The role of transport priorities, transport attitudes and situational factors for sustainable transport mode use in wintertime

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Abstract

The aim of this study was to investigate transport priorities as a predictor over and above transport attitudes and situational factors, for the use of active and public transport (PT) to and from university among Norwegian university students in wintertime. A cross-sectional self-completion survey was carried out with 441 university students (229 females, 206 males), at two university campuses in Trondheim (Dragvoll and Gløshaugen), Norway. Transport priorities added to the explained variance above and beyond situational factors and transport attitudes. The transport priority of *Exercise* was associated with increased active transport use and the priority of *flexibility* was associated with decreased active transport use. In line with previous research, a more positive environmental attitude was related to increased active transport use as well. Among psychological factors, the transport attitude of comfort in PT, related to lower levels of PT use, possibly indicating dissatisfaction with using this mode. Overall, psychological factors (transport priorities, transport attitudes) contributed less explained variance of sustainable transport use, than situational factors (e.g. campus location, travel distance). Reminding students of the health and environmental benefits of active transport might be a promising way to promote this transport mode. Improving PT comfort might also promote continued usage of this mode in later life. However, increased sustainable transport mode use during winter appear to also depend on reducing situational constraints (e.g. clear snow on available walking and bicycling paths, improve infrastructure).

Key words: Active transport, Active commuting, Public transport, Motivation, Winter, Context, University students

Car use has both short and long-term negative consequences for the environment. The long-term consequences are greenhouse gas emissions and global warming. Short term consequences are air and noise pollution, especially in densely populated areas (van Wee, 2014). Traffic jams and accidents are other problematic consequences of motorized travel mode use (Gärling & Friman, 2015; World Health Organization, 2015), which is a growing problem in areas with high population growth. Consequently, there has been a surge of interest in promoting use of alternative transport modes in cities around the world. Public transport (PT) has environmental advantages due to more effective transport by carrying more people simultaneously which results in fewer total trips (Gärling & Friman, 2015). The transport mode that is least damaging to the environment, however, is walking and bicycling, which we will refer to as active transport. Together we will refer to PT and active transport as sustainable transport.

It is also desirable to promote use of sustainable transport mode use because of potential benefits on public health (Dons et al., 2018; Hamer & Chida, 2008). Dons et al. (2018) showed an association between transport mode use and Body Mass Index (BMI). Bicycling was associated with the lowest BMI, followed by walking, PT, motorcycle or moped, e-bike and car use. Not only was bicycling associated with the lowest BMI at one point in time, but longitudinal analyses showed that decreases in BMI followed from increases in bicycling as a transport mode. Results suggested BMI-decrease from PT use as well, perhaps because this often also involves active transport use. In fact, transport mode use might be a central factor explaining differences in obesity rates. In line with this assumption, a strong negative association has been found between active transport and obesity levels (Bassett, Pucher Jr, Buehler, Thompson, & Crouter, 2008). Countries with high levels of active transportation mode use (Switzerland, the Netherlands and Sweden) have lower levels of obesity than countries where active transport is less common (The United States had the

highest levels of obesity) (Bassett et al., 2008) In addition studies suggest PT use results in less accidents and injuries than car use (Albertsson & Falkmer, 2005; Nordfjærn, Şimşekoğlu, & Rundmo, 2014). In other words, there are several profound reasons for policy makers to intensify promotion of sustainable transport mode use. Young adults are valuable targets of interventions that aim to increase sustainable transport use, as their transport habits are less established (Beige & Axhausen, 2012) and behavioral change might persist and have long-term consequences on physical activity (Yang et al., 2014).

Situational factors, such as travel distance (Bopp, Kaczynski, & Besenyi, 2012; Lemieux & Godin, 2009) and residential location (Scheiner & Holz-Rau, 2013; Stinson & Bhat, 2004) are related to use of sustainable transport. Unsurprisingly, a longer travel distance decreases the chance of using active transport (Handy, Van Wee, & Kroesen, 2014; Handy & Xing, 2011). Suburbanization leads to decreased PT and active transport use(Scheiner & Holz-Rau, 2013; Stinson & Bhat, 2004). Related to this is that neighborhoods with high walkability (high land use mix and residential density) rather than low walkability is associated with more walking (Hajna et al., 2015). Of course, temporary situations might also affect mode choice and subsequent use. Following a freeway closure lasting 8 days, PT use increased among frequent car users, and this increase continued up to one year later (Fujii & Gärling, 2003; Fujii, Gärling, & Kitamura, 2001).

