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RUNNING HEAD: Active Commuting on a College Campus

Active Commuting Patterns at a Large, Midwestern College Campus

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Abstract

Objective: To understand patterns and influences on active commuting (AC) behavior.

Participants: Students and faculty/staff at a university campus.

Methods: In April-May 2008, respondents answered an online survey about mode of travel to
5 campus and influences on commuting decisions. Hierarchical regression analyses predicted
variance in walking and biking using sets of demographic, psychological, and environmental
variables.

Results: Of 898 respondents, 55.7% were female, 457 were students (50.4%). Students reported
more AC than faculty/staff. For students, the models explained 36.2% and 29.1% of the variance
10 in walking and biking, respectively. Among faculty/staff, the models explained 45% and 25.8%
of the variance in walking and biking. For all models, the psychological set explained the
greatest amount of variance.

Conclusions: With current economic and ecological concerns, AC should be considered a
behavior to target for campus health promotion.

Introduction

Active commuting (AC), walking or biking to work or school, has been identified as an important target for increasing population-level physical activity (PA) patterns.¹⁻³ Current guidelines for PA recommend that adults should engage in at least 30 minutes of moderate-intensity activity on five days of the week and that this amount can be accumulated in 10 minute bouts.⁴ Thus, AC offers individuals a potential strategy to integrate the recommended amount of PA into daily life routines. The health benefits of AC have also been identified, including significant improvements in VO₂max and cholesterol and reduced risk of obesity, cardiovascular disease, stroke, and all-cause mortality.⁵⁻¹⁰ In addition to physical health benefits, AC has the potential to facilitate positive social (e.g., increased contact with other residents), environmental (e.g., less pollution), and economic (e.g., lower insurance costs) benefits as well.¹¹

Although the benefits are well documented, rates of AC in the United States remain low. Data from the 2001 National Household Transportation Survey indicate that 90.8% of respondents reported their usual mode to work was an automobile, 5.1% took public transit, 2.8% walked, and 1.3% reported using some other form of transportation.¹² Kruger et al.¹³ examined data from the 2005 National Health Interview Survey and reported that only 28% of adults reported engaging in any transportation-related walking for at least ten minutes within the past week. To address these concerns, Healthy People 2010 objectives for PA include a goal of increasing the proportion of trips by walking and biking compared with other modes of transportation.¹⁴

Several studies have documented patterns and influences on children's AC to school,¹⁵⁻¹⁷ and other studies have examined AC among adults, investigating either environmental factors (e.g., variety of destinations, aesthetics, traffic safety, distance, etc.) or individual level factors

(e.g., demographics, perceptions of the utility of AC for reducing expenses, health improvements, and concerns about eco-friendliness)¹⁸⁻²², though few studies have examined multiple levels of influence. Generally however, there is very little information on AC patterns and influences on college campuses, which serve diverse purposes as being an educational institution as well as being large employers. In order to understand effective strategies for interventions promoting walking and cycling for transportation, it is essential to document the correlates of these behaviors.

Social ecological models theorize that multiple levels of influence impact physical activity²³, and much research has suggested that examining a combination of factors at an interpersonal as well as community or environment levels will lead to a more complete understanding of the potential influences on a behavior²⁴. Thus, the basis for this study was a social ecological framework, adding to currently existing literature on AC influences while expanding on past studies that have largely only focused on one level of influence.

In the United States, approximately 4300 colleges and universities serve more than 17 million students annually, the largest portion of which are young adults ages 18-24.^{25, 26} Individuals in this age group, transitioning from one life phase to another, are at risk for developing unhealthy habits such as poor eating and being physically inactive.²⁷ Instilling lifetime healthy behaviors during this crucial period will increase the likelihood of sustained positive habits throughout adulthood and other transitional life stages.

