PROPENSITY TO CYCLE AMONG STUDENTS IN BELLVILLE, CAPE TOWN: A BEST-WORST SCALING APPROACH

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ABSTRACT

Cape Town can be described as a Starter Cycling City as it has a policy intention to grow the mode share of cycling from a marginal base to about 8% by 2030. With a possible 1.5 million peak period trips, this would amount to 120 000 bicycle trips. It is not clear that strategies that have been employed to date are likely to help achieve this goal. This paper builds on a targeted approach to promote cycling, focussing interventions to enable cycling within one geographic node at a time and for specific market segments prevalent in each node. Previous work identified the substantial student community in the Bellville area of Cape Town as a market segment that is likely to adopt cycling should the main barriers to cycling be removed. Students at the Cape Peninsula University of Technology were surveyed using a Best-Worst scaling approach to determine their attitudes and key barriers to cycling. Safety and security concerns were raised as among the most significant barriers to cycling, which aligns with the attitudes of cyclists globally and commuters in South Africa. In contrast, students don't view the fitness or discomfort as a barrier to cycling, and very few students experience family or social pressure to keep them from cycling. This paper concludes with insights gained from the survey, and how this information might contribute towards achieving the City's objective to grow cycling as a mode.

1. INTRODUCTION

Cycling is a highly desirable mode of transport and is increasingly promoted to play a significant role in urban transportation systems. Its social, environmental and economic benefits are widely reported in the literature (ITDP, 2022; Litman, 2021) and shared from various entities that collect relevant data from across the globe.

1.1 Benefits of Cycling

For individuals and households cycling reduces reliance on cars and could delay or even remove the need to own and operate a car for many. Cycling is typically faster than other modes for short to medium distance trips, as it eliminates waiting time for public transport and delays associated with driving on congested roads (Ellison and Greaves, 2011). Not only does regular cycling have substantial health benefits, it also increases mental agility, resulting in greater productivity and superior performance compared to those driving to the same places of education or work (Rajé & Saffrey, 2016).

The potential benefit cycling holds for society is tremendous. Data of benefits have been collected in a variety of cities and countries across the globe, while quantitative estimates

have been done for many others. The ITDP (2022) provides a comprehensive summary of some of the critical cost elements.

- A USA study found that operating a car costs at least six time more than operating a bicycle, at $18/100km compared to $3 by bicycle.
- A study in Mexico City shows that cycling could save 11.5 minutes per trip with the provision of adequate cycle lanes.
- Data from 13 European countries shows a dramatic reduction in cycling fatalities with an increase in utility cycling. A similar trend exists in Bogota, Columbia, where cycle-related injuries and death was shown to decrease with an increase in cycling.
- An India study estimates that a 15% increase in cycling could lead to saving 755 lives per year, resulting in healthcare saving of about $166 million per year.
- It is estimated that the cost of emissions from car use is about ten times that of cycling.
- The cost of air pollution in terms of premature births and deaths, disabilities, sick leave, etc, is estimated to be 3.3% of global GDP.
- The global cost of car infrastructure is estimated at about $1.5 billion per 1 000 passenger kilometres, compared to only $10.4 million for bicycles.
- The presence of high-quality cycling infrastructure has been shown to increase property prices in some US cities.
- Data shows that cyclists spend more money and more frequently than car drivers, especially on food. This despite a persistent belief among shop owners that the opposite is true.
- Studies for both Europe and the US show that about 2.5 times more jobs are created for every $1 million spent on walking and cycling.
- An analysis for Copenhagen shows that the economy gains $0.18 for every kilometre cycled, compared to a cost of $0.16 when driving a car, an effective benefit of $0.34 per km.

The potential benefits from more cycling in the world is immense in relative and absolute terms. The challenge for South Africa is to assess the size of the opportunity it could derive from this global ambition to adopt cycling. It could then develop strategies to unlock these benefits.