The natural environment is also found to impact on sustainable transport use. During winter season, fewer people choose to bicycle (Børrestad, Andersen, & Bere, 2011; Collins & Mayer, 2015; Kallio, Turpeinen, Hakonen, & Tammelin, 2016; Liu, Susilo, & Karlström, 2015), although it appears that winter season does not decrease walking and PT (Collins & Mayer, 2015; Mitra & Faulkner, 2012). A study conducted in Sweden showed that the chance of walking and PT-use was actually increased during winter (Liu et al., 2015). Though these

findings on how season impacts on sustainable transport are valuable, more insight on the role of psychological factors' for mode use during specific seasons is needed (Liu et al., 2015).

Psychological factors may also be of relevance for transportation mode use. In some cases, for instance, it has been demonstrated that cognitive factors explain more variance than situational factors (Lemieux & Godin, 2009). According to a recent review attitudes, perceived behavioral control (PBC) and behavioral intentions are the strongest cognitive correlates of alternative (non-car) transport mode use (Hoffmann, Abraham, White, Ball, & Skippon, 2017). This implies that alternatives to motorized transport use is partly a deliberate and planned behavior, reflecting conscious processing.

This line of reasoning is in accordance with the theory of planned behavior, which describes human behavior as deliberate and planned (Ajzen, 1991). The theory of planned behavior is the most widely used psychological theory in the literature of travel mode use. According to the theory, behavior results from several beliefs associated with attitudes, subjective norm and perceived behavioral control. Attitude is an evaluation of a specific behavior. In relation to transport mode use, attitude might be defined as the evaluation of walking to work or taking the bus to university. This evaluation stems from beliefs about the behavior in question. For instance, the belief that walking is dangerous could lead to a negative attitude towards walking commuting, depending on several other beliefs about the behavior. Accordingly, a negative belief is associated with beliefs about likely negative consequences from the behavior. It is the sum of positive and/or negative beliefs about the behavior to be evaluated that influences the resulting attitude. The theory also refers to social cognition through the concept of subjective norm. Subjective norm is described as social pressure to conduct the behavior. It is based on beliefs about other people's evaluation of the behavior. Finally, the perceived obstacles and possibilities to carry out the behavior affects behavior. This variable, referred to as PBC concerns the perceived easiness or difficulty of

conducting the behavior and closely relates to self-efficacy. In travel mode research this can concern the perceived easiness of traveling by car or the perceived difficulty of walking long distances when time is of essence. In sum, all the above-mentioned variables are theorized to affect actual behavior through the intention to carry it out (Ajzen, 1991). Attitude appears to be an important predictor for sustainable transport mode use (Hoffmann et al., 2017).Bopp et al. (2012) showed that people within the top quartile of eco-friendly attitudes were more likely to actively commute and less likely to drive than people within the lower three quartiles. People within the top quartile of eco-friendly attitudes also scored higher on self-efficacy (similar to PBC) and perceived less obstacles to actively commute. Lemieux and Godin (2009) conducted a prospective study among undergraduate and graduate students and their transport mode use to school and work. They found that intention, commuting attitudes, PBC and habits predicted active transport at follow-up. Previous studies indicate that seeing bicycling as efficient, safe and comfortable increases the likelihood of using this transport mode (Handy & Xing, 2011; Muñoz, Monzon, & López, 2016).