Although college campuses are a valuable forum for reaching young adults who are students, they are also often major employers within communities and present prime settings in which to deliver preventive health programs. In the United States, colleges and universities nationwide employ approximately 3.6 million faculty and staff.²⁸ Worksite wellness programs

have well-documented health benefits including improved PA participation, fitness, cardiovascular disease risk profile, decreased obesity, better work attendance, and lower job stress among employees.²⁹⁻³¹ Such initiatives often include multiple approaches for improving health, including health education, health risk assessments, behavioral strategies, or environmental or policy approaches. However, encouraging AC among employees remains a fairly uncommon approach. Wen and colleagues were successful in improving rates of active transportation to work among healthcare setting employees, yet few interventions have included or evaluated AC among employees.³² A cross sectional study examining AC influences showed that workplace setting physical supports (e.g., bike parking) and the social/cultural environment for AC (e.g., social support for AC from other employees) were significant predictors of AC patterns.³³

In summary, increasing rates of AC presents a promising strategy for improving population physical activity levels, and college and university campuses, with their large, well-educated populations, provide a promising venue for promoting such behaviors. The purpose of this study was to examine patterns of AC among students and faculty/staff at a university campus and the factors that predict AC in these populations using a social ecological framework. Using evidence from other studies examining influences on physical activity as well as AC^{19, 21, 34}, we included both individual level influences as well as environmental influences in an attempt to create a more comprehensive understanding of AC behavior. Better understanding rates and predictors of AC among college students and personnel can suggest promising avenues for future research and intervention to promote physical activity and health in educational and other large worksite settings.

Methods

Setting, Population and Recruitment

This study was a cross-sectional examination of AC behaviors and influences. Data were collected exclusively using an online electronic survey (Axio Learning Systems, Manhattan KS). The 5 survey was conducted at a large Midwestern University during April-May 2008. The university had a population of approximately 25,000 undergraduate and graduate students within six academic colleges, 1,100 faculty and 1700 staff, and was situated in a town with a population of approximately 50,000.³⁵

All faculty, staff, and students associated with the university were eligible to participate in the study. The survey was disseminated through email to personal contacts of the authors, through listservs 10 targeted to reach students, faculty, and/or staff (e.g., departmental, student organizations, faculty senate, etc.), and was offered as an extra credit opportunity in multiple undergraduate classes. The number of potential respondents was equivalent to the student, faculty and staff population of Kansas State University, though because of the recruitment strategy, where respondents were not invited individually, it is not possible to determine a response rate. However, the final study sample was reflective of both the 15 student and faculty/staff population in terms of sex and undergraduate/graduate distribution³⁶. The study was approved by the Institutional Review Board at Kansas State University.

Measures

Variables were included to be reflective of our social ecological framework, including individual level influences (demographics and psychological factors) and environmental influences. These variables were 20 selected based on an examination of other known influences of physical activity and AC^{18, 19, 34}.

Individual-level Influences

Demographic influences: Participants were asked to report their age, sex, current role at the university (student, faculty/staff), year of study (if a student), and the academic college with which they were affiliated. Participants also reported their moderate and vigorous PA, based on questions from the Behavioral Risk Factor Surveillance System Questionnaire , which asked about the frequency and

- 5 duration of moderate and vigorous physical activity.³⁷ Individuals were also asked to respond to demographic items that could impact their choice of transportation to campus on a 5-point scale ranging from 1 (is not an important factor) to 5 (is a very important factor) including: having access to a car, health related concerns, traveling to other points before and after campus, and economic constraints.

Psychological influences: Participants reported their self-efficacy for AC by indicating their level of

- 10 confidence to increase the number of times they walked or biked to campus on a scale from 1 (not at all confident) to 4 (very confident). Individuals were also asked to respond to psychological items that could impact their choice of transportation to campus on a 5-point scale ranging from 1 (is not an important factor) to 5 (is a very important factor) including: environmental concerns, perceived health benefits, and time constraints.

15 *Environmental-level influences*

Individuals were also asked to respond to environment items that could impact their choice of transportation to campus on a 5-point scale ranging from 1 (is not an important factor) to 5 (is a very important factor) including: availability of sidewalks, preferences of traveling companions, terrain, safety from traffic or crime, and parking cost and availability. Participants were also asked to report their 20 perception of how long it would take them to walk or bike to campus (0-20 minutes, greater than 20 minutes).

Active Commuting Patterns

Respondents were asked to report the number of times per week they traveled to campus by walking, biking, and driving, resulting in a frequency score of how many trips per week an individual made by each mode of transportation.

