

Cycling Under Influence: Summarizing the influence of attitudes, habits, social environments and perceptions on cycling for transportation

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For Citation please use: Willis, D., Manaugh, K., & El-Geneidy, A. (2013). *Cycling Under Influence: Summarizing the influence of attitudes, habits, social environments and perceptions on cycling for transportation*. Paper accepted for presentation at the 92nd Transportation Research Board Annual Meeting, Washington D.C., USA.

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ABSTRACT

Due to cycling's many benefits, research on factors that could increase this activity has greatly expanded. Clear connections have been found between elements of the built environment and cycling for transportation. However, social and psychological factors, such as attitudes, perceptions, and habits, have recently been shown to play an important role in affecting travel behaviour and mode choice. This review paper sets out to summarize the literature concerning the influence of these social and psychological factors on the choice to cycle for transportation. The findings highlight the importance of these factors on bicycle commuting; implications for policy are presented.

1 INTRODUCTION

Many studies have sought to identify the factors that affect bicycle use for transportation. Several of these studies have focused on objectively measured elements of the built environment (e.g., design of bicycle routes, connectivity of the road network, density, land use mix), and socio-economic and demographic factors (e.g., age, gender, income, education). While there exists a demonstrated correlation between certain aspects of the built environment and the decision to cycle for transportation (Dill and Carr 2003; Nelson and Allen 1997), improvements to the built environment may not be sufficient. Further, although gender (Heinen, Maat, and van Wee 2011), income (2010; 2006), car ownership

(2011; 2006) and education level (Xing, Handy, and Mokhtarian 2010) are correlated with bicycle commuting, they are not the only determinants of travel mode. There are other factors that influence the decision to cycle. The current work presents a review of the literature about those other factors - including attitudes and perceptions; social norms, work environments and neighbourhoods; attitudes and behaviours of family, friends and colleagues; and habits - and their impact on the decision to cycle for transportation. The next section offers a brief summary of other review papers on cycling. Following this section, relevant theories and models are explained, followed by the methods used and the results. The final section will offer a brief discussion about the methodologies used in the mentioned studies and the implications of these findings for increasing bicycle mode share.

2 BACKGROUND

2.1 Cycling Review Papers

Several review papers have examined bicycle commuting, although none of them have focused exclusively on the effects of attitudes, habits, social-environment factors, and perceptions on bicycle commuting. Panter and Jones (2010) reviewed peer-reviewed articles written between 1990 and 2009 about environmental and psychological influences on bicycle commuting. They found 43 relevant articles that both applied psychological theories to travel behaviour and also explored influences of the social and physical environment on cycling. The authors did not explicitly distinguish between perceived physical environment and objectively measured physical environment and they examined “active travel”, grouping together walking and cycling. They conclude their

review with a list of suggested components and measures to be included in future studies. Handy et al. (2002) reviewed the effect that the built environment has on travel behaviour and physical activity. The paper offers a summary of the various components of the built environment and how they are measured. It concludes that while walking and cycling have been successful as forms of exercise, they have been much less successful as modes of transportation. The authors emphasize the importance of changing the built environment and they focus on design, land use and transportation systems to promote active travel.

Pucher et al. (2010) reviewed both peer-reviewed and non-peer reviewed papers on the effect of interventions on bicycling. They included only papers on bicycling in the review (excluded papers that group walking and cycling together) and considered travel-related infrastructure, parking and end-of-trip facilities, transit integration, programs and legal interventions, to increase cycling and bicycle access. They conclude with a section of case studies of cities that have implemented various programs and policies to increase cycling. They note that the methods used for most of the studies were not rigorous and did not involve an ideal research design (e.g., they had no “control” and “treatment” groups and thus were unable to control for other relevant factors). Further, many of these studies were not peer-reviewed. They suggest that public agencies implementing interventions for cycling should collect data before and after interventions, to facilitate the analysis of the effectiveness of these changes, and should work with academic researchers. Also, the development of standardized instruments to measure bicycling would facilitate data collection. They conclude that the discussed interventions seem to have increased bicycling to varying degrees, but that these increases are not usually large.

The need to combine interventions with policies and programs, land use planning and restrictions on car use is emphasized. While they promote a multi-pronged approach, they do not consider the importance of attitudes, habits, social environments and perceptions on cycling outcomes. In the same year, Yang et al. published a similar review paper about interventions to promote cycling (Yang et al. 2010).

Heinen et al. (2009) performed a comprehensive overview of the literature on correlates of bicycle commuting. They divided the paper into five sections: built environment; physical environment; socio-economic variables; psychological factors (including attitudes); and time, cost, effort and safety. Their section on psychological factors included attitudes, social norms and habits and they concluded that while only a limited amount of research has been done on the relationships between attitudes, norms and cycling, it may be the case that attitudes play a significant role in the decision to bicycle.

Review papers have also explored walking and bicycling to school (Sirard and Slater 2008), the effect of transportation infrastructure on bicycling injuries and crashes (Reynolds et al. 2009), attitudes about walking and cycling among children, young people and parents (Lorenc et al. 2008), and environmental correlates of walking and cycling (Saelens, Sallis, and Frank 2003).

This paper intends to review the literature that focus on attitudes, habits, social-environment factors and perceptions that affect cycling behaviour. The goal is to summarize what is known about the effect of these factors on the decision to cycle for transportation and the methods being used to measure these effects. The next section offers a discussion of the major theoretical models used in travel behaviour research.

Next, we will present the methods used for the literature review, followed by the results section, which is divided into four sections: 1) Attitudes, 2) Habits, 3) Social-environment factors and 4) Perceptions. The final section will discuss these findings, the methodologies used, the implications for increasing bicycle mode share, the gaps in the research, and paths for future research.

2.2 Theories and Models

The most influential theoretical models for travel behaviour that have been applied to active transportation are the Theory of Planned Behaviour (Ajzen 1991) and the Social-Ecological Model (Banks-Wallace 2000, for example; Stokels 1996). These models are summarized briefly in the following sections.