Despite the well-documented utility of TPB-variables in the context of sustainable transportation, further insight into other determinants of sustainable transport mode use is needed (Lanzini & Khan, 2017). A less researched psychological factor is transport priorities. Transport priorities can be defined as what individuals believe to be important qualities of their transportation (Şimşekoğlu, Nordfjærn, & Rundmo, 2015). Transport priorities are interesting in relation to travel behavior because the priorities people have, can motivate them to specific travel behavior. Individuals might use predominantly car, bicycle, walking or PT depending on the quality attributes they believe is important to them. While attitudes reflect people's evaluations of transport modes, transport priorities are what people believe is *important* to them when commuting (e.g. comfort, convenience). Thus, one might have a positive attitude towards car use and associated beliefs that it has positive consequences such

as comfort. However, one might still choose to commute by bus because it is less expensive (thereby prioritizing convenience over comfort). A range of motivations, both objective (service access, reliability and cost) and perceived (e.g. convenience and comfort), appear to affect transport mode use (Redman, Friman, Gärling, & Hartig, 2013). Both pro-environmental and pro-social (Bamberg, Hunecke, & Blöbaum, 2007; Nordlund & Garvill, 2003) affective (i.e. feelings of freedom and independence) and symbolic (i.e. providing identity and status) (Steg, 2005) motivations are related to car use and PT use.

More recently, Şimşekoğlu et al. (2015) found that priority of convenience and priority of safety and security, along with a positive attitude towards public transport, predicted intentions to use public transport among urban commuters in Norway. Priorities of flexibility (e.g. being able to choose when to travel) on the other hand, increased the likelihood of car use. Furthermore, another study by Nordfjærn, Şimşekoğlu, Lind, Jørgensen, and Rundmo (2014) showed that active transport and PT were associated with priorities of safety among a representative sample of urban commuters in Norway. In addition, environmental and health priorities have been found to characterize general urban travelers using alternative transport modes (Rundmo, Sigurdson, & Cerasi-Roche, 2011). These studies demonstrate that transport modes (i.e. car users vs public and active transport) differ in associated transport priorities. Knowing what types of priorities are associated with these transport modes is needed for promoting sustainable transport modes in the future. In addition, the relative importance of different transport priorities may differ according to seasonal variations. For instance, comfort may emerge as more important than exercise when choosing a transport mode in the cold winter season, while the relative importance of the two could be reversed in milder seasons.

It has been shown that working young adults are more likely to use a car than studying young adults (Simons et al., 2017). This may be due to different priorities (among other factors). Hence, researching transport priorities in distinct demographic groups such as

students could be beneficial. This might be valuable, not only to increase sustainable transport among groups where car use is preferred. It may also allow for better customization of sustainable transport to those groups who are more prone to use this mode and thereby promote continued usage into working adult life.

The aim of this study was to evaluate transport priorities as a predictor for the use of sustainable transport to and from university among university students, above and beyond transport attitudes and situational factors. The study was conducted among university students in Norway. We consider students to be a particularly interesting group to study. Students are the future users of the transport system and knowledge of their preferences is therefore especially valuable. Also, university students typically live in urban areas, a context where people are more inclined to walk and bicycle, compared to rural areas (Stinson & Bhat, 2004). Furthermore, the study took place during winter season, which seems to have a large impact on the use of sustainable transport use (Børrestad et al., 2011; Kallio et al., 2016). Previous research on the seasonal effects on active transport mode use did not consider concurrent psychological factors (Collins & Mayer, 2015; Liu et al., 2015) and very few studies have previously focused on psychological and situational factors in tandem. We will therefore also clarify whether the psychological factors of transport attitudes and transport priorities are relevant for student's sustainable transport use during winter or whether situational factors are more pressing during this season.

Methods and materials

Procedure

A cross-sectional self-completion survey was carried out at the two main campuses in Trondheim, Norway (Dragvoll and Gløshaugen) during February through April, 2018. Sixty psychology students were affiliated with the project and conducted the data collection. These research assistants were divided into eight groups consisting of 5-8 assistants each.

Respondents were recruited by convenience sampling at various locations inside and outside the university buildings, during office hours 09.00 – 15.00. Gender, estimated age and reasons for not participating among non-respondents were registered on a dedicated form. All participants received oral information about the confidentiality of responses, assured anonymity and secure data storage. The voluntary nature of participation was also highlighted to all approached respondents. In addition to recruitment at the campuses, respondents were recruited during four lectures. After agreement with the course instructors, the study was presented, and questionnaires were handed out to students during the lectures. The students completed the questionnaires during the lecture break. Since the study was fully anonymous, it was not formally processed by the Norwegian Centre for Research Data. However, the study was presented both orally and written to this ethical board and the study procedures were recommended and approved.