1.2 The Case for Cycling in South Africa

Data from the 2020 National Household Travel Survey (NHTS) (StatsSA, 2020, 2022) paints a picture of a country in need of innovative transportation solutions. Of the 45 million South Africans that reported travelling, 17.4 million walk all the way to their destinations, including 10.1 million learners. It is reported that learners walk for an average 29 minutes per direction. This is still much shorter than those travelling by public transport modes, which ranges from 51 minutes by taxi to 91 minutes by train.

The data shows a similarly dire situation for those travelling to work. Train users travel for an average 107 minutes, while bus and taxi passengers travel 84 and 63 minutes respectively. Car drivers and passengers travel for an average of 44 and 49 minutes, respectively. These times are per direction in the morning peak and excludes the time to travel back home.

Globally, people in urban areas exhibit a travel budget of about 30 minutes per direction across all modes. Communities have been shown to adapt their land use and transportation systems to ensure they remain within this budget (Stopher et al., 2017).

Given that only 6.2 million trips (about 14%) are made by car confirms that the weighted average travel time for South Africans is more than 60 minutes per direction, or more than double the global average. A significant shift towards utility cycling could contribute towards lower cost and time when travelling, as experiences from across the globe have shown.

Since cycling is about four times faster that walking, about six times cheaper than driving a car, and also significantly less than the cost of public transport, it presents a substantial opportunity to improve urban accessibility for a large proportion of the population. Despite the apparent need and substantial potential benefit, South Africa appears to have an ambivalent approach to cycling.

The National Department of Transport organised NMT Conferences for more than a decade to promote the application of cycling across urban centres. However, the 2021 White Paper on National Transport Policy (NDoT, 2022) does not recognise cycling, or walking, as an independent mode of travel for which clear policies and strategies are defined. Indeed, only passing mention is made under policies for both road traffic and public transport that NMT integration must be considered in the development of those modes.

1.3 Intervening for Cycling

The City of Cape Town adopted a Cycling Strategy which stated an objective to grow cycling from about 1% to 8% of commuter / utility trips by 2030 (CCT, 2017). Assuming that demand for travel grows to 1.5 million daily trips by 2030, the strategy would see the generation of at least 120 000 trips by bicycle on a typical work day.

A large contingent of tertiary institutions are situated in the greater Bellville area of Cape Town. While CPUT and UWC hosts more than 15 000 students each, significant numbers of students also attend the campuses of Northlink College and Stellenbosch University's Tygerberg campus.

As will be discussed in terms of the literature, students have been shown to have a high propensity to cycle compared to other user groups. Interventions aimed at students in Bellville have the advantage of reaching a very large market of potential cyclist through a very small number of institutions within a confined urban space. Interventions would therefore have a high penetration rate which are more likely to yield a significant return on effort and investment, compared to strategies that target smaller groups over larger areas. The lessons learned from promoting cycling in Bellville would help unlock cycling among more user groups and in more areas of Cape Town.

The research hypothesis of the problem with promoting cycling in South Africa, and especially Cape Town, is that decision makers may not be convinced that cycling would be considered as a viable mode of transport among the broader community. Provision of cycling infrastructure in various parts of the City has not had any noticeable effect on cycling to date. This may lead to a reluctance to invest more or in different ways to unlock cycling.

Better understanding of factors that affect cycling among students will not resolve the larger questions. The aim of this paper is to shed light on the potential demand for cycling among a particular market segment within a defined geographic area in Cape Town. This

belief is that this may contribute to the selection of appropriate strategies and interventions that would move Cape Town along the path to becoming a cycling city.

1.4 Layout of Paper

The next section describes the fundamental theory and principles that supports that a shift to cycling is a realistic expectation for Cape Town. This is followed by a description of the methodology used to design and execute the survey. The fourth section describes the outcome of the survey, followed by conclusions and discussion of possible next steps.