2.2.1 Theory of Planned Behaviour

An often-cited framework used to understand behaviour is the Theory of Planned Behaviour (Ajzen 1991). This theory posits that the most important factor influencing an individual's behaviour is their intention to perform that behaviour. That is to say, how hard they are willing to try. Intention to perform behaviour is itself affected by three factors, conceptually independent of each other: the individual's attitude toward the behaviour, the subjective norm, and the degree of perceived behavioural control. Their attitude toward the behaviour can be favourable or unfavourable; the subjective norm can be pressure to perform the behaviour or pressure to not perform the behaviour; and the perceived behavioural control refers to the perception of the ease of difficulty to perform the behaviour.

2.2.2 *Social-Ecological Model*

Much work on travel behavior is modeled in a random utility maximization framework, which deliberately places all matters related to personal preferences, motivations, and values in the error term (35). In recent years, however, the effect of such variables are often explicitly brought into the research framework and modeled in statistical analysis. For example, the Hybrid Choice Model, developed by Ben-Akiva and colleagues (Ben-Akiva et al. 2002), takes into account perceptions and attitudes and uses more flexible error structures to better model the realism of choice models.

These dynamic relationships are at the core of the social-ecological model, which situates an individual in a series of interrelated and nested contexts. This includes such aspects as cultural and national norms, family obligations and customs, and neighborhood standards, as well as personal expectations and desires. This approach is inherently dynamic and multivariate: that is, the unique assortment of factors ensures that their effects are differentially experienced. An important strength of socio-ecological frameworks is the ease with which attitudes, perceptions, and cultural forces can be incorporated.

Alfonzo (2005) applies the social-ecological model to the decision to walk. The decision has antecedents, mediators, inter-processes and multiple outcomes. Within this model, the built environment is critical in that environmental factors are antecedents to walking. However, they alone do not determine the decision to walk. The decision is also influenced by the *perceived* environmental factors. Thus Alfonzo distinguishes between the built environment objectively measured and subjectively perceived. There are also

inter-processes, and this includes the social-environment (“group-level”) and individual (“individual-level”) factors. Here, Alfonzo also includes regional-level factors such as geography, climate and topography. Together, measured and perceived environmental factors, and inter-processes (moderators), including the individual-level, the group-level and the regional-level, influence the choice of mode.

3 RESEARCH FRAMEWORK

This paper will review research that considers the effect of social and psychological factors on the decision to cycle for transportation. As mentioned above, many studies have examined associations between built environment, active travel, and personal factors (socio-economic and demographic characteristics). The associations between these factors and the decision to cycle have been established and reviewed and the objective of the present work is to review the papers that associate attitudes, habits, social environment factors and perceptions with bicycle commuting, as in the third diagram in **Figure 1**. **Figure 1** represents the three kinds of empirical studies on cycling behavior: 1) studies that consider only elements of the physical environment as correlates of active travel, 2) Studies that consider both physical environment elements and personal factors as correlates of active travel, and 3) Studies that consider physical environment elements and personal factors as well as social and psychological factors in the decision to cycle

for transportation. Only the latter group of studies are reviewed herein.