Sample

The sample consisted of in total 441 university students. Among these students, 257 (58%) students from Dragvoll campus and 184 (42%) from Gløshaugen campus. Dragvoll hosts the campus for faculties of social sciences and humanities, while Gløshaugen campus hosts natural science faculties. A total of 150 (34%) was recruited from the campuses, whereas 291 (66%) were recruited from lectures. Four lectures were visited. Only one of these, a foundational course in personality psychology, included psychology students (30%). The 3 remaining lectures were in other disciplines (36%). The response rate at Dragvoll campus was 80% and 84% responded at Gløshaugen (pooled response rate = 82%). The two lectures at Dragvoll had a total response rate of 90%, whereas the two at Gløshaugen had in total 82% response rate (pooled response rate = 87%). There were 229 (53%) females and 206 (47%) males in the sample. The average age was 23.06 years (SD = 4.83). In total 91 (21%) students reported that they or their spouse owned a car. There were no significant differences between

respondents (n = 441) and non-respondents (n = 33) in age (t = 0.18, df = 419, n.s.). However, individuals in the non-respondent group were more likely to be male (67%) than in the group containing respondents (47%) (χ^2 = 4.51, df = 1, p <.05). Common reasons for a non-response were that the students were going to a lecture or did not have time to devote to the survey.

Measures

Demographics and situational factors. The questionnaire included demographic information regarding each respondent's gender and age. Information about situational factors were gathered by two items asking how much time in hours and minutes the respondents would use by walking or using a non-electric bicycle from their home to their university. Times were converted to minutes when used in analyses. The questionnaire also included one item that recorded information about whether the respondents had an available dedicated walking\bicycling path from their home to the university (no, yes on the entire route, yes parts of the route and do not know). The item was dichotomized to a yes, no variable and response in the 'do not know' category were set to system missing values. The questionnaire also included one item asking whether the respondents themselves and/or their spouse owned a car (no, yes).

Sustainable transportation mode use. Information about active transportation mode use was obtained from a larger validated battery of mode use (Rundmo, Nordfjærn, Iversen, Oltedal, & Jørgensen, 2011). The measure was slightly adjusted to fit the specific context of the current study. The respondents were asked to report how frequently they used 11 different transportation modes when travelling to and from the university during the winter season, including walking, jogging/running, bicycling (non-electric), and electric bicycle. The measure was scored on a Likert scale ranging from (1) never to (6) five days or more in a week. The measure was recoded into a scale ranging from (0) never to (5) five days or more in a week. A composite score of walking, jogging/running and both electric and non-electric

bicycling was used in analyses. For simplicity this score will further be referred to as active transport use. We consider electric bicycling as an active transport mode, because this mode is at least partly dependent on the user's physical activity. A composite score of tram and bus use was used in analyses and will be referred to as PT use.

Psychological variables. Attitudes towards transport were measured by a revised version of a previously validated measurement instrument (Nordfjærn, Lind, Şimşekoğlu, Jørgensen, & Rundmo, 2014; Şimşekoğlu et al., 2015). The measure included 15 items where respondents evaluated statements regarding use of different transport modes, e.g. 'The type of transport mode you use tells a lot about your social status' and 'Only those who do not care about the environment use a car when travelling to the university'). The items were scored on a five-point Likert scale ranging from (1) strongly disagree to (5) strongly agree. Responses were coded to make high scores reflect more pro-environmental attitudes towards transportation.

Information about transport priorities were collected with an 18-item instrument, devised and utilized in several previous studies (e.g. Nordfjærn & Rundmo, 2015; Nordfjærn, Şimşekoğlu, Lind, et al., 2014; Şimşekoğlu et al., 2015). The respondents reported the importance of different factors when choosing transportation modes, such as costs, weather conditions, comfort, flexibility as well as safety regarding accidents and security regarding theft, harassment etc. Responses were recorded on a five-point Likert scale ranging from (1) not at all important to (5) very important.

Statistical procedures

Descriptive statistics were used to reveal sample characteristics. Chi-square (χ^2) and independent samples t-tests were used as appropriate for categorical and continuous variables when testing differences between the sample and non-respondents.

A PCA with iteration, Kaiser criterion and varimax rotation was used to explore the dimensionality of attitudes towards public and active transport and transport priorities.