2. LITERATURE REVIEW

Market segmentation is a recognised method when investigating travel behaviour (Shiftan et al., 2008). Demographic factors that appear to have the greatest impact on propensity to cycle include age, income, household composition, dwelling type, population density, education level, car ownership and presence of students (Shay and Khattak, 2012; Silva 2019). While there is agreement on the effect of some attributes, studies in different cities appear to revealed conflicting effects.

The vast majority of studies demonstrate clear and consistent relationships between age and propensity to cycle. Cycling numbers are highest among teenagers and young adults, whereafter it declines steadily as age increase (Goldsmith, 1992; O'Connor & Brown, 2010; Wooliscroft, 2014). Men typically cycle more and longer distances in most cities where cycling is a marginal or modest mode. Women cycle as much or even more than men in cities where cycling has a significant market share (Pucher et al., 1999, Plaut, 2005). Research has not found a strong link between the propensity to cycle and income (Heinen et al., 2010). However, affordability has been raised as a barrier to cycling among poorer communities (Irlam and Zuidgeest (2018). A significant relationship exists between the number of dependents in a household and the frequency of cycling. Persons who do not care for children or the elderly are more prone to cycle (Ryley, 2006).

Students, as a market segment, exhibit several characteristics that are positively associated with the propensity to cycle. They are typically young adults with relatively high levels of fitness, mostly do not have dependents, do not own a car, and have simple trip chains. The scale achievable by targeting students at more than one tertiary institution in a geographic node reduce the risks associated with investment in time and effort to unlock this potential.

However, fitting the profile of a likely cyclist does not guarantee the person would cycle, even if the environment is created where all the barriers to cycling are removed. Individuals must still make active choices to switch from prevailing modes to cycling.

The Theory of Planned Behaviour (TPB) (Ajzen, 1991) posits that travel decisions, such as selecting cycling as a mode, depends largely on a person's intention (to cycle). Intention, in turn, is influenced by:

- *Attitude* – a positive personal belief about the behaviour. E.g.: that cycling is affordable, healthy, fast enough, good for the environment, etc.;
- *Subjective norms* – belief that the community (friends, family, institutions, public in general) support the behaviour;

- *Perceived behavioural control* – ability to execute their intention. Includes: can ride a bike or learn to, have access to a bicycle, place to safely park bicycle at home and destinations, feel safe from traffic and crime, etc.

A strategy to promote and enable cycling must create an ecosystem that is conducive to cycling. This means intervening in the hard and soft components that give both structure and life to the strategy. Adopting the TPB, means addressing barriers to cycling in all three areas to raise the likelihood of forming a positive intention to cycle.

The conventional approach to implementing cycling strategies is very often focused on the provision of infrastructure. Cycling infrastructure improves road safety and allow for higher travelling speed. Spending on infrastructure is also highly correlated with an increased modes share of cycling (Young et al., 2020). However, a significant proportion of cities have not been able to make a noticeable impact on commuter cycling using mainly this strategy (Jennings et al., 2017).

3. METHODOLOGY

The objective of this study is to better understand the intentions of students at the CPUT campus in Bellville, to adopt cycling as travel mode to class. A survey was designed and conducted to test aspects of students' attitude towards cycling, their view of subjective norms and their perceived behavioural control.

3.1 Survey Design

A Case 1 Best-Worst-Scaling (BWS) stated choice survey design was used, rather than a Likert-scale technique. This BWS technique requires less complex decision making from respondents, mainly as it does not have an attribute of level structure (Potoglou et al., 2011). For example, a respondent is asked whether they can afford a bicycle or whether they can store a bicycle safely at home. They do not have to consider whether the cost of a bicycle is slightly or much more of a deterrent than slight or strong wind.

The survey consists of three components. The **first** establishes the demographic characteristics of respondents, including type and address of homes, primary trip purpose, existing mode and number of dependents.

The **second** component establishes a baseline of respondents' experience with the performance of their current travel choices. This provides an indication whether travel time, cost, security or other factors dominate their experience. These question, in addition to the demographic information, inform priority interventions for infrastructure and facilities for the selected market segment in the study area that would help improve their *perceived behavioural control*. The question for section 2 and an example of a set of options to choose from is shown below.