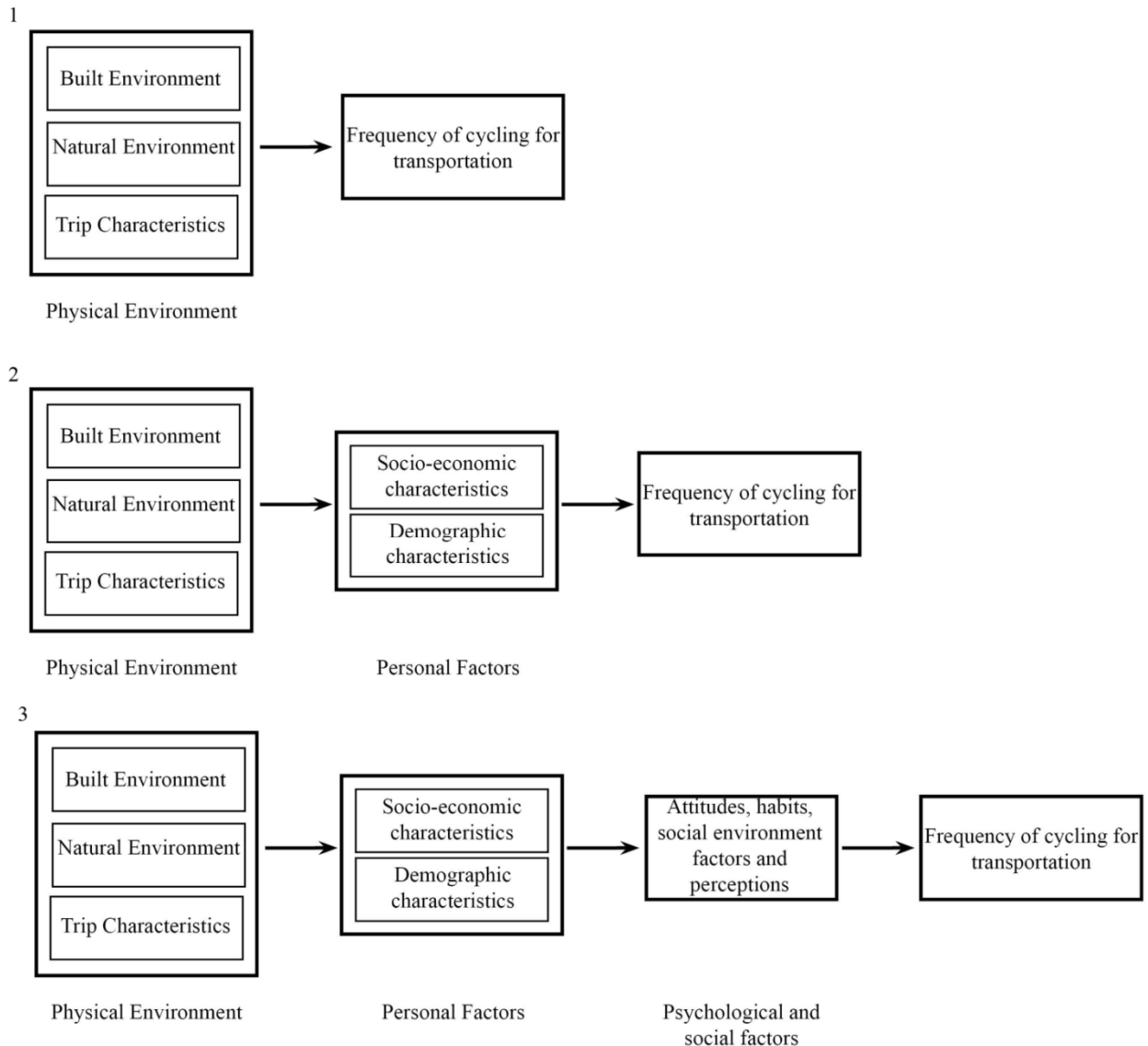


Figure 1: **Representation of the different types of research regarding correlates of cycling for transportation**

4 METHODS

This review examines quantitative (as well as a smaller number of qualitative), peer-reviewed articles about cycling for transportation (or “active transportation” when it includes cycling) that consider the effect of attitudes, habits, social-environment factors

and perceptions on the decision to cycle for transportation. Papers were found through an extensive search which made use of three sources: Google Scholar, Web of Science and Science Direct. Search terms included “cycling”, “active transportation”, “active commuting”, “bicycle commuting”, “attitudes”, “perceptions”, “social environment”, “bicycle use” and “preferences”. The authors combed through the references of each paper to find more relevant papers, and used Google Scholar to search papers that cited each relevant paper. Through this method nearly 60 papers were found. After further examination, 28 papers were deemed relevant to the research topic and are referred to in the following results section.

5 RESULTS

The 28 relevant papers featured in this review were published between 2006 and 2012. **Table 1** summarizes the findings for attitudes, habits, social-environment factors and perceptions, and their association with commuting by bicycle, and the sections that follow offer an expanded discussion of these findings.

5.1 ATTITUDES

In a recent review paper on attitudes in research on travel behaviour, Bohte et al. (Bohte, Maat, and van Wee 2009) define attitudes according to the definition given by Eagly and Chaiken (Eagly and Chaiken 1993): “an attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour”.

Eight articles were found that cited attitudes as correlates of bicycling for transportation. Attitudes found to positively influence bicycle transportation were concern for the environment (Dill and Voros 2006; Bopp, Kaczynski, and Wittman 2011; Handy, Xing, and Buehler 2010), enjoyment of cycling (Dill and Voros 2006; Handy and Heinen 2012; Handy, Xing, and Buehler 2010; Xing, Handy, and Mokhtarian 2010; Heinen, Maat, and van Wee 2011; Gatersleben and Uzzell 2007) and dislike for driving (Dill and Voros 2006; Handy and Heinen 2012; Xing, Handy, and Mokhtarian 2010). Attitudes found to negatively influence bicycle transportation were enjoying driving (Xing, Handy, and Mokhtarian 2010), enjoying walking (Handy, Xing, and Buehler 2010), the belief that driving is a symbol of independence and freedom (Jensen 1999) and the belief that a car is necessary to do activities that an individual enjoys (Handy, Xing, and Buehler 2010). The following section will elaborate on these attitudinal effects.

5.1.1 CONCERN FOR THE ENVIRONMENT (ECO-FRIENDLY ATTITUDES)

Dill and Voros (2006) found a relationship between environmental values and cycling. Individuals in their random phone survey in Portland, Oregon who thought air quality was a problem, those who tried to limit their driving to improve the air quality, and those who thought that the region did not need to build more highways were more likely to be regular or utilitarian cyclists. Using an online cross-sectional survey, Bopp and colleagues (2011) studied the association between eco-friendly attitudes and variables related to active commuting. They found that eco-friendly attitudes were positively related to active commuting, and that respondents in the highest quartile of eco-friendly attitudes were significantly more likely than other respondents to actively commute,

made fewer trips to work by car and reported greater cycling self-efficacy. Further, eco-friendly attitudes were positively correlated with motivators for active commuting and negatively correlated with barriers to active commuting. Handy et al. (2010) also found that those with higher levels of environmental concern were more likely to bike regularly for transportation.

5.1.2 ATTITUDE TOWARDS CYCLING

In the above-mentioned survey, Dill and Voros (2006) found that the more individuals like to ride a bicycle and the more positive their views about bicycling are, the more likely they are to be regular or utilitarian cyclists. Similarly, using an internet survey measuring the differences in attitudes between cyclists and non-cyclists in the Netherlands, Heinen et al. (2011) found that the more positively people viewed cycling the more they cycled. Thus, cyclists have a more positive view of cycling than do non-cyclists and full-time cyclists have a more positive view of cycling than do part-time cyclists. They also found that the longer the commute, the more positive views on cycling were. In another online survey, in six small American cities, Xing et al. (2010) found that respondents who stated that they like to cycle were more likely to cycle for transportation and that enjoyment levels were positively related to distance cycled.

In a qualitative study consisting of 31 in-depth interviews in Davis, California and Delft, Netherlands, Handy and Heinen (2012) found that enjoyment of cycling is the most significant predictor of cycling. Not surprisingly, non-cyclists more often dislike cycling. Enjoyment is particularly important for long trips.