Reliability was analyzed for the resulting dimensions. In line with recent recommendations we interpreted Cronbach's alpha above .60 as tolerable , and the average corrected inter-item total correlations of .30 or above as satisfactory where Cronbach's alpha were assumed to be biased by a small number of items (Hair, Black, Babin, Anderson, & Tatham, 2006).

Two hierarchical linear regressions with demographics, situational factors, transport attitudes and priorities were used to predict active transport and PT respectively, among students in wintertime. Active transport mode use and PT use was treated as the dependent variables in the analyses. The first block in the analysis was demographics and situational factors, followed by transport attitudes and transport priorities. This sequence was set to investigate whether transport priorities added to the explained variance while adjusting for the two preceding variable blocks in the two regression analyses. For hierarchical linear regression with active transport use as the dependent variable, a Sqrt- transformation was used to reduce outliers and improve distribution of residuals. For both analyses, all assumptions were inspected. Inspection of a plot of studentized residuals versus predicted values and partial regression plots indicated that assumptions of homoscedasticity and linearity were met. No multicollinearity was indicated by Tolerance values (all above the recommended value of 0.1) (Hair, Black, Babin, & Anderson, 2014). Unusually high values in variables were set to missing values, to avoid outliers. These were the values of 180 and above in total minute walking time to university, 150 minutes and above for bicycling to university and age-values of 61 and 99. Cook's distance showed no values with high influence and a QQ-plot indicated that the assumption of normality was met.

Dimensionality and reliability of the measurement instruments

Table 1 shows the outcome of a PCA for the 15-item measure of attitudes towards transport modes. Five items were removed from the analysis because they failed to load consistently. These were the following items: '*I do not like to bicycle to university because I get sweaty', 'I*

choose the transport mode that is most convenient for me', 'The public transport system in Trondheim is too unpredictable', 'Bicycling to campus is not convenient in this area' and '*Those who use public transport to/from the university would have used a car if they had the opportunity'.*

The attitude measure consisted of four dimensions in this sample. These dimensions explained 69% of the total variance. The first dimension was termed *Social status* and consisted of three items. This dimension included items such as "Choice of transport mode strongly indicates social status" and "Public transportation is primarily for people with a low income". The second dimension was termed *environmental concern* and consisted of items related to environmental concern regarding travelling by car. The third dimension, *comfort* included items evaluating the comfortability of traveling with public transport. Finally, the fourth dimension, *physical activity* contained items evaluating attitudes towards physical activity as part of traveling to or from campus.

In Table 1 it is shown that *Social status, Environmental concern* and *Comfort* have alpha coefficients in the acceptable range. The fourth dimension, *physical activity,* has an alpha value somewhat lower than this, but the average corrected item-total correlation of .36 was considered satisfactory.

Table 1
Dimensionality of attitudes towards public and active transport

Item	Social status	Environmental concern	Comfort	Physical activity
Only left-radicals take the bus to campus	.77			
Public transport is primarily for people with a low income	.76			
Transport mode use tells a lot about social status	.75			
A person who drives a car is careless regarding the environment		.86		
Only those who do not care about the environment use a car to university		.86		
It is exhausting traveling by public transport to/from university			.86	
I do not like to take the bus. It is too crowded			.81	

I look at the travel to/from university as an opportunity to be physically active				.82
There is no point in walking to campus if it requires more time than using the bus				.80
Explained variance	23,95%	18,52%	14,92%	11,55%
Cronbach`s alpha	.65	.67	.62	.52
Average corrected item-total correlations	.47	.52	.45	.36

-Factor loadings <.30 not reported

Dimensionality of transport priorities for travel between home and university are displayed in Table 2. The construct consisted of 18 items. In this sample, the construct segmented into four dimensions explaining 67% of the total variance. Four items were excluded due to inconsistent loading. These were items regarding the importance of *Practicalities, Weather conditions, Opportunity for social interaction* and *Environmental transport* during transport to/from the university. The first dimension, *Safety and security,* concerns priority of safety from danger such as terror and security from theft and unpleasant episodes. The second dimension was termed *Exercise* and relates to priorities of exercise in transport. The third dimension *Convenience* consisted of items related to practicalities such as travel time and punctuality. Finally, the fourth dimension *Flexibility* measured priorities of flexibility in terms of departure time and travel routes. All four dimensions had Cronbach's alpha >.6. All dimensions also had average corrected item total correlation well above the suggested level of >.3.

