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Prospective Examination of Self-Regulatory Efficacy in Predicting Walking for Active Transportation: A Social Cognitive Theory Approach

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Walking for transportation is associated with health benefits. Minimal theory-based research has examined social cognitive and environmental predictors. This study examined social cognitions (self-regulatory efficacy to plan/schedule and overcome barriers; distance and travel time cognitions) and an environmental factor (proximity) as predictors of walking for transportation. Participants ($n = 105$) were university students, faculty, and staff, living within a walkable distance to campus. Social cognitions and proximity measures were completed at baseline, followed by walking for transportation to/from the campus over 2 weeks. A hierarchical multiple regression analysis predicted walking ($R^2_{\text{adjusted}} = .55$; $p < .05$). Self-regulatory efficacy to plan/schedule and overcome barriers were independent predictors (p's $< .01$). Findings supported theoretical contentions that self-regulatory efficacy predicts walking for transportation.

Active transportation is a type of motivated physical activity behavior involving human-powered transportation (e.g., walking, cycling). Active transportation is important to study due, in part, to the more recent focus on incorporating physical activity into individuals' lifestyles (MacDougall, 2007). Although active transportation is associated with health benefits, such as reductions in body mass index and waist circumference (von Huth Smith, Borch-Johnsen, & Jørgensen, 2007; Wagner et al., 2001), less than 10% of adults engage regularly in this type of health-promoting behavior (Butler, Orpana, & Wiens, 2006; Statistics Canada, 2001). The main research focus in this area has been on identifying possible correlates of active transportation, a large aspect of which has concerned the built environment. Some of the

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correlates examined have included proximity to common destinations, land use, street connectivity, and residential density (Bourdeaudhuij, Sallis, & Saelens, 2003; Owen, Humpel, Leslie, Bauman, & Sallis, 2004; Saelens, Sallis, Black, & Chen, 2003; Saelens, Sallis, & Frank, 2003; Sallis et al., 2006). In addition to environmental variables, investigators have examined social cognitions, such as attitude, perceived barriers, and social support. Of interest, the social cognitive predictors in these studies have accounted for more of the explained variance in active transportation than the environmental variables (Bourdeaudhuij et al., 2003; Lemieux & Godin, 2009; Saelens, Sallis, & Frank, 2003; Titze, Stronegger, Janschitz, & Oja, 2008).

Whereas both social cognitive (i.e., person) and environmental variables have been identified as being related to the use of active transportation, this descriptive information has been gathered from studies that are primarily cross-sectional and atheoretical (Heath et al., 2006; Owen et al., 2004). As such, the current knowledge amounts to identifying correlates of active transportation without providing insight into what motivates this behavior over time, and whether personal and environmental correlates vary in the strength of their relationship with active transportation. One well-recognized theory, which accommodates the interaction between the person and the environment, is social cognitive theory (Bandura, 1986). One result of this interaction is social cognitions, the best known of which is self-efficacy beliefs.

Efficacy beliefs reflect the confidence of individuals to perform in their environment after taking into account its possible influence on their actions (e.g., engage in active transportation; Bandura, 2004). Social cognitive theory can be used to form hypotheses as to the conditions in which either social cognitions or the environment would be more likely to predict active transportation. Surprisingly, social cognitive theory (Bandura, 1986) has not been frequently utilized in the study of active transportation.

The tenets of social cognitive theory (Bandura, 1986) propose that environmental/situational constraints may vary in their influence on a behavior, such as active transportation. According to the theory, their strongest influence should occur when the environment produces significant constraints, such as during highly inclement weather. Alternatively, when these constraints are weak, social cognitions should explain more of the variance in active transportation. An example of weaker environmental constraints to active transportation would occur when individuals live in close proximity to a destination or when the weather is pleasant.