TABLE 1: A Summary of the Effect of Attitudes, Habits, Social Environment Factors and Perceptions on Commuting by Bicycle

FACTORS		Association with commuting by bicycle (Number of studies finding relationship)		
		Negative	None/ Inconclusive	Positive
ATTITUDES				
Concern for the environment	“Environmental attitudes”; “Eco-friendly attitudes”; “Environmental concern”			3
Enjoy cycling	“Like to ride a bicycle”, “Positive views of cycling” “Pleasant commute”			7
Attitude toward other modes				
Driving	Dislike or limit driving			3
	Enjoy driving	1		
	Driving is a symbol of independence and freedom	1		
	Sense that s/he needs a car to do what s/he likes to do	1		
Walking	Enjoy walking	1		
HABITS				
Cycled in the past	Cycled as a child, for fun			1
	Cycles regularly			1
Contemplation	Has never contemplated cycling	1		
SOCIAL ENVIRONMENT				
Subjective norm	Positive subjective norm for cycling; “Cycling is normal”; Community positive reactions to cycling			4
	Positive subjective norms for driving; Positive descriptive norms for driving; Strong intention to drive	1		
	Community supportive to bicycling			1
	Community pressure not to cycle	1		
Neighbourhood effects	Parental perception that there are not many children in the neighbourhood	1		
	Perception that there are adults cycling on their street more than once per week			1
	Perception that the community is cycling-oriented			1
	Parental perception that there is a sense of community in neighbourhood			1

		Association with commuting by bicycle (Number of studies finding relationship)		
		Negative	None/ Inconclusive	Positive
SOCIAL ENVIRONMENT (continued)				
	Child perception that the neighbourhood is safe			1
	Children cycle in the neighbourhood for fun	1		
FAMILY AND FRIENDS				
Parental attitudes	Parent perception that it is more convenient to drive children to school, that parents are around to bring their children to school	1		
Parental encouragement	Parental encouragement to bike to school			3
Friends encouragement	Encouragement from friends to cycle			3
Parental behaviour	Parents use active transportation to get to work			1
Friends behaviour	Friends use active transportation			2
Work	Part-time (vs. full-time)			1
	Casual dress (vs. formal/business attire)			1
	Work during the day (vs. night)			2
	Transport objects to work	1		
	Need to drive during the day	1		
	Need to bike during the day			1
	Work for government/education sector			1
	Own companies/volunteer			1
Work culture	Co-workers that cycle to work			1
	Co-workers that expect individual to bike to work			1
	Co-workers that expect individual to drive	1		
	Free parking spot/free transit pass	1		
PERCEPTIONS				
Perceived benefits of cycling	Health and fitness			2
	Direct benefits (time, comfort, flexibility)			1
	Perceive environmental benefits		2	1

	Perceive a lot of benefits			1
Perceived barriers to cycling	Motor vehicle traffic	2		
	Lack bicycle lanes/safe places to cycle/facilities	2		
	Distance - too long	2		
	Distance - too short	1		
	No bicycle	1		
	Bad weather	3		
	Need to carry objects	1		
Association with commuting by bicycle (Number of studies finding relationship)				
PERCEPTIONS (continued)		Negative	None/ Inconclusive	Positive
	Clothing/Sweating	2		
	Time	1		
Perception of cyclists	Cyclists are regular people ("hippy-go-lucky"/"commuter" cyclists)			1
	Cyclists are athletic, professional, require special equipment ("lifestyle" cyclists)	1		
	"Cyclists are too poor to own a car"	1		
Perceived safety	Parental perception of risk to children's safety en route to school	1		
	Parental perception of dangerous traffic on child's route to school	1		
	Perception that "cyclists have little regard for safety"			1
	Perceived risk from traffic	1		
Perceived ability to cycle	"Perceived behavioural control"			1
	Comfort with bicycling			1
	Physical discomfort with bicycling	1		
	External self-efficacy			1
	Confidence cycling		1	1
	Cycling is something other people do	1		
	Feasibility of cycling			1
Perceived efficiency of cycling	Time: Perceived time to cycle to destination	1		
	Speed: Cycling perceived as rapid			1
	Cycling is impractical	1		

Gatersleben and Appleton (2007) grouped respondents to their online survey of members of the University of Surrey, United Kingdom, into phases of cycling, from “pre-contemplation” to “maintenance”, based on how often they used a bicycle to get to work and whether they had contemplating cycling to work. They found that regular cyclists (“maintenance”) had the most positive attitudes towards cycling, followed by occasional cyclists, and that those who had never contemplated cycling had the least positive attitudes towards cycling. Using the same survey, Gatersleben and Uzzell (2007) found that cyclists perceived their commute as more pleasant than did other mode users. They divided modes according to whether they were arousing or not arousing and pleasant or unpleasant. Driving was considered arousing but unpleasant; walking was pleasant but unarousing; transit was both unarousing and unpleasant; whereas cycling was pleasant and arousing.

5.1.3 ATTITUDES TOWARDS OTHER MODES

In a study that combined qualitative methods (in-depth interviews) and quantitative methods (phone survey) to identify six mobility types (three of car drivers and three of cyclists/transit users), Jensen (1999) found that while car drivers are the most likely to perceive the automobile as a symbol of independence and freedom, individuals who cycle or use transit out of necessity are more likely to perceive the car as a symbol of independence and freedom than are those who are motivated by convenience or enjoyment of these modes. This makes sense, as Jensen emphasizes that these cyclists and public transit users are doing so only because they do not have access to a car and

that as soon as they are able to drive they intend to. This study is problematic, however, as Jensen groups cyclists and public transit users together. These are very different modes of transportation, each offering its own benefits and constraints.

Using the same survey as Xing et al. (2010), Handy et al. (2010) found that those who agreed that they need a car to do what they enjoy doing and those who stated they like walking are less likely than others to cycle regularly. Also, simply enjoying driving decreases the likelihood of cycling for transportation (Xing, Handy, and Mokhtarian 2010). It seems that disliking driving has a positive effect on cycling. Dill and Voros (2006) and Handy and Heinen (2012) found that respondents who dislike driving are more likely to cycle for utilitarian purposes and Xing et al. (2010) found that those who prefer to limit their driving were more likely to cycle for transportation.