Table 2
Dimensionality of transport priorities for travel between home and university

Item	Safety and Security	Exercise	Convenience	Flexibility
Protection against unpleasant episodes/harassment	.87			
Protection against theft	.84			
Protection against terror	.83			
Protection against accidents	.82			
Exercise/Physical activity		.90		
Physical fitness		.88		
Opportunity to shower at university		.61		
Punctuality			.72	
Frequency of departures			.69	
Travel costs/prices			.67	
Travel time			.65	.33
Flexible time of departure				.86
Flexible travel route	.35			.75

Explained variance	32,16%	13,77%	11,84	8,92%
Cronbach's alpha	.89	.74	.64	.74
Average corrected item-total correlations	.76	.57	.57	.59

-Factor loadings <.30 not reported

Results

Descriptives of contextual and psychological constructs

Descriptive statistics for situational and psychological constructs are displayed in Table 3. PT was more frequently used (72%) than active transport (35%) for university commuting. Most respondents had access to foot and bicycle paths. Travel time for walking in total minutes were on average 44 minutes. For bicycling, the mean was 21 minutes. For travel time to PT start point, the mean time was 2 minutes. Furthermore, attitudes towards public and active transport were all negative to neutral, indicating negative or neutral evaluations of sustainable transport. Convenience was on average most prioritized among the sample, followed by flexibility, safety and security and exercise.

Table 3
Descriptive statistics for demographics, situational factors and psychological constructs

Construct/Dimension	Min	Max	Mean	S.D.	N (%)
Sustainable transport mode use					
Active transport mode use	.00	2.24	.51	.62	143 (35)
Public transport mode use	.00	5.00	1.83	1.38	303 (71.6)
Demographics and situational factors					
Do you or your roommate/spouse own your own car?	.00	1.00	.21	.41	91 (20.6)
Available foot path/Bicycle path	.00	1.00	.96	.21	380 (86.2)
Time it takes to walk to university (total minutes)	1.00	156.00	43.91	30.88	
Time it takes to bicycle (non e-bicycle) to university (total minutes)	1.00	122.00	21.25	17.79	
Time is takes to public transport start point	0.00	75.00	5.27	6.41	
Transport attitudes					
Social status	1.00	4.33	1.57	.63	

Environmental concern	1.00	4.50	2.29	.83
Comfort	1.00	5.00	2.66	.95
Physical activity	1.00	5.00	2.50	.69
Transport priorities				
Safety and Security	1.00	5.00	3.54	1.11
Exercise	1.00	5.00	2.58	1.00
Convenience	1.00	5.00	4.28	.60
Flexibility	1.00	5.00	3.64	.96

Higher scores reflect more frequent use of active transport (days of week), longer travel time to university (in minutes), more favorable attitudes toward public and active transport and higher importance ascribed to different transport priorities. N (%) displays frequency of respondents using either active transport or public transport 1 day a week or more, frequency of respondents owning a car and frequency of respondents having access to foot and bicycle paths. Values of 0.00 and 1.00 are semantically related to answering no and yes respectively.

Predictors of active transport mode use

A hierarchical linear regression with demographics, situational factors, transport attitudes and priorities to predict active transport use among students in wintertime is shown in Table 4. The addition of transport attitudes to the prediction of active transport (Model 2) led to a statistically significant increase in explained variance (R^2 = .42, F (4.33) = 2.79, p < .05), where the attitude of environmental concern was related to increased use of active transport (β =0.10, p=<.05).

The full model of demographics, situational factors, transport attitudes and priorities to predict active transport use (Model 3) was statistically significant, (R^2 = .45, F (4.32) = 17.53, p < .001). Transport priorities (F change= 2.79, p<.01) added to the explained variance above and beyond demographics, situational factors and transport attitudes. Transport priority of exercise was related to higher levels of active transport use (β =0.17, p=<.001). Transport priority of flexibility was on the other hand, related to lower levels of active transport use (β = -0.11, p=<.05).