"What is more important when you travel? Please choose the one that MOST concerns you AND the one that LEAST concerns you":

Most	Feature	Least
	Traffic Jams/Congestion	
	Travel Delays	
	Overcrowding	
	Personal Safety (crime)	

The **third** component tests the *attitude* and *subjective norms*, as experienced by the target market. It is assumed that respondents have an adequate knowledge of cycling to have formulated opinions about barriers to them cycling. The information obtained in this section provides for a design of interventions targeting decision making among potential cyclists and the community that affects their behaviour. This information may also help to prioritise or determine an appropriate sequence of intervening. The question for Section 2 and an example of a set of options to choose from is shown below.

"How do you and others feel about cycling? Please choose the one that MOST concerns you AND the one that LEAST concerns you":

Most	Feature	Least
	I cannot afford a bicycle	
	I can't carry loads on a bicycle	
	I won't be able to cycle in the rain	
	My friends and family don't think I should cycle	

Two recent studies in Cape Town that are relevant to this project also employed the BWS survey technique. Irlam and Zuidgeest (2018) applied the technique to test attitudes towards and interventions that may increase cycling in the informal settlement community of Masiphumelele in Cape Town. Teffo *et al.* (2019) applied the technique more broadly by testing attitudes towards travel in general among six lower income communities in Cape Town. While the three studies have different objectives, the data provides insights into factors that affect a variety of communities similarly or notably different.

3.2 Survey Planning and Execution

Surveys were done on the Bellville campus of CPUT in the week of 15 October 2023. Three surveyors were recruited and were given on-site training by the primary researcher. Participants were selected at random by approaching the next nearest students after completing any survey.

Surveyors were paired to witness participants' acceptance of the conditions of participation, after which a single surveyor conducted the survey with one participant. Survey sheets were paper-based and filled in manually by the surveyors and researcher.

The survey design was given ethical clearance from both the primary research institution and CPUT, whose students were surveyed.

A pilot survey resulted in minor changes to the survey form, and a confirmation that a survey could be completed in under about 15 minutes. Changes included the removal of some questions and reorganising some options to avoid a repetitive pattern that emerged from the original algorithm used to create permutations for the BWS options.

Determining the minimum and preferred sample size for a transportation survey can be a complex endeavour when considering confidence levels, acceptable error levels and standard deviations (Stopher & Stecher, 2006). In a review of best practice to determine survey sample size, Staller (2021) finds no conclusive recommendation, with some sources indicating that the "how" and "why" of embarking on the survey is much more important that the "how many".

For a similar Best-Worst-Scaling survey, Irlam and Zuidgeest (2018) argued that a sample of 100 households were sufficient, given that 1 000 choices are reflected when each survey contains 10 questions. The survey designed for this study contains 22 questions in two sections. A sample size of 100 surveys would therefor reflect 2 200 choices, which is deemed adequate to gauge the attitude of students towards various aspects relating to cycling.

A target of 120 surveys were set for the survey team and 109 surveys were completed by the end of day two. Upon capturing the data, eight survey sheets were deemed incomplete or having contradictory replies. The remaining 101 survey sheets were deemed enough to conclude the survey.

4. RESULTS AND ANALYSIS

4.1 Demographics

The main features are summarised below:

- 74 respondents were between the ages of 18 and 24, with a further 19 between 25 and 34.
- 54 respondents were male, 28 were female, and 19 chose not to reply to this question.
- While 16 respondents were drivers of passengers in cars and 5 walked, 37 used minibus taxis and 42 used the university shuttle buses.
- None of the participants currently cycles to campus, which is reflective of the negligible mode share of cycling in Cape Town in general.

4.2 Existing Travel Experience

The results of the section on existing travel experience are shown in Table 1.