5.2 HABITS

In her Theory of Interpersonal Behaviour, Triandis (Triandis 1977) defines habits as “situation-specific sequences that are or have become automatic, so that they occur without self-instruction”. Three papers discuss the effect of habits on the decision to cycle for transportation. Individuals who have a habit of cycling are more likely to cycle in the future. Gatersleben and Appleton (2007) found that individuals who had never contemplated cycling have the least positive attitudes towards cycling. Dill and Voros (2006) found that individuals who bicycled for leisure as children were more likely to cycle as adults. Finally, Gatersleben and Haddad (2010) found a strong relationship between past bicycling behaviour and intentions to cycle.

5.3 SOCIAL-ENVIRONMENT

Thirteen papers referred to social-environmental factors, such as the subjective norm (Eriksson and Forward 2011; Handy and Heinen 2012; Heinen, Maat, and van Wee 2011; Xing, Handy, and Mokhtarian 2010), the effect of the neighbourhood (Timperio et al. 2006; Dill and Voros 2006; Xing, Handy, and Mokhtarian 2010; Panter et al. 2010; Handy, Xing, and Buehler 2010), the effect of family and friends (Panter et al. 2010; De Geus et al. 2008; Titze et al. 2008) and the effect of the workplace (Dill and Voros 2006; Engbers and Hendriksen 2010; Heinen, Maat, and van Wee 2012, 2009; De Geus et al. 2008) on the decision to cycle for transportation.

5.3.1 SUBJECTIVE NORM

Subjective norm is one part of the Theory of Planned Behaviour and refers to “the perceived social pressure to perform or not to perform a behaviour” (Ajzen 1991). Four papers featured the effect of subjective norms. Positive subjective norms for cycling (Eriksson and Forward 2011; Handy and Heinen 2012; Heinen, Maat, and van Wee 2011; Xing, Handy, and Mokhtarian 2010) and a community supportive of cycling (Xing, Handy, and Mokhtarian 2010) are positively associated with bicycle commuting, while positive subjective and descriptive norms for driving, the intention to drive (Eriksson and Forward 2011) and community pressure not to cycle (Handy and Heinen 2012) are negatively associated to bicycle commuting.

Heinen et al. (2011) found that subjective norm was only important for short bicycle trips. Using a mail-out questionnaire completed by 620 people in Sweden, Eriksson and Forward (2011) found that while many respondents had strong *subjective*

norms of cycling (i.e., that they believe their friends and family would support them cycling), they did not have strong *descriptive* norms for cycling (i.e., their friends and family do not themselves cycle for transportation). At the same time, the subjective and descriptive norms of driving were both strong, as individuals believe their friends and family support driving and do in fact drive themselves. They also found a strong intention of respondents to drive and that this intention to drive is associated with a weak intention to use the bus or cycle.

Xing et al. (2010) found that if individuals consider that cycling is normal they are more likely to cycle. Similarly, Heinen and Handy (2012) found that cyclists feel pressure in certain situations not to cycle, but that they do sometimes perceive positive reactions to cycling from their communities.

5.3.2 NEIGHBOURHOOD EFFECTS

The effect of the neighbourhood social environment on bicycle commuting was featured in five papers. The effect of an individual's neighbourhood was found to significantly impact rates of cycling in several studies. Timperio et al. (2006) administered a questionnaire to parents and children in Melbourne, Australia and found that when parents perceived that there were not many children around the neighbourhood, their 5-6 year olds and 10-12 years olds had lower odds of walking or cycling to school. Xing et al. (2010) found that respondents who perceive that their community has a cycling-oriented culture are more likely to cycle. Dill and Voros (2006) found that when individuals see adults cycling on their street more than once per week they are more likely to cycle regularly. In a survey of parents and children in the United Kingdom, Panter et al. (2010)

found that when parents perceived a neighbourhood sense of community, their children were more likely to cycle to school for distances of less than 2 km. Finally, the perception that children cycle in the neighbourhood for fun is negatively associated to cycling for transportation (Handy, Xing, and Buehler 2010).

5.3.3 FAMILY AND FRIENDS

Three articles found that the attitudes, encouragement, and behaviour of friends and family are associated with cycling for transportation (Panter et al. 2010; De Geus et al. 2008; Titze et al. 2008). Parental attitudes and behaviour have an effect on children's cycling behaviour. Panter et al. (2010) administered a cross-sectional survey measuring parents' and children's perceptions of the physical environment and safety. They found that when parents considered it more convenient to drive their children to school or when they were around to bring their children to school, children were less likely to walk or cycle to school. Further, they found that children are more likely to use active transportation to get to school if their parents use active transportation to get to work or if their friends or parents encouraged them to cycle. Overall, people who have relatives who cycle or encourage them to cycle are more likely to cycle themselves (De Geus et al. 2008; Titze et al. 2008).

5.3.4 WORK, WORKPLACES AND COLLEAGUES

Cycling for transportation largely entails cycling to work. The work environment, responsibilities of the job and the influence of colleagues are all therefore important

factors in the decision to cycle. Four articles found that an individual's work and work culture influence the decision to cycle (Dill and Voros 2006; Engbers and Hendriksen 2010; Heinen, Maat, and van Wee 2012, 2009).

5.3.5 Work

The type of work that individuals do, their work schedule, and job-specific requirements (special attire, the transport of objects to work or for work, travel during working hours) all influence the decision to cycle to work. Part-time work (Engbers and Hendriksen 2010), casual attire (Heinen, Maat, and van Wee 2012), daytime work hours, (Heinen, Maat, and van Wee 2012, 2009) the need to bike during the workday, working for the government or the education sectors, owning a company or being a volunteer (Heinen, Maat, and van Wee 2012) are positively associated with bicycle commuting. The need to drive during the workday and the need to transport objects (Heinen, Maat, and van Wee 2012) are negatively associated with bicycle commuting. Heinen et al. (2009) surveyed employees and residents of two cities and two rural municipalities in the Netherlands. They found that work-related issues do impact the decision to cycle. In particular, a person who dresses casually to go to work has more positive views towards cycling, while those who wear suits or other formal attire to work have less positive views towards cycling. Employees who work at night are less likely to cycle for transportation, owing to safety concerns. They also found that the more hours individuals work, the less likely they are to cycle to work. Similarly, using an internet survey of 799 Dutch employees, Engers and Hendrikson (2010) found that people who work full-time are less likely to cycle to work than those who work part-time. Needing to transport objects to

work and needing a car during working hours decreases likelihood to be a full-time cyclist (Heinen, Maat, and van Wee 2012). Correspondingly, a person who needs to bike during working hours is more likely to be a full-time cyclist (Heinen, Maat, and van Wee 2012). People who have two work locations are less likely to commute by bicycle than those who work in one location (Heinen, Maat, and van Wee 2012). Finally, individuals who work in the government or education sectors are more likely to be full-time cyclists than other sectors, as are those who own their own companies or do volunteer work (Heinen, Maat, and van Wee 2012).