Table 4
Predictors of active transport mode use

Block	Indicators	B	β	95% CI Lower	95% CI Upper	R square change	F-change
1						**.40**	**31.00**
	Demographics and situational factors						
	Gender	-.09	-.07	-.21	.03		

	Age	.01	.04	.01	.03		
	Do you or your roommate/spouse own your own car?	.05	.03	-.09	.18		
	Campus	.36***	.29	.23	.49		
	Foot path/Bicycle path	.13*	.04	.10	1.38		
	Time it takes to walk to university (total minutes)	-.01***	-.42	-.01	-.01		
	Time it takes to bicycle to university (total minutes)	-.00	-.05	-.01	.01		
2	*Transport attitudes*						
	Social status	-.01	-.01	-.11	.08	**.02**	**2.79**
	Environmental concern	.07*	.10	.01	.14		
	Comfort	.06	.09	-.00	.12		
	Physical activity	.04	.05	-.04	.12		
	Transport priorities						
3	Safety and security	.01	.01	-.05	.06	**.03**	**4.79**
	Exercise	.11***	.17	.05	.17		
	Convenience	.08	.07	-.02	.18		
	Flexibility	-.07*	-.11	-.13	-.01		

Dependent variable= sum score of active transport mode use (higher scores reflecting more frequent use of this transport mode).
Adjusted R2= .42.
Significant (p<.001) F-changes in bold.
* p<.05
** p<.01
*** p<.001

Predictors of public transport mode use

A second hierarchical regression with demographics, situational factors, transport attitudes and priorities were carried out to predict public transport use (Table 5). The full model of demographics, situational factors, transport attitudes and priorities (model 3) was statistically significant (R^2 = .114, F (4,346) = 3,186, p < .001). Male respondents used PT more than female respondents (β =.14, p=<.05). The transport attitude of comfort in PT, related to lower levels of PT use (β =- .18, p=<.01). Transport priorities did not however, add to the explained variance above and beyond demographics and situational factors (p> .05).

Table 5
Predictors of public transport mode use

Block	Indicators	B	β	95% CI Lower	95% CI Upper	R square change	F-change

1						**.07**	**4.38**
	Demographics and situational factors						
	Gender	.39*	.14	.08	.70		
	Age	.01	.02	-.05	.06		
	Do you or your roommate/spouse own your own car?	.24	-.07	-.60	.11		
	Campus	-.74***	-.26	-1.05	-.43		
	Foot path/Bicycle path	-.15	-.02	-.83	.53		
	Time it takes to get to public transport start point for transport to university (total minutes)	-.01	-.04	-.03	.02		
2	*Transport attitudes*						
	Social status	.12	.05	-.13	.36	**.03**	**2.88**
	Environmental concern	.00	.00	-.18	.18		
	Comfort	-.26**	-.18	-.41	-.10		
	Physical activity	-.10	-.05	-.31	.11		
3	*Transport priorities*						
	Safety and security	.14	.11	-.01	.30	.02	1.52
	Exercise	-.15	-.12	-.31	.01		
	Convenience	-.09	-.04	-.36	.18		
	Flexibility	-.01	-.01	-.18	.16		

Dependent variable= sum score of public transport mode use, by tram and bus (higher scores reflecting more frequent use of this transport mode).
Adjusted R2= .08.
Significant (p<.01) F-changes in bold.
* p<.05
** p<.01
*** p<.001

Discussion

The aim of this study was to examine the role of transport priorities for sustainable transport mode use among university students, above and beyond transport attitudes and situational factors. The results showed that transport priorities were associated with active transport use even after situational factors and transport attitudes were considered. Transport priority of *Exercise* was related to higher levels of active transport use to and from university. This contrasts with previous research on transport priorities among representative samples of Norwegians, which suggested that motivations of safety was related to PT and active transport (Nordfjærn, Şimşekoğlu, Lind, et al., 2014). Thus, the transport priorities of students for