Analyses

5 Frequencies and other descriptive statistics were used to describe the sample. T-tests, one-way analysis of variance (ANOVA), and chi-square analyses were used to examine differences between faculty/staff and students with respect to AC behavior and influences. Pearson correlations were used to examine relationships between number of walking and biking trips and influences on AC for inclusion in the subsequent regression analyses. Four hierarchical regression analyses were then used to predict
10 walking and biking trips separately for students and faculty/staff. Only variables that were significantly correlated ($p < 0.05$) with walking or biking were included in the models. Three sets of variables were created, representing individual-demographic (e.g., age, gender), individual-psychological (e.g., self-efficacy, perceived individual barriers), and environmental (e.g., parking, safety, sidewalks) influences on AC. These three sets of variables were entered in the order listed above, and the amount and significance
15 of the increment in explained variance (i.e., ΔR^2) for predicting walking and biking was examined. All analyses were conducted using SPSS 16.0.

Results

Participants

The demographics of study participants are displayed in Table 1 by group (student, faculty/staff).
20 The majority of students were female, young adults, undergraduate, and regularly active. Participants reported being affiliated mainly with the Colleges of Arts & Sciences; Architecture, Planning & Design; Business Administration; and Engineering, in similar proportion to enrollment patterns at the university.

Among faculty/staff, most respondents were female, middle-aged, and regularly active. Most faculty/staff participants were affiliated with the Colleges of Arts & Sciences; Agriculture; and Engineering.

Active Commuting Behavior and Influences

Active commuting patterns by group are shown in Table 2. For students, on average, participants reported walking more (4.5 ± 4.5 times/week) than driving (2.3 ± 2.7 times/week) or biking (0.9 ± 2.3 times/week) to campus. Most students reported living within a 20 minute walk (71.2%) or 20 minute bike ride (91.3%) of campus. Students reported greater self-efficacy for walking to campus than biking ($t=9.75$, $df=428$, $p<0.01$). Faculty/staff reported driving more (4.3 ± 2.2 times/week) than walking (0.8 ± 1.8 times/week) or biking (0.5 ± 1.3 times/week) to campus. The majority of faculty/staff reported living farther than a 20 minute walk (79.5%) or bike ride (50.8%) to campus. There was no difference in self-efficacy for walking compared with biking for faculty/staff.

Among students, those associated with the College of Architecture, Planning & Design were more likely to walk ($F=2.6$, $df=7$, $p=0.01$) and bike ($F=2.3$, $df=7$, $p=0.02$) to campus compared to students reporting other college affiliations. For faculty/staff, those affiliated with the College of Arts & Sciences were more likely to walk to campus ($F=4.1$, $df=8$, $p<0.001$) compared with faculty/staff affiliated with other colleges, though there were no differences by college for biking to campus among faculty/staff.

As depicted in Table 2, students were more likely to walk ($t=15.1$, $df=826$, $p<0.001$) and bike ($t=3.3$, $df=827$, $p<0.001$) to campus compared to faculty/staff, who were more likely to drive ($t=11.5$, $df=827$, $p<0.001$) than students. Faculty/staff reported significantly less self-efficacy for walking ($t=14.6$, $df=818$, $p<0.001$) and biking ($t=5.1$, $df=826$, $p<0.001$) than students.

Influences on AC are shown in Table 3. Students reported that traffic congestion, safety from crime, parking availability and parking cost were greater influences on their AC compared with faculty/staff (p 's <0.05). The influences of time constraints, environmental concerns, health problems,

health benefits, availability of sidewalks, terrain of landscape, and safety from traffic were stronger for faculty/staff than for students ($p < 0.05$).

Predictors of Active Commuting

Four hierarchical regression analyses predicted walking and biking trips separately for students
5 and faculty/staff, examining the independent associations of sets of demographic, psychological, and environmental influences with frequency of walking and biking.

Students

The first two models examined predictors of walking and biking among students. For walking, the complete hierarchical model explained 36.2% of the variance, [$F(12,410) = 19.4$, adjusted $R^2 = 0.34$,
10 $p < 0.001$], with the demographic set (age, economic concerns) explaining 3.9% of the variance [$F(2,420) = 8.63$, adjusted $R^2 = 0.035$, $p < 0.001$], the psychological set (self-efficacy, environmental concerns, time barriers) explaining an additional 18.9% [F change $(3,417) = 34.0$, adjusted $R^2 = 0.22$, $p < 0.001$], and the environmental set (walking distance, parking cost and availability, crime, weather, access to a vehicle, traveling preferences of others) explaining an additional 13.4% [F change $(7,410) = 12.3$, adjusted $R^2 = 0.34$, $p < 0.001$]. Economic concerns, self-efficacy, time barriers, weather, parking availability, and distance to campus were significant predictors ($p < 0.05$).
15

