*. Website: www.Europansocialsurvey.org
33. Silm,S., Ahas, R., (2010). "The seasonal variability of population in Estonian municipalities, Environmnet and Planning A, 42, 2527-2546.
34. Smith, K. (1993). The influence of weather and climate on recreation and tourism. Weather, 48, 398–404.
35. Tuomaala, P., Holopainen, R., Piira, K., Airaksinen, M. (2013) Impact of individual characteristics – such as age, gender, BMI, and fitness – on human thermal sensation. Proceedings of the 13th Conference of the International Building Performance Simulation Association, Chambéry <http://ibpsa.org/proceedings/BS2013/p_2240.pdf> (Accessed 06-06-14)
36. Verplanken, B., Aarts, H.,Van Knippenberg, A. (1997) Habit, information, acquisition, and the process of making travel mode choices. European Journal of Social Psychology, 27, 539-560.