sustainable transport use appears to be different from that of the general public. Our results suggest reminding students of the health benefits of active transport use might be a promising way to promote this transport mode. This improvement potential was also reflected by the rather weak transport priorities regarding exercise and negative transport attitudes regarding physical activity in the current study. In addition, transport attitudes were associated with active transport use. The transport attitude of environmental concern was associated with increased use of active transport. This result is in line with previous research which has found attitude to be an important precursor for sustainable transport mode use (Bopp et al., 2012; Hoffmann et al., 2017; Lemieux & Godin, 2009). In contrast to active transport, transport priorities were not related to PT use in the current study. However, the transport attitude of comfort was associated with decreased use of PT. This might indicate a dissatisfaction with this mode in the current study. One might speculate that these students are inclined to change to less sustainable alternatives such as car use when they become available to them (e.g. when their economic situation changes). Thus, improving the comfort of PT (e.g. offer more frequent departures and thus less crowded buses/trams) might be a promising way to promote continued usage into working adult life. Overall, active commuters appear more engaged (by health benefits, environmental concern) in their transport mode than public commuters. Thus, different measures to promote sustainable transport use seem logical.

The current study was conducted during wintertime. Previous research has demonstrated how season can have a large impact on active transport mode use (Børrestad et al., 2011). Our study showed that most students use PT during winter season (72% used public transport at least 1 days a week), while fewer choose to commute actively (35% used active transport at least 1 days a week). Furthermore, our study contributed to the literature by the inclusion of psychological factors and situational factors in tandem to gain a fuller understanding of precursors of sustainable transport use during winter. The priority of

flexibility was inversely related to active transport use. This might be specific for active transport in winter season when snow and ice might prevent one from walking or bicycling certain routes. Overall however, the factors that were most strongly related to sustainable transport mode use in wintertime were situational. Students affiliated with Campus Gløshaugen were more likely to commute actively to university and less likely to use PT, than students affiliated with Campus Dragvoll. Furthermore, the more time it took to walk to university, the less likely it was for students to actively commute. This supports research demonstrating that travel distance negatively affects active transport mode use (Handy et al., 2014). The Campuses included in our study differed largely in location. While Dragvoll is located outside of the city center, Gløshaugen is located near the city center. Our findings are very much in line with previous research demonstrating that a suburban residential location reduces active transport mode use (Stinson & Bhat, 2004). It appears that campus location has a similar impact. One may speculate that a rural location of Campus is associated with situational constraints such as insufficient clearing of snow on walking and bicycling paths and unsatisfying infrastructure for active transport. Overall, the results suggest that psychological factors are less relevant for sustainable transport mode use during wintertime. Situational factors appeared to be of stronger importance. Thus, it could be argued that promotion of active transport mode use during wintertime should mainly focus on reducing the impact of situational constraints and improve infrastructure. On the other hand, we did not include factors of potential importance, such as PBC and subjective norm, in the current study. As PBC can be related to situational constraints, this psychological factor might be especially relevant to consider in future research. Overall it appears that the full TPB model should be included in future research to further examine the role of psychological factors of sustainable transport mode use during wintertime.

Limitations of the study

Some limitations of the current study should be noted. Although most outliers were eliminated by removing extreme values from the analyses, a few outliers remained (3 for analyses on active transport use and 1 for the analyses on PT). This could have affected the results, although Cook's distance indicated that no values had high influence. Also, a high mean for the transport priority of *Convenience* suggests a ceiling effect for this variable which might not be optimal for analysis of this variable. The current study was cross-sectional in design, which limits our understanding of causal relationships between transport priorities, attitudes, situational factors and sustainable transport mode use. Furthermore, data were collected via a self-report survey. Therefore, social desirability bias might have affected the results. However, the survey was completely anonymous, which should reduce social desirability bias. In addition, the transport attitudes reported in the sample were negative to neutral, indicating that the respondents did not over-report environmentally desirable attitudes.

Implications and future directions

The presented results suggest a priority of exercise and the attitude of environmental concern relates to increased active transport mode use in wintertime. Promoting the health- and environmental benefits of active transport could therefore be an effective way to increase the use of active transport among students. No motivation was found among students commuting publicly. The attitude of travel comfort was related to reduced PT use. Comfort improvements might promote continued usage. Overall, situational factors were more strongly related to active transport use in wintertime. Reducing the impact of situational constraints of active transport mode use might be especially important in colder seasons. Future research should include the full TPB model to further examine the roles of psychological factors during this season. PBC might be especially relevant to examine in this context.

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