One social cognitive theory-based social cognition that may be most salient when examining engagement in motivated behaviors, like active transportation, is self-regulatory efficacy beliefs (Bandura, 2004). Such beliefs revolve around individuals' confidence to regularly implement control over their thoughts and actions needed to achieve a desired outcome, such as an on-time arrival to a routine destination (Bandura, 1986, 1997; Baumeister & Vohs, 2003; Brawley, Rejeski, & King, 2003; Maddux & Gosselin, 2003; McAuley & Mihalko, 1998). In considering the action of walking to a routine destination, individuals may need to self-regulate their weekly scheduling of walking and how they will overcome barriers that might impede their active transportation (e.g., poor weather; pressed for time). More efficacious individuals will spend considerable self-regulatory effort and persistence to accomplish the actions leading to their desired outcomes (Bandura, 1997; Brawley, Rejeski, & King, 2003; Maddux & Gosselin, 2003; McAuley & Mihalko, 1998).

Despite findings that efficacy beliefs in self-regulatory skills (e.g., scheduling, overcoming barriers) are significant predictors of physical activities, such as attending scheduled exercise classes, minimal research has examined the association between self-regulatory efficacy beliefs and active transportation (Forsyth, Oakes, Lee, & Schmitz, 2009; Fridlund Dunton & Schneider, 2006; Lemieux & Godin, 2009; Merom et al., 2009). For example, self-regulatory efficacy to overcome an investigator-provided list of barriers (e.g., physical effort, cost, weather) was significantly higher among university students who engaged in walking for active transportation as compared to those not engaged in this behavior (Shannon et al., 2006). However, active transportation also takes time from individuals' days, and thus self-regulatory efficacy to plan/schedule this mode of transport may be another important efficacy belief to examine. Planning/scheduling has been found to be an effective predictor of other types of physical activity (Baumeister & Vohs, 2003; McAuley, Pena, & Jerome, 2001; Poag-DuCharme & Brawley, 1993; Woodgate, Brawley, & Weston, 2005). Based on past research, self-regulatory efficacy to manage both barriers and scheduling/planning seem to be candidates to examine as logical, theoretically based predictors of active transportation.

In order to examine the influence of the environment in individuals' engagement in active transportation from the perspective of social cognitive theory (Bandura, 1986), individuals' perceptions about that environment need to be considered. Perceptions of travel time and distance may be important when predicting active transportation. Such perceptions occur as a result of individuals' experiences in navigating through their physical environments. From a social cognitive theory perspective (Bandura, 1986), the resultant perception of what has been experienced is important, not simply what exists in individuals' actual physical environment (Golledge & Stimson, 1997; Hart & Moore, 1973; Lloyd, 1997). In the case of active transportation, perceptions of distance involve individuals' cognitions of the distance to/from a destination (Lloyd, 1997). These cognitions are distinct from measures of objective distance/proximity (McCormack, Cerin, Leslie, Du Toit, &

Owen, 2008) and have been associated with the use of active transportation (Lloyd, 1997; McCormack et al., 2008; Shannon et al., 2006). The perception of travel time involves individuals' cognitions about the time needed to travel from one destination to another destination (Lloyd, 1997). Travel time cognitions have been associated with transportation mode choice, such that longer travel time cognitions were related to using faster transportation modes, such as car use (Fuji, Gärling, & Kitamura, 2001).

While travel time and distance cognitions have been identified as correlates of active transportation, they have not been investigated using a theoretical framework, in concert with self-regulatory efficacy beliefs. Recall that past cross-sectional, active transportation research found that social cognitions correlated more strongly with behavior compared to environmental factors, but only speculative reasons could be offered as to why this occurred. On the other hand, in a social cognitive theory-based study (Bandura, 1986), perceptions of distance and time, which result from individuals' interpretations of their objective environment, could be utilized as conditions that individuals consider when determining if they should engage in active transportation. Distance and time perceptions may be associated with active transportation, in particular when their influence is perceived as strong (i.e., long distance requiring a large amount of time; Bandura, 1986). However, when these perceptions are weaker (i.e., shorter distance), efficacy beliefs should be the predominant predictor of active transportation. Thus, to extend the research on active transportation, we conducted a prospective study, grounded on social cognitive theory (Bandura, 1986), to examine the utility of self-regulatory efficacy, perceptions of distance and time, and actual proximity to a destination (i.e., environmental factor) as predictors of walking for active transportation.