Table 1: Factors that affect current travel experience among students the Most and Least

No*	Travel attitudes	Most	Least	Times chosen	Ratio M:L**	Ratio L:M**
1	Personal Safety from crime	112	19	131	5.9	0.17
4	Reliability (availability)	93	22	115	4.2	0.24
5	Protest Action (strikes)	84	33	117	2.5	0.39
2	Frequency (waiting time)	109	57	166	1.9	0.52
6	Lack of Disability Service	73	69	142	1.1	0.95
3	Overcrowding	94	103	197	0.9	1.10
8	Traffic Delays / Congestion	58	79	137	0.7	1.36
	FALSE	26	37	63	0.7	1.42
7	Safe from accidents	62	93	155	0.7	1.50
10	Walking Safety	55	90	145	0.6	1.64
9	Travel Costs	57	103	160	0.6	1.81
11	Walking Distance	47	103	150	0.5	2.19
12	Unclean Conditions	39	101	140	0.4	2.59
		909	**909**	**1818**		

*No: The number shows the ranking of how many times a statement was chosen as “Most” important.
**M:L = Ratio of Most to Least; and inverse L:M = Ratio of Most to Least

Each question appeared in the survey three times. If it was chosen by all participants every time it appeared it would be selected 303 times. *Overcrowding* was therefore chosen 197 times, or 65% of the time, and was of highest concern about 48% of the time it was selected.

"Personal Safety from crime" and "Reliability" of transport were the most important factors of the current travel experience among students, with Protest Action also significant. "Walking Distance" and "Unclean Conditions" were significantly less important to the majority of participants. Shuttle buses stop near student residences, which remove the need for long walks to access transport.

Overcrowding was selected most of the time, but almost equally as the most or least important factor. It may be that this factor is front of mind for most participants and that they evaluate its impact on a constant basis.

A large proportion of students currently make use of a university supplied shuttle services that brings then to and from campus once daily. The "Frequency" concern is likely linked to a limited schedule of shuttle buses.

"Safety from accidents" and "Traffic Delays / Congestion" were more often not of concern to participants. This may allude to safe driving practices by the student bus operator, and that the bus schedule reliably enables buses to arrive on time.

Surprisingly at first that cost is of very little concern to most participants – until it became clear that cost of shuttle service is included in tuition fees and therefore do not require a direct daily expense to most participants.

Shuttle buses have no special access arrangements for students with disabilities. Many respondents recognised the importance of disability services for other students, even though they may not know anyone it may affect. This may indicate high level of awareness of "*Subjective norms*" in their community.

Items recorded as "False" indicate that no item was chosen, the same item were chosen as best and worst in a particular option box, or that a mark covered a line between two options. These instances were not deemed significant enough to reflect the entire survey.

4.3 Attitude Towards Cycling

Table 2 reveals the attitude that participants have towards different aspect of cycling as a mode to replace their current primary modes.

The L:M ratios for three questions were significantly high, indicating a strong belief among respondents that "Comfort", "Opinion of friends and family" and "Fitness" do not present barriers to cycling at all. This is significant as there is often a perception among planners and policy makers, who are invariably car users, that these factors are likely to be significant barriers. Many participants observed that cycling during a drizzle would not concern them.

In contrast, safety and security concerns while cycling again rated as the most important barriers to cycling, echoing the sentiments from current travel experiences. The next important concern was the perception that the distance they would travel is too high.

Table 2: Factors that affect students' attitudes towards cycling the most and least