5.3.6 Work culture

Three studies found that an individual's co-workers and the general culture at work have an effect on their travel behaviour. Dill and Voros (2006) found that 32% of individuals who have co-workers that cycle to work are regular cyclists. Individuals are more likely to commute to work by bicycle if their colleagues expect it (Heinen, Maat, and van Wee 2012). Likewise, if they are expected to drive, they are less likely to cycle (Heinen, Maat, and van Wee 2009). Finally, when employers provide parking spaces or transit passes employees are less likely to cycle to work (Heinen, Maat, and van Wee 2012).

5.4 PERCEPTIONS

This section considers perceptions about benefits and barriers, safety, time, and cyclists, using the definition of perceptions offered by Ben-Akiva et al.: “the individual's beliefs

or estimation of the attributes of the alternatives” (Ben-Akiva et al. 1999). Alfonzo (Alfonzo 2005) emphasizes the role of individual perceptions in the “Hierarchy of Walking Needs”, explaining how different people will experience the same setting or conditions in drastically different ways, depending on their own needs. This emphasizes the difference between the objectively-measured built environment and the perception of the built environment, and conveys the importance of the latter in determining travel choice.

Fifteen papers discuss effects of perceptions on the decision to cycle for transportation, including that perceptions about ability to cycle (2008; 2006; Gatersleben and Appleton 2007; Whannell, Whannell, and White 2011; 1991; 2005; 2010; 2008), benefits of cycling (Engbers and Hendriksen 2010; Shannon et al. 2006; Heinen, Maat, and van Wee 2011; Handy and Heinen 2012; Gatersleben and Appleton 2007; De Geus et al. 2008), barriers to cycling (Dill and Voros 2006; Handy and Heinen 2012; Whannell, Whannell, and White 2011; Engbers and Hendriksen 2010; Titze et al. 2007), cyclists (Gatersleben and Haddad 2010; Handy, Xing, and Buehler 2010), safety (Panter et al. 2010; Handy, Xing, and Buehler 2010; Handy and Heinen 2012), and time (De Geus et al. 2008; Titze et al. 2008),

5.4.1 PERCEIVED ABILITY TO COMMUTE BY BICYCLE: Self-efficacy, comfort and confidence

An individual’s perceived ability to cycle for transportation has been found by a number of studies to be significant in the decision to cycle for transportation. It appears in both Ajzen’s Theory of Planned Behaviour (1991) and Alfonzo’s Hierarchy of Walking

Needs. Ajzen refers to it as perceived behavioural control, one's perceived ability to perform a behaviour, while Alfonzo (2005) includes it in the base of the pyramid, under "feasibility".

An individual's cycling comfort level cycling has been found a significant factor in cycling for transportation. Xing et al. (2010) found that comfort while cycling increased bicycle use for transportation and miles cycled per week. Similarly, using a computer-assisted phone survey in Austria, Titze et al. (2008) found that physical discomfort associated with cycling was negatively related to cycling for transportation.

Self-efficacy and confidence in one's ability to cycle have also been found to be significant in the decision to cycle for transportation. Using a mail-out questionnaire filled out by 343 Dutch workers, De Geus et al. (2008) found that respondents reporting high levels of external self-efficacy, meaning their confidence cycling is not affected by external obstacles such as bad weather or having to carrying items from shopping trips, are more likely to take their bicycle for transportation. In an online survey of 1040 students and 1170 staff at an Australian university, Shannon et al. (2006) found that cyclists who are confident that they can bike to work are more likely to do so.

The inability to imagine oneself as a cyclist and the idea that cycling is something that other people do, is a barrier to cycling (Gatersleben and Appleton 2007). In fact, Handy et al. (2010) found that people who agreed that "Kids often ride their bikes around my neighbourhood for fun" were less likely to bike for transportation. This is perhaps because they associate bicycling with the children's activity, to be done within the residential area for fun and not for transportation and not by them.

However, one study at a university in Australia found no correlation between the likelihood to cycle and confidence in relation to riding a bicycle (Whannell, Whannell, and White 2011). Nonetheless, this was an in-class survey of just 270 students in a Science, Technology and Society class and is probably not representative of a wider population.

5.4.2 PERCEIVED BENEFITS

Perceiving benefits of cycling for transportation is important in the decision to cycle. In fact, Heinen et al. (2011) found that the more reasons that they cycle a cyclist states, the more likely they are to cycle to work over all distances. People concerned with health and fitness are more likely to cycle for transportation (Engbers and Hendriksen 2010; Shannon et al. 2006; Akar and Clifton 2008), although Heinen (2011) found that the direct benefits to the cyclist are the most important in terms of influencing decision to cycle. They found that cyclists largely base their decision to cycle on matters of time, comfort and flexibility over all distances. De Geus (2008) also found that saving money on travel is a perceived benefit of cycling and likely to lead to more cycling.

Individuals who perceive the environmental benefits of bicycle commuting are more likely to cycle (De Geus et al. 2008). Nonetheless, awareness of the environmental benefits may not be enough to get people to cycle. Gatersleben and Appleton (2007) found that respondents in their online survey seemed to understand the health and environmental benefits of cycling, but this does not necessarily mean they cycle for transportation. This means that there are other constraints, perhaps personal (physical, social or psychological), or external (such as a lack of bicycle lanes and paths or parking

facilities). Handy and Heinen (2012) similarly found that while most people they interviewed perceived the environment and health benefits of cycling, they did not necessarily cycle. This is because while they perceive the benefits, they do not deem them sufficiently important. This leads to their conclusion that attitudes and beliefs are sometimes not enough to overcome constraints to cycling and that emphasis is needed on perceived behavioural control, an individual's perceived ability to perform an action.