Purpose and Hypotheses

The purpose of the study was to examine whether the self-regulatory efficacy beliefs of scheduling/planning and overcoming barriers, distance and travel time cognitions, and proximity would be predictive of walking for active transportation to/from a university campus over a 2 week period. We hypothesized that self-regulatory efficacy beliefs would be significant predictors of walking for active transportation in a prospective study, while cognitions about time and distance and actual proximity to destination would not contribute significantly. Our rationale for the hypothesis was theoretically based. We specifically limited the influence of perceived and actual environmental constraints. Our study examined participation in active transportation of individuals living within a self-reported walkable distance to a university destination. Thus, time and distance cognitions and the environmental measure of proximity would be perceived as weak constraints to active transportation. If social cognitive theory-based predictions (Bandura, 1986) are correct about the influence of efficacy beliefs on behavior when environmental constraints are weak (i.e., perceptions of time and distance; proximity to destination), then self-regulatory efficacy beliefs should significantly predict subsequent active transportation and other predictors would not contribute significantly to the predictive model.

Methods

Participants

Participants were comprised of 105 students, faculty, and staff, aged 17–55 years ($M = 24.62 \pm 8.15$), from a large university in Western Canada. The majority of participants were female ($n = 73$), White ($n = 97$), and single ($n = 69$). Full-time university students comprised the majority of the sample ($n = 87$), followed by faculty and staff ($n = 15$). All participants lived at least a 10 minute walk from the university campus, based on their proximity to the university and an estimated walking speed of 5 km/hour (Duncan & Mummery, 2007). The mean body mass index of the participants, calculated from self-reported height and weight, was 25.13 ± 4.83 kg/m^2. A body mass index ranging from 25 to 29.9 kg/m^2 is considered overweight (Health Canada, 2003).

Design and Procedures

After granting the study approval from the University Behavioral Research Ethics Board, participants were recruited via announcements in classrooms and the campus web terminal. Participants' inclusion criteria were: (a) being an adult, aged 17 years or older; (b) being a student, faculty, or staff member at the university; (c) a need to commute to/from the university campus; (d) not car pooling with others to the campus (i.e., due to potential error variance in distance and travel time cognitions; Rietveld, Zwart, van Wee, & van den Hoorn, 1999); and (e) resided within a self-reported walkable distance to/from the campus. As well, all participants had access to at least one other mode of transportation to the university. These alternative modes of transportation were typically in the form of a UPASS (public transportation included in student fees) or owning/having access to a motor vehicle. Thus, walking for active transportation was a volitional behavior, which was necessary to test the social cognitive theory-based study hypothesis.

This prospective, observational study required participants to complete three web-based surveys over a 2-week period, beginning in mid-November through the last week of November (i.e., Monday to Friday of each week; 10 days in total). Individuals who accessed the first survey, satisfied participant inclusion criteria, and provided informed consent were participants of the study. The first web-based survey assessed demographics, self-regulatory efficacy to schedule/plan and to overcome barriers, distance and travel time cognitions, and proximity. The second and third web-based surveys assessed walking for active transportation at the end of the first and second weeks (i.e., 5 day periods, respectively).

Measures

Self-Regulatory Efficacy to Schedule/Plan. Based on recommendations, self-regulatory efficacy to schedule/plan walking for active transportation was assessed using five items (McAuley & Mihalko, 1998; McAuley et al., 2001). The items were derived from the content of scales used in past research (Ducharme & Brawley, 1995; Woodgate et al., 2005). The scales were revised for the current behavioral focus of walking for active transportation, and pilot tested with a university-based sample ($n = 30$). Pilot testing involved assessing readability of the measure and whether pilot participants could identify other relevant scheduling items.

The five items included: (a) use walking for transportation to get to or from the university one to three times per week no matter what; (b) plan to use walking for transportation to or from the university during a usual school/work week; (c) arrange my schedule to use walking for transportation to or from the university on 4 or more days per week no matter what over the 2 next weeks; (d) organize my time around walking for transportation to or from the university no matter what; and (e) organize my responsibilities around walking for transportation to or from the university no matter what. Participants reported their confidence to complete each planning/scheduling item, regularly over the next 2 weeks, on a 0% (*Not at all confident*) to 100% (*Completely confident*) scale. Items were summed and averaged to form a single score. Cronbach's alpha was acceptable at .97 (Nunnally, 1978; Tabachnik & Fidell, 2006).

Self-Regulatory Efficacy to Overcome Barriers. Based on recommendations (McAuley & Mihalko, 1998; McAuley et al., 2001), self-regulatory efficacy to overcome barriers to walking for active transportation was assessed using seven items drawn from content in past active transportation research (Crawford, Mutrie, & Hanlon, 2001; Shannon et al., 2006) and pilot testing with a university-based sample ($n = 30$) who self-reported barriers to walking for active transportation. Barriers that were identified as common across all sources were included in the present measure.

Barrier items included: (a) during bad weather; (b) when I am anxious or stressed about school or work; (c) when I am feeling sick; (d) when I have to cross many busy intersections; (e) when I have to walk at a dark time of day; (f) when there are no sidewalks to walk on; and (g) when I have the option to use a faster mode of transportation. Participants reported their confidence to do active transportation when faced with each barrier in the next 2 weeks on a 0% (*Not at all confident*) to 100% (*Completely confident*) scale. The scores on the seven items were summed and averaged to form a single score. Cronbach's alpha was acceptable at .91 (Nunnally, 1978; Tabachnik & Fidell, 2006).

Distance Cognitions. Similar to past research (Golledge & Stimson, 1997; Lloyd, 1997), participants reported the perceived distance, in kilometers, from their place of residence to the university based on the open-ended question: "*Please think of the route and mode of transportation you normally take in order to get to the campus. How far (in kilometers) do you live away from the university?*"

Travel Time Cognitions. Similar to past research (Burnett, 1978), travel time was measured by participants responding to the open-ended question, "*If you were to walk to the university campus from your home, how long (in minutes) would it take?*"

Proximity. Proximity was computed using Geographic Information Systems. The shortest network route between each participant's self-reported home postal code and a centrally located postal code on the university campus was determined in kilometers. The measurement of proximity was consistent with past research (Duncan & Mummery, 2007; McCormack et al., 2008).

Walking for Active Transportation. Each participant recalled her/his transportation mode to or from the university campus over the first week of the study (i.e., Monday to Friday) on Survey 2 and again over the second week of the study on Survey 3. Participants selected the transportation mode they used in order to get to/from the university on each weekday (i.e., walk, cycle, personal vehicle, public transportation, or other). A total walking for active transportation score was calculated by summing the number of days that a participant reported engaging in this behavior over the 2-week study period. The total walking for active transportation score could have ranged from 0 (*No days of walking for active transportation*) to 10 (*Walking for active transportation every day*).

Statistical Analyses

Descriptive statistics and bivariate correlations were examined to provide an overview of the data. We conducted a three-step hierarchical multiple regression analysis to examine the study hypothesis. As we wished to examine whether self-regulatory variables would predict walking for active transportation after controlling for environmental variable link, proximity followed by distance and travel time cognitions were entered in the first two steps. This was followed by self-regulatory efficacy beliefs in the third step.

Results

Descriptive and Bivariate Correlations

Participants reported being more than moderately confident in their self-regulatory efficacy beliefs to schedule/plan ($M = 66.40 \pm 35.88$) and to overcome barriers ($M = 63.42 \pm 27.35$). Average perceived residence distance to the university campus was 2.61 ± 1.24 km and respondents perceived that walking to campus would take, on average, 25.80 ± 12.93 minutes. The proximity measure revealed that participants lived 2.66 ± 1.22 km from the campus. Participants reported traveling to/from the university on the 10 days of the study period and walking for active transportation on nearly half of their trips ($M = 4.60 \pm 4.11$). The average temperature during the study period was –14°C (minimum = –27°C; maximum = –1°C), which was similar to the historical average (1971–2000) of –10°C (average minimum = –15°C; average maximum = –1°C) for the same city during the same period (Environment Canada, 2010). Thus, the weather did not present a greater challenge to the participants to walk for active transportation during the study period as compared to other years.

Table 1 contains the bivarate correlations between the study variables. Self-regulatory efficacy to schedule/plan and to overcome barriers were significantly and positively correlated, but not redundant, $r = .79$ ($p < .05$; Tabachnik & Fidell, 2006). Self-regulatory efficacy to schedule/plan was significantly and negatively correlated with travel time cognitions, $r = -.48$ ($p < .05$), and proximity, $r = -.43$ ($p < .05$). Similarly, self-regulatory efficacy to overcome barriers was significantly and negatively correlated with travel time cognitions, $r = -.31$ ($p < .05$), and proximity, $r = -.36$ ($p < .05$). Walking for active transportation was significantly correlated with all study variables (ranged from $r = -.44$ to .71, p's < .05) with the exception of distance cognitions ($r = -.14$, $p > .05$).

Table 1

Pearson Correlation Matrix Between Study Variables (n = 105)

	Walking for active transportation	Proximity	Distance cognitions	Travel time cognitions	SRE to schedule/plan	SRE to overcome barriers
Walking for active transportation	–	−.47**	−.14	−.44**	.72**	.66**
Proximity		–	.43**	.80**	−.43**	−.36**
Distance cognitions			–	.52**	−.12	−.04
Travel time cognitions				–	−.48**	−.31**
SRE to schedule/plan					–	.79**
SRE to overcome barriers						–

SRE = self-regulatory efficacy.
**p* < .05. ***p* < .01.

Hierarchical Multiple Regression to Predict Walking for Active Transportation

Table 2 illustrates the results from the hierarchical multiple regression analysis predicting walking for active transportation to/from the university campus. In step 1, proximity contributed significant variance to the model, $F(1, 103) = 29.24$, $p < .01$, $R^2_{adjusted} = .21$. The addition of perceived distance and travel time cognitions in step 2 did not contribute additional unique variance, $F(3, 101) = 10.88$, $p < .02$; $R^2_{change} = .02$, $p > .05$. In step 3, however, self-regulatory efficacy to schedule/plan and to overcome barriers contributed additional unique variance, $F(5, 99) = 26.06$, $p < .01$; $R^2_{change} = .33$, $p < .01$. As seen in Table 2, the final, overall model was significant, $F(5, 99) = 26.06$, $p < .01$, accounting for 55% of the variance in walking for active transportation. As expected, the significant, independent predictors included self-regulatory efficacy to schedule/plan ($\beta = .45$, $p < .01$) and self-regulatory efficacy to overcome barriers ($\beta = .24$, $p < .05$).

Discussion

The purpose of the study was to examine whether self-regulatory efficacy beliefs to schedule/plan and to overcome barriers, distance and travel time cognitions, and proximity would be predictive of walking for active trans-

Table 2

Hierarchical Multiple Regression Predicting Walking for Active Transportation (n = 105)

Variable	R^2 adjusted	R^2 change	$\beta_{standardized}$
Model 1	.21**		
Step 1			
Proximity			−.47**
Model 2	.22**	.02	
Step 1			
Proximity			−.33**
Step 2			
Distance cognitions			−.24
Travel time cognitions			.12
Model 3	.55**	.33**	
Step 1			
Proximity			−.19
Step 2			
Distance cognitions			−.003
Travel time cognitions			.01
Step 3			
SRE to schedule/plan			.45**
SRE to overcome barriers			.24*

Note. SRE = self-regulatory efficacy. *$p < .05$. **$p < .01$.

portation to/from a university campus over a 2 week period. Results of the study supported the hypothesis that the self-regulatory efficacy variables would be significant predictors of walking for active transportation.

According to social cognitive theory, when environmental constraints are weaker, self-regulatory efficacy beliefs will predict motivated behaviors (Bandura, 1986, 2004). In the case of using active transportation to achieve a desired outcome (i.e., reaching a routine destination), individuals must successfully self-regulate across a number of actions. In particular, walking for active transportation consumes individuals' time on any given day, thus the scheduling/planning of this action and overcoming barriers that might affect transport are needed self-regulatory actions. Further, individuals must be confident in their skills and abilities in order to regularly and persistently schedule and overcome barriers. Evidence to support this theoretical contention and our hypothesis was detected by the positive and strong relationship between self-regulatory efficacy and walking for active transportation.

Also consistent with the study hypothesis, environmental perceptions (i.e., distance and travel time cognitions) and the proximity factor were not significant predictors of walking for active transportation. To test our theory-based hypothesis favoring self-regulatory efficacy beliefs in the prediction of active transportation (Bandura, 1986), the environment should not have been perceived as constraining behavior. We attempted to ensure that this condition was met by setting the inclusion criterion for study participation as being that participants had to report living within a perceived walkable distance from their home to the university. Given that participants were practiced walkers, as evidenced by their use of active transportation in the current study, they had fairly accurate perceptions of time and distance. The relationship between these cognitions and actual proximity was reflected by the positive and significant correlations between these variables.

Strengths and Limitations

As mentioned earlier, a number of the previous studies of the active transportation domain have been cross-sectional and atheoretical in nature. Strengths of the current study included the theoretical foundation, prospective design, and control over the strength of the environment. However, these strengths were also accompanied by related limitations to generalizability. Specifically, control over the strength of an environmental constraint, while related to theory, limited generalizability to only one aspect of this condition (i.e., examining under a condition of a weak constraint). Other controls that limited generalizability were the focus on a single aspect of active transportation, the walkable, home–university campus route, which, while allowing for specific measurement of one aspect of active transportation in participants' lives, may have underestimated the total amount of active transportation in which participants engaged. Consistent with this focus was the sample itself, comprised mainly of individuals employed by or attending university. Thus, generalizability was also limited to the specific controls used for design and protocol strengths in the present study. Nonetheless, the advantages of the strengths remedy a few of the criticisms of previous active transportation investigations attempting to identify multiple correlates of this behavior. This begs the question of how future investigations should be conducted.

Conclusion and Future Directions

In keeping with calls to conduct theory-based research, the present study was framed using social cognitive theory in order to predict walking for active transportation (Heath et al., 2006; Saelens et al., 2003). Under the condition of a weaker environmental constraint, self-regulatory efficacy beliefs were significant predictors of individuals' use of walking for active transportation. In the future, examination of the relationships that social cognitive theory (Bandura, 1986) proposes as occurring between social cognitions and active transportation should take place under conditions that vary the strength of environmental constraints from weak to strong in order to test the use of the theory relative to predicting active transportation. Understanding when social cognitions strongly impact the use of active transportation would provide a starting point for interventions designed to improve this type of health-promoting behavior through a focus on personal factors. Alternatively, understanding when environmental factors are strongly related to the use of active transportation would provide valuable information in the design of environmental or policy change interventions.

Continued examination of the independent variables examined in the present study should take place in order to determine the consistency of the findings. Additional social cognitions, identified in past research as being associated with active transportation (e.g., intention, walking self-efficacy; Fridlund Dunton & Schneider, 2006; Lemieux & Godin, 2009; Shannon et al., 2006), should also be examined. As part of this research, participants should range from beginners to those struggling with engaging in regular use of active transportation to regular users of active transportation (Bandura, 2004). Understanding if social cognitive differences exist between regular users compared to those beginning or struggling in their use of active transportation may improve our understanding of social cognitions in the latter two groups.

It is also important to capture the use of multiple modes of active transportation in people's lives. For example, our participants may have used other forms of active transportation in addition to walking, and prevalence of use may have also been a seasonal moderator. Future studies could also consider a comparison of those individuals who utilize a number of forms of active transportation year-round as a lifestyle choice, compared to those who use single modes of active transportation, motivated by necessity. How different are their activity levels and what predicts adherence to total active transportation?

In summary, we have conducted a controlled theoretically based study that represents an initial step to carefully planned research in this area. However, we encourage others to consider the advantages of systematically examining active transportation from various theoretical perspectives in order to advance investigation beyond the first-generation research level of identifying correlates.

References

Bandura, A. (1986). *Social foundations of thought and action*. New York: Prentice Hall.

Bandura, A. (1997). *Self-efficacy. The exercise of control*. New York: W.H. Freeman and Company.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education and Behavior*, *31*, 143–164.

Baumeister, R. F., & Vohs, K. D. (2003). Self-regulation and the executive function of the self. In M. R. Leary & J. N. Tangney (Eds.), *Handbook of self and identity* (Vol. 1, pp. 197–217). New York: The Guilford Press.

Bourdeaudhuij, I. D., Sallis, J. F., & Saelens, B. E. (2003). Environmental correlates of physical activity in a sample of Belgian adults. *American Journal of Health Promotion*, *18*, 83–92.

Brawley, L. R., Rejeski, W. J., & King, A. C. (2003). Promoting physical activity for older adults: The challenges for changing behavior. *American Journal of Preventive Medicine*, *25*, 172–183.

Burnett, P. (1978). Time cognition and urban travel behavior. *Human Geography*, *60*, 107–115.

Butler, G. P., Orpana, H. M., & Wiens, A. J. (2006). By your own two feet—factors associated with active transport in Canada. *Canadian Journal of Public Health*, *98*, 259–264.

Crawford, F., Mutrie, N., & Hanlon, P. (2001). Employee attitudes towards active commuting. *International Journal of Health Promotion and Education*, *39*, 14–20.

Ducharme, K. A., & Brawley, L. A. (1995). Predicting the intentions and behavior of exercise initiates using two forms of self-efficacy. *Journal of Behavioral Medicine*, *18*, 479–497.

Duncan, M. J., & Mummery, K. W. (2007). GIS or GPS? A comparison of two methods to assess route taken during active transportation. *American Journal of Preventive Medicine*, *33*, 51–53.

Environment Canada. (2010). *Canadian climate normals 1971–2000*. Retrieved May 28, 2010, from www.climate.weatheroffice.gc.ca/climate_normals/index_e.html.

Forsyth, A., Oakes, M., Lee, B., & Schmitz, K. H. (2009). The built environment, walking and physical activity: Is the environment more important to some people than others. *Transportation Research Part D*, *14*, 42–49.

Fridlund Dunton, G., & Schneider, M. (2006). Reliability and validity of a scale to measure self-efficacy to overcome barriers to walking for transportation. *Journal of Physical Activity and Health*, *3*, 48–58.

Fuji, S., Gärling, T., & Kitamura, R. (2001). Changes in drivers' perception and use of public transportation: Effects of temporary structural change on cooperation in a real-life social dilemma. *Environment and Behavior*, *33*, 796–808.

Golledge, R. G., & Stimson, R. J. (1997). *Spatial behavior: A geographic perspective*. New York: The Guilford Press.

Hart, R. A., & Moore, G. T. (1973). The development of spatial cognition: A review. In R. M. Downs & D. Stea (Eds.), *Image and environment: Cognitive mapping and spatial behavior* (pp. 246–288). Chicago, IL: Aldine.

Health Canada. (2003). *Canadian guidelines for body weight classification in adults*. Retrieved October 30, 2009 from http://www.hc-sc.gc.ca/fn-an/nutrition/weights-poids/guide-ld-adult/index-eng.php.

Heath, G. W., Brownson, R. C., Kruger, J., Miles, R., Powell, K. E., & Ramsey, L. T. (2006). The effectiveness of urban design and land use and transport policies and practices to increase physical activity: A systematic review. *Journal of Physical Activity and Health*, *3*, S55–S76.

von Huth Smith, L., Borch-Johnsen, K., & Jørgensen, T. (2007). Commuting physical activity is favorably associated with biological risk factors for cardiovascular disease. *European Journal of Epidemiology*, *22*, 771–779.

Lemieux, M., & Godin, G. (2009). How well do cognitive and environmental variables predict active commuting? *International Journal of Behavioral Nutrition and Physical Activity*, *6*, 12.

Lloyd, R. (1997). *Spatial cognitions: Geographic environments*. Boston, MA: Kluwer Academic Publishers.

MacDougall, C. (2007). Reframing physical activity. In H. Keleher, C. MacDougall, & B. Murphy (Eds.), *Understanding health promotion* (pp. 326–342). New York: Oxford University Press.