Among students, the complete hierarchical model explained 29.1% of the variance in biking [$F(9, 412) = 18.8$, adjusted $R^2 = 0.29$, $p = 0.03$], with the demographic set (sex, economic concerns) explaining 3.7% [$F(2,419) = 8.00$, adjusted $R^2 = 0.032$, $p < 0.001$], the psychological set (self-efficacy, environmental concerns, perceived health benefits) explaining an additional 23.7% [F change $(3,416) = 45.2$, adjusted $R^2 = 0.27$, $p < 0.001$], and the environmental set (biking distance, parking availability, safety concerns from traffic, weather) explaining an additional 1.8% [F change $(4,412) = 2.6$, adjusted $R^2 = 0.28$, $p = 0.03$]. Self-efficacy, weather and parking availability were significant predictors ($p < 0.05$).
20

Faculty/staff

The complete hierarchical model predicting walking among faculty/staff explained 45.0% of the variance [$F(10,377) = 30.1$, adjusted $R^2 = 0.44$, $p < 0.001$]. Since no individual demographic variables were significantly correlated with walking, there was no demographic set included for this model. The 5 psychological set (self-efficacy, environmental concerns, time barriers, perceived health benefits) explained 36.8% of the variance [F change ($4,373$) = 54.3 , $p < .0001$] and the environmental set (walking distance, parking cost, safety from traffic, terrain, weather, traveling to other destinations before/after campus) explained an additional 8.2% [F change ($6,637$) = 9.1 , adjusted $R^2 = 0.44$, $p < 0.001$]. Perceived health benefits, self-efficacy, time barriers, terrain, and distance to campus were significant predictors 10 (ps<0.05).

For faculty/staff, the complete hierarchical model explained 25.8% of the variance in biking [$F(10, 364) = 12.6$, adjusted $R^2 = 0.24$, $p < 0.001$], with the demographic set (sex, health related barriers) explaining 6.0% of the variance [$F(2,372) = 12.0$, adjusted $R^2 = 0.055$, $p < 0.001$], the psychological set (self-efficacy, environmental concerns, perceived health benefits, time barriers) explaining an additional 15 18.8% [F change ($4,368$) = 22.9 , $p < .0001$], and the environmental set (biking distance, terrain, safety concerns from traffic) explaining an additional 1.0% [F change ($4,412$) = 1.2 , adjusted $R^2 = 0.24$, $p = 0.30$]. Environmental concerns, time barriers, and self-efficacy were significant predictors (ps<0.05).

Comment

College campuses serve an important role for impacting the well-being and behavioral habits of 20 both their students and staff. With their large numbers of young adults and their sizeable employee base, universities and colleges can be influential institutions for public health. This study provided insight on patterns of and a wide range of influences on AC at a large university campus, supportive of a social

ecological framework. As such, it contributes to a relatively small field of knowledge about AC amongst adults, and is among the first to examine AC in this setting.

Our analyses revealed that students actively commuted to campus more often than faculty/staff, and that walking was more common than biking. We also found that faculty/staff had lower levels of self-efficacy for AC, cited health as an important influence, and had several environmental factors that influenced AC (distance, lack of sidewalks, safety concerns from traffic) compared with students. More importantly, the findings also highlighted several demographic, psychological, and environmental predictors of AC for students and faculty/staff. For example, distance was an important influence on commuting patterns, especially for students, and this trend was not unexpected since many students live within close proximity of the university, with many living on campus, also confirming previous findings from the literature.²² This indicates that there may be community design or urban planning issues that could influence AC patterns for students, including zoning laws and policies that would include a network of trails or bike lanes connecting campuses with residential areas that have a high student population.