5.4.3 PERCEIVED BARRIERS

Non-cyclists perceive more barriers than do cyclists and these barriers are usually different (Gatersleben and Appleton 2007; Handy and Heinen 2012). In fact, individuals who have never contemplated cycling are more likely to perceive personal or physical barriers (e.g. fitness) whereas regular cyclists are more likely to cite specific facilities barriers (e.g. change facilities at work) (Gatersleben and Appleton 2007). Dill and Voros (2006) found that traffic was a barrier for 56% of respondents in their random phone interview in Portland, Oregon, and the absences of bike lanes or trails and safe places to cycle nearby were also mentioned. Handy and Heinen (2012) found that perceived risk to personal safety was a barrier to cycling.

Several other studies have cited barriers to cycling. Whannell et al. (2011) found several barriers to cycling, including distances that are too short or too long, not owning a bicycle, bad weather, the absence of cycling facilities and the need to carry objects. Engers and Hendriksen (2010) found that distance, sweating, weather and time are barriers to cycling. Finally, Titze et al. (2008) found that weather and impractical clothing are barriers.

5.4.4 PERCEPTION OF CYCLISTS

Gatersleben and Haddad (2010) examined the stereotypes held by individuals about cyclists and assessed respondents' intentions to cycle. Their study consisted of a questionnaire exploring views that cyclists and non-cyclists have about the typical bicyclist and the effect that these views have on bicycling behaviour and intentions in the United Kingdom. They found that there were four stereotypes: *responsible cyclists*, *lifestyle cyclists*, *commuting cyclists* and *hippy-go-lucky cyclists*. They found no correlation between stereotypes and general bicycle use. However, cyclists who indicated that they bicycled more frequently in the past two months were more likely to indicate that the typical bicyclist is a hippy-go-lucky cyclist, that is to say a person who uses their bicycle for everyday activities such as shopping, wears normal clothing and owns no special equipment. Also, those who indicated they bicycle more frequently were slightly less likely to indicate that the typical bicyclist is a lifestyle bicyclist, who cycles to stay fit, has expensive equipment and wears specialized clothing. This is to be expected as individuals who cycle more often, to get to work, shopping or other activities, see other non-lifestyle cyclists on the road. Further, respondents were more likely to say they intend to bicycle in the future if they perceived the typical bicyclist as a hippy-go-lucky cyclist or a commuter cyclist. The authors define a commute cyclist as a young professional, often male, who is likely to be assertive, good looking and well-educated, and who commutes to work on the cycle in all kinds of weather. In another study, Handy et al. (2010) found that individuals who agreed that "cyclists are too poor to own a car" were less likely to cycle regularly.

5.4.5 *PERCEIVED SAFETY*

One of the main deterrents to cycling is the perception of risk to personal safety. In a stated preference survey of motivators and deterrents of bicycling, Winters et al. (2011) found that bicycling was significantly deterred by safety risks, especially motorists who do not know how to drive safely around bicycles, bicycle-car collisions, bicycle theft and violent crime when cycling. Heinen and Handy (2012) found that cyclists perceive little to no traffic safety risk, which the opposite is true for non-cyclists.

Safety becomes an even more significant concern when children are involved. Timperio et al. (2006) found that when 10-12 year olds perceived the roads to be unsafe, or when they perceived that their parents perceived the roads to be unsafe or heavy in local traffic, they had lesser odds of walking or cycling to school. Similarly, Panter et al. (2010) found that for trips over 1 km, parental concern about dangerous traffic en route to school was negatively associated with travel by bicycle. For trips under 2 km, parental concern about something happening to their child on the way to school was also negatively associated with travel by bicycle. Further, when children felt it was safe to play in their neighbourhoods during the day, they were more likely to cycle to school.

Most studies focus on the risk to safety from traffic. Heinen et al. (2011) found that there are greater chances of commuting by bicycle when individuals do not consider cycling to be dangerous or perceive any risk associated with traffic or personal safety, although this relationship seems to only exist for trips less than 5km and those more than 10km (not for those trips in between). Xing et al. (Xing, Handy, and Mokhtarian 2010) found that individuals who perceive that cyclists have little regard for personal safety

cycled longer distances. They speculate that this captures the perception that cycling is not a risk to personal safety.

Risk to safety from crime is also significant. In a web-based transport survey at the University of Maryland College Park, Akar and Clifton (2008) found that people who feel safe walking and biking on campus after dark were significantly more likely to walk or cycle.

5.4.6 EFFICIENCY: Time, speed & practicality

Time is an important consideration in the decision to cycle for transportation. A lack of time is the reason given for not cycling to work by many non-cyclists (De Geus et al. 2008). In fact, non-cyclists perceived trips to be longer than did cyclists (Engbers and Hendriksen 2010). This is perhaps because they are not aware of the fastest routes (Engbers and Hendriksen 2010). Time is seen as a deterrent for all types of cyclists in Shannon et al. (2006), although those who were in the “action” stage, meaning they have been cycling on a regular basis for the previous 6 months, and “maintenance” stage, meaning they have been cycling on a regular basis for more than 6 months, were less phased by time.

Titze et al. (2008) found that individuals who perceive cycling as rapid are more likely to cycle for transportation. In the same study, individuals, especially women, who perceived cycling as impractical, either because of bad weather or formal work attire, were less likely to cycle for transportation, while respondents who were active outside of their bicycle commute and perceived that cycling was rapid were more likely to commute by bicycle.

6 DISCUSSION AND CONCLUSION

This section discusses the implications of the findings of articles reviewed in this paper and suggests some ways of increasing bicycle mode share based on what is known about how attitudes, habits, social-environment factors and perceptions influence the decision to commute by bicycle. It should be noted that the authors do not want to imply that built-environment factors play a negligible role in determining mode choice; clearly these factors are vital, as dozens of empirical studies have shown. Furthermore, design characteristics—street and intersection in particular—not only affect mode choice but might also be among the most important element for both comfort and safety. Planners and engineers are continually searching for effective policy and design mechanisms to influence behaviour. Developing a deeper understanding of how attitudes, habits, social environments, and perceptions interact with built form increases the effectiveness of these other measures. Further, Engbers and Hendriksen (Engbers and Hendriksen 2010) found that in environments that are already well-suited to travel by bicycle, such as the Netherlands, the effect of these determinants exceeds that of environmental factors. Further, for places that are not yet bicycle friendly, while the focus may remain on improving facilities and infrastructure in the city for cycling, it must be understood that an individual may still choose not to cycle if they are not confident in their ability to perform the behaviour. Similarly, the influence of the attitudes and behaviours of friends, family and co-workers cannot be understated.

Perhaps the most important lesson from this review is the fact that attitudes, habits, social environment factors and perceptions are integral aspects of travel

behaviour. While there has been a recent increase in these elements in research, two issues remain:

- What are the most effective methodologies to capture and analyse these factors?
- and,
- How can these findings be turned into effective public policy?

While this research does not claim to have answered these questions, it is hoped that the importance of asking these questions has been highlighted. It should be noted that an array of methods have been used to capture social and psychological factors, including in-depth interviews (Handy and Heinen 2012; Jensen 1999), travel diaries (Gatersleben and Appleton 2007), and mail-out, online and in-person surveys and questionnaires (Akar and Clifton 2008; Bopp, Kaczynski, and Wittman 2011; De Geus et al. 2008; Dill and Voros 2006; Engbers and Hendriksen 2010; Eriksson and Forward 2011; Flamm 2009; Gatersleben and Haddad 2010; Gatersleben and Uzzell 2007; Heinen, Maat, and van Wee 2011; Ogilvie et al. 2008; Panter et al. 2010; Parra et al. 2011; Sener, Eluru, and Bhat 2009; Shannon et al. 2006; Stronegger, Titze, and Oja 2010; Timperio et al. 2006; Titze et al. 2008; Jensen 1999). Often combinations of quantitative and qualitative methods are employed (Gatersleben and Appleton 2007; Jensen 1999). At times, sample sizes are quite small (Handy and Heinen 2012) and possibly unrepresentative (Whannell, Whannell, and White 2011). Since the factors to be measured are social and psychological, it is advisable that studies include qualitative components in order to properly capture differences between individuals.

Policies and programs can be implementing using this knowledge. One possible way of increasing cycling mode share would be an information campaign that presents cyclists as regular people, without fancy equipment or training. Gatersleben and Haddad (Gatersleben and Haddad 2010) found that individuals who perceived cyclists as regular people as rather than lycra-clad enthusiasts cycled more frequently in past months. Further, the perceptions that cyclists are too poor to drive (Handy, Xing, and Buehler 2010) and that cycling is a children's activity (Handy, Xing, and Buehler 2010) are negatively associated to cycling. If individuals perceive that adults in their neighbourhood cycle regularly, they are more likely to cycle (Dill and Voros 2006). If cyclists are perceived to be normal people, then anyone can cycle. It is especially important that individuals are comfortable cycling (Xing, Handy, and Mokhtarian 2010; Titze et al. 2008) and although some findings were inconclusive (Whannell, Whannell, and White 2011), it seems that feeling confident cycling is an important factor in the decision to cycle (Shannon et al. 2006).

Another way that cycling mode share may be increased is the creation of a social environment that is supportive of cycling. Positive subjective norms (Heinen, Maat, and van Wee 2011; Eriksson and Forward 2011) and the perception that cycling is normal (Xing, Handy, and Mokhtarian 2010) are associated with cycling, as is the feeling that the community is supportive of cycling (Handy and Heinen 2012; Xing, Handy, and Mokhtarian 2010) or cycling-oriented (Xing, Handy, and Mokhtarian 2010). A more general sense of community is also important (Panter et al. 2010). The school and the workplace are therefore good targets for encouraging bicycle transportation. Employers can encourage cycling by providing secure bicycle storage (De Geus et al. 2008; Heinen,

Maat, and van Wee 2012) and clothes changing facilities (De Geus et al. 2008; Heinen, Maat, and van Wee 2012; Sener, Eluru, and Bhat 2009), as well as eliminating free automobile parking (Heinen, Maat, and van Wee 2012). Schools can play important roles in educating children on how to cycle safely and provide the basis for a lifelong habit.

While this paper focuses on the psychological, social and behavioural influences on the decision to cycle, many of these are related to the built environment. For instance, time is a deterrent to cycling for transportation that can be lessened with more direct bicycle routes and with traffic signalisation that prioritizes cyclists. Further, these studies found that individuals who perceive that the built environment is not “bikeable” –lacking bicycle paths, featuring heavy local traffic and poor connectivity, and being unsafe, especially for children—are less likely to cycle. These perceptions could be remedied with modifications to the built environment, such as the addition of separated bicycle lanes that provide direct routes through the city, as well as traffic calming in residential neighbourhoods.

Finally, while the perception of benefits is positively associated with bicycle commuting, it appears that even non-cyclists perceived these benefits (Handy and Heinen 2012), and they are not enough to get them cycling. This means that while the perception of benefits is important, there may be constraints that outweigh these benefits, or these benefits may not be valued by certain individuals.

Future research should examine the effect of social and psychological factors in cities with varying degrees of bicycle-friendly infrastructure and facilities. Further, data should be collected before and after the implementation of policies, campaigns, programs and infrastructural changes, in order to measure the change in attitudes over time and

how these factors interact with built environment, socio-economic and demographic characteristics. Knowledge and understanding of how these factors impact cycling are crucial when devising and implementing policies and programs to encourage this mode of transportation.

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