No*	Cycling attitudes	Most	Least	Times chosen	Ratio M:L**	Ratio L:M**
11	Cycling is uncomfortable	28	184	212	0.2	6.57
12	My friends and family don't think I should cycle	23	131	154	0.2	5.70
10	Not FIT enough to cycle	31	122	153	0.3	3.94
7	Cannot carry loads on a bicycle	48	85	133	0.6	1.77
9	Cannot ride a bicycle	45	73	118	0.6	1.62
8	Cannot store my bike safely at home	47	58	105	0.8	1.23
	FALSE	57	67	124	0.9	1.18
6	Cannot store my bike safely at work / class	50	52	102	1.0	1.04
4	Not able to cycle in the rain or wind	93	70	163	1.3	0.75
5	Cannot afford a bicycle	72	47	119	1.5	0.65
3	Cycling is too slow for the distance I travel	140	52	192	2.7	0.37
2	Afraid of being robbed on my way when cycling	186	36	222	5.2	0.19
1	Afraid of being hit by a car / truck when cycling	190	33	223	5.8	0.17
		1 010	**1 010**	**2020**		

*No: The number shows the ranking of how many times a statement was chosen as "Most" important.
**M:L = Ratio of Most to Least; and inverse L:M = Ratio of Most to Least

5. CONTEXT AND DISCUSSION

The natural environment in Bellville is mostly favourable towards cycling. Gradients are generally flat or have moderate grades. Rain in Cape Town is moderate to heavy, but thunderstorms with lightning are rare. Temperatures are moderate, but exceed 30 degrees from mid-January to mid-March. In addition, strong winds are also present during the summer months. However, temperatures during the morning commute are unlikely to be high.

Several Class 3 cycle ways have been built on roads in the vicinity of this campus. It would, however, appear that students' do not view these as adequate to ensure their safety while cycling. Wide roads and road reserves present the opportunity to create Class 2 cycling facilities with greater protection from traffic and more capacity.

Travel distance is a significant factor when comparing cycling to motorised modes. Residences on or adjacent to campus means lower demand for cycling as walking is sufficient. Whether the concern raised by many about their travel distance apply to those living in residences could be tested through a more detailed assessment of students living within a four to five km radius from the campus.

Cycling may provide flexibility in terms of when to leave – can leave earlier or later, and even still leave for second period if missed the last morning bus. Also, cycling provides the opportunity to make secondary trips to shops that are not offered by shuttle buses, including visits to friends and entertainment, including sport. Once a bicycle is used for the primary trip, unlimited secondary trips can be made at virtually no extra cost.

Comparison to similar surveys by Irlam and Zuidgeest (2018) found that safety concerns, affordability and an inability to cycle accounted for 53% of the barriers to cycling for the community of Masiphumelele (a township in Cape Town). Wind and rain also did not appear to be significant barriers for men in this community, but it does pose as a constraint

to women. These results are similar to a variety of studies that highlight road safety, affordability of bicycles and long distances as the main barriers.

The premise of this project is that an approach that targets specific market segments in their sphere of movement, is likely to yield much better results than a generic approach. Since the profile of residents in Masiphumelele differs substantially from that of residents and daytime visitors of Bellville, it can be assumed that the Bellville community would have different barriers to cycling (Teffo et al., 2019).

6. CONCLUSION

It is concluded that students at CPUT generally have a positive *attitude* towards cycling when considering that comfort and fitness are least likely to be a barrier to cycling for most. They are also less concerned about many issues that may present barriers to other market segments, and are likely to consider cycling as a mode of transport.

Their lack of concern with peer pressure and the belief that bicycle parking does not present a concern alludes to a positive view of *subjective norms*.

The main barrier to cycling among the student population appears to be their *perceived behavioural control*. The concern for personal security expressed with their current travel experience is transferred to their view of cycling. This reflects the wider sentiment of safety concern in Cape Town and South African cities in recent years. Their concern about safety while travelling reflects the data and experience of cyclists around the globe, and requires the provision of high-quality cycling infrastructure.

Security concerns could be addressed through various interventions – including riding in groups, for which students may coordinate rides through social media or Apps that tracks movement while travelling. Security also includes safe lock-up for bicycles at all destination frequented by students. Primarily campus and students' residences / other home locations, but also public spaces such as at retail or entertainment locations.

The generally positive feedback obtained from this survey warrants further investigation to unlock the potential demand among students in Bellville, students elsewhere in Cape Town as well as possibly other market segment and areas across Cape Town.

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