Faculty and staff were less likely to actively commute overall when compared with students, with distance to campus again being an important influence. Faculty/staff were significantly more likely to report living further from campus compared with students, resulting in a greater chance for the presence of barriers to AC (e.g., lack of sidewalks, traffic, unfriendly terrain, etc.). Natural settlement patterns of higher density housing with multi-family dwellings close to campus often draw a greater number of students compared with faculty or staff, who often choose to live away from such student-dense neighborhoods. Thus, given the likely barrier of distance, environmental accommodations may be necessary to encourage greater AC among faculty and staff. For example, some research has found that physical environment factors are significantly associated with AC to work among university community members. In a study of over 500 students and staff at the University of North Carolina, Rodriguez et al.³⁸ reported that the addition of several environmental variables (e.g., topography of streets, sidewalk

availability, presence of paths) helped to better explain travel mode choice above and beyond traditional travel decision criteria such as time and cost variables. Thus, although distance may be a significant deterrent to AC amongst older members of the campus community, improving the built environment for walking and cycling may help to overcome some of this limitation.

5 The differences between students by academic college (i.e., architecture students were more active than students from other colleges) was another interesting finding from our study. It is possible that some social/cultural (e.g., support for sustainable transport) or logistical (e.g., class scheduling, building location) differences exist that present opportunities or barriers to active transport and should be examined further.

10 Other significant influences on AC for faculty/staff included time constraints and health benefits. This latter finding is not unexpected, given that faculty/staff were more likely to be older than students, and it is well documented that as individuals age, health benefits are an important motivator for engaging in regular physical activity.³⁴ Time constraints are also understandable, since faculty/staff are more likely to have families and other commitments beyond the campus community competing for their time and
15 attention. It is also possible that faculty/staff are more likely to have other places to travel to before or after traveling to campus or as part of their on- and off-campus occupational duties, thus making AC more impractical. From a worksite wellness perspective, several initiatives could be implemented to use these influences to promote AC. Employee health programs could provide educational or encouraging materials outlining some of the documented health benefits associated with AC. Environmental or policy changes
20 could make AC more viable for employees, including bike parking within close proximity of buildings, shower or locker facilities, or access to a campus motorpool for local travel.³³

Among all respondents, for walking and biking, individual level psychological variables explained the greatest amount of variance in behavior when compared with environmental level influences. Self-efficacy for AC was a significant predictor, similar to many other studies showing that

self-efficacy for physical activity is an important correlate.³⁴ Strategies to increase self-efficacy for AC on campus could include educational classes on AC or bike safety to improve skills, forming clubs or organizations related to AC to enlist social support, or marketing strategies to encourage participation in AC. Though self-efficacy was important for the entire sample, perhaps strategic efforts to improve 5 faculty/staff self-efficacy for AC would be warranted, given the observed disparities between that group and students for this factor. Although self-efficacy was found to be a valuable predictor in this study, it is noteworthy that using this variable; reflecting on future behavior; to predict the main dependent variables in this study; past AC behavior; is conceptually limiting. Regardless, this finding highlights the importance of addressing a wide range of influences within a social ecological framework and simple 10 environmental changes may not be enough to result in an increase in AC behavior.

This study highlights that both faculty/staff and students' concerns about the environment and being ecologically friendly were also related to walking and biking behavior, thus presenting a possible motivator that has not been examined in detail in most other studies of active transportation. A study by Bopp et al.²⁰ also found that individuals with more ecologically-friendly attitudes were significantly more 15 likely to actively commute and perceived more motivators and fewer barriers for AC compared with those with less ecologically-friendly attitudes. Intervention strategies on campuses encouraging AC could promote active transport as an eco-friendly option, invoking the campus community's "green consciousness." Current trends in higher education have included a great deal of focus on sustainability efforts ranging from recycling efforts to reducing emissions.³⁹ This focus on green efforts may provide 20 health promotion staff on campuses with nontraditional partners in their efforts to promote AC, bringing together a transdisciplinary team with multiple areas of expertise and interest.

Limitations

This study yielded a number of important insights, but several limitations should be considered when interpreting the results. For example, since the survey was conducted online, our reach may have

been limited, especially among staff that traditionally may not have regular access to computers (e.g., custodial staff, groundskeepers, etc.). As well, there may have been a volunteer bias in the sample, with those individuals more interested in activity, walking, or biking more likely to respond to the survey. Further, we measured AC behaviors by self-report, which may be subject to some recall biases. The 5 measure we used for assessing AC had not been previously validated, which is also a limitation for this study. Future studies should explore the feasibility of objective methods for assessing AC habits. Finally, as stated previously, it is possible that we failed to examine certain important influences on AC and future research should continue to explore the factors that are associated with greater walking and biking to work or school among individuals on college campuses.