Maddux, J. E., & Gosselin, J. T. (2003). Self-efficacy. In M. R. Leary & J. P. Tangney (Eds.), *Handbook of self and identity* (pp. 218–238). New York: The Guilford Press.

McAuley, E., & Mihalko, S. L. (1998). Problems in assessing perceived barriers to exercise: Confusing obstacles with attributions and excuses. In J. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp. 371–381). Morgantown, WV: Fitness Information Technology.

McAuley, E., Pena, M. M., & Jerome, G. (2001). Self-efficacy as a determinant and an outcome of exercise. In G. C. Roberts (Ed.), *Advances in motivation in sport and exercise* (pp. 235–261). Champaign, IL: Human Kinetics.

McCormack, G. R., Cerin, E., Leslie, E., Du Toit, L., & Owen, N. (2008). Objective versus perceived walking distance to destinations: Correspondence and predictive validity. *Environment and Behavior*, *40*, 401–425.

Merom, D., Bauman, A., Phongsavan, P., Cerin, E., Kassis, M., Brown, W., et al. (2009). Can a motivational intervention overcome an unsupportive environment for walking: Findings from the step-by-step study. *Annals of Behavioral Medicine*, *38*, 137–146.

Nunnally, J. C. (1978). *Psychometric theory*. Toronto, ON: McGraw-Hill Book Company.

Owen, N., Humpel, N., Leslie, E., Bauman, A., & Sallis, J. F. (2004). Understanding environmental influences on walking: Review and research agenda. *American Journal of Preventive Medicine*, *27*, 67–76.

Poag-DuCharme, K. A., & Brawley, L. R. (1993). Self-efficacy theory: Use in the prediction of exercise behavior in the community setting. *Journal Applied Sport Psychology*, *5*, 178–194.

Rietveld, P., Zwart, B., van Wee, B., & van den Hoorn, T. (1999). On the relationship between travel distance and travel time of commuters. *The Annals of Regional Science*, *33*, 269–287.

Saelens, B. E., Sallis, J. F., Black, J. B., & Chen, D. (2003). Neighborhood-based differences in physical activity: An environment scale evaluation. *American Journal of Public Health*, *93*, 1552–1558.

Saelens, B. E., Sallis, J. F., & Frank, L. D. (2003). Environmental correlates of walking and cycling: Findings from the transportation, urban design and planning literatures. *Annals of Behavioral Medicine*, *25*, 89–91.

Sallis, J. F., Cervero, R. B., Archer, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health*, *27*, 297–322.

Shannon, T., Giles-Corti, B., Pikora, T., Bulsara, M., Shilton, T., & Bull, F. (2006). Active commuting in a university setting: Assessing commuting habits and potential for modal change. *Transport Policy*, *13*, 240–253.

Statistics Canada. (2001). *Where Canadians work and how they get there*, Retrieved October 30, 2009, from www12.statcan.ca/english/census01/products/highlight/Pow/RetrieveTable.cfm?Lang=E&T=601&GH=4&D1=1&D2=1&SC=1&S=99&O=A.

Tabachnik, B. G., & Fidell, L. S. (2006). *Using multivariate statistics* (5th ed.). Boston, MA: Pearson/Allyn & Bacon.

Titze, S., Stronegger, W. J., Janschitz, S., & Oja, P. (2008). Association of built-environment, social-environment and personal factors with bicycling as a mode of transportation among Austrian city dwellers. *Preventive Medicine*, *47*, 252–259.

Wagner, A., Simon, C., Ducimetiere, P., Montaye, M., Bongrad, V., Yarnell, J., et al. (2001). Leisure-time physical activity and regular walking or cycling to work are associated with adiposity and 5y weight gain in middle-aged men: The PRIME study. *International Journal of Obesity*, *25*, 940–948.

Woodgate, J., Brawley, L. R., & Weston, Z. J. (2005). Maintenance cardiac rehabilitation exercise adherence: Effects of task and self-regulatory self-efficacy. *Journal of Applied Social Psychology*, *35*, 183–197.