10 Conclusions

Our results yielded a number of important insights into patterns and influences on AC on a large campus. Though specific to one large university, the results may easily translate to similar sized college towns nationally. College campuses are often the juncture of student health, employee health, sustainability efforts and health promotion programming, resulting in a venue with substantial public 15 health potential for promoting AC and its many benefits. The findings and ideas presented here offer ample opportunities for developing individual and environmentally-focused interventions that can increase active transport and improve the health of the campus community.

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Table 1. Demographics of the Sample (n=898)

Characteristic	Students (n=457)	Faculty & Staff (n=441)
Age, years (SD)	22.0 (3.33)*	44.5 (11.5)
Year in class (%)		
Undergraduate student	88.1	
Graduate student	11.9	
% Female	57.5	54.0
% Meeting physical activity recommendations	60.6	71.8
College Affiliation (%)		
Arts & Sciences	43.8	32.6
Architecture, Planning & Design	16.8	7.5
Business Administration	10.0	5.7
Education	7.7	5.3
Human Ecology	9.5	8.4
Agriculture	6.2	19.8
Engineering	5.3	11.0
Veterinary Medicine	0.7	7
Other	0.0	2.6

* denotes significant difference between groups ($p<0.05$)

Table 2. Commuting Related Variables (n=898)

Variable	Students (n=457)	Faculty & Staff (n=441)	t or χ^2	p
Commuting patterns				
Number of times/week driving to campus (SD)	2.3 (2.7)	4.3 (2.2)	-11.5	<0.001
Number of times/week walking to campus (SD)	4.5 (4.5)	0.8 (1.8)	15.1	<0.001
Number of times/week biking to campus (SD)	0.9 (2.3)	0.5 (1.3)	3.3	0.001
Self reported distance to campus				
Less than a 20 minute walk (%)	71.4	20.5	2.1	<0.001
Less than a 20 minute bike ride (%)	91.3	49.2	1.75	<0.001
Self-efficacy for increasing active commuting				
Self-efficacy for walking to campus (SD)	3.6 (1.9)	1.8 (1.5)	14.6	<0.001
Self-efficacy for biking to campus (SD)	2.5 (1.6)	2.0 (1.4)	5.1	<0.001

Table 3. Differences for Influences on Active Commuting by Campus Role

Influence on Active Commuting	Mean for Students, (SD) (n=457)	Mean for Faculty & Staff, (SD) (n=441)	t	p
Individual factors				
Time constraints	4.0 (1.3)	4.2 (1.3)	-2.1	0.03
Traveling to other points before/after campus	3.4 (1.4)	3.6 (1.5)	-1.7	0.09
Environmental concerns (e.g. pollution)	2.5 (1.5)	2.7 (1.4)	-2.1	0.04
Economic concerns (e.g. cost of maintaining a car)	2.6 (1.4)	2.6 (1.4)	-0.4	0.70
Having access to a car	1.9 (1.2)	2.0 (1.4)	-1.8	0.07
Health problems	1.7 (1.1)	1.9 (1.2)	-2.4	0.02
Perceived health benefits	3.1 (1.4)	3.3 (1.4)	-2.0	0.04
Environmental factors				
Availability of sidewalks	2.1 (1.3)	2.7 (1.5)	-6.5	<0.001
Traffic congestion	2.6 (1.4)	2.4 (1.4)	2.0	0.04
Weather	3.6 (1.3)	3.7 (1.4)	-0.76	0.45
Terrain	2.0 (1.2)	2.4 (1.4)	-4.3	<0.001
Safety concerns from crime	2.3 (1.4)	1.8 (1.1)	5.0	<0.001
Safety concerns from traffic	2.1 (1.3)	2.7 (1.6)	-5.6	<0.001
Parking availability	3.2 (1.5)	2.7 (1.5)	4.7	<0.001
Parking cost	3.0 (1.5)	2.5 (1.4)	4.4	<0.001
Traveling preference of others traveling with you (spouse, children, etc)	2.2 (1.4)	2.3 (1.5)	-1.4	0.18

* All items rated on a 5-point scale (1= not much of an influence on active commuting to 5=a strong influence on